The Grinch Who Stole Thoughts: A Virtual Reality Study of Theory of Mind in Early Psychosis and Chronic Schizophrenia

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Abstract

Social cognition refers to the collection of cognitive processes that enable fluid social engagement. One of the core processes subsumed under social cognition is theory of mind (ToM), which refers to the capacity to infer the thoughts, feelings, and intentions of others. A substantial body of research has demonstrated that ToM is impaired in a variety of neuropsychiatric disorders including schizophrenia. There is good empirical evidence that many psychotic symptoms may best be understood in light of a disturbed capacity to monitor one’s own and others’ intentions. Nonetheless, exactly how impaired ToM contributes to the clinical presentation of schizophrenia remains unclear, as is the magnitude of deterioration in ToM that results from illness chronicity. Furthermore, the extent to which ToM is associated with neurocognition and other domains of social cognition (e.g., empathy) is still under debate. Preliminary research has also started to examine the different types and functional consequences of ToM impairment in schizophrenia. Examination of these potential research areas has likely been limited by the lack of psychometrically sound and sensitive measures of ToM that are suitable for use with healthy and clinical adult populations.

The first study examined the reliability and validity of a newly developed measure of ToM, the Virtual Assessment of Mentalising Ability (VAMA), using a sample of healthy adults (n = 62). The VAMA was designed to measure first- and second-order cognitive and affective ToM as well as provide indices of three different types of mentalising errors (viz., no ToM, reduced mentalising, and overmentalising). The VAMA was found to have sound internal consistency, high test-retest reliability, and convergent validity with other measures of ToM. Furthermore, the VAMA was found to have strong verisimilitude and veridicality. These results provided preliminary evidence that the VAMA is an ecologically valid tool that is sensitive to normative variation in ToM processes.
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The second study used the VAMA to examine the nature, correlates, and functional significance of mentalising abilities in individuals with early psychosis \((n = 26)\) and chronic schizophrenia \((n = 32)\). Whereas individuals with early psychosis were found to have intermediate performance between healthy controls and individuals with chronic schizophrenia on first-order affective, and second-order cognitive and affective ToM, individuals with chronic schizophrenia were significantly impaired on all ToM subscales relative to healthy control participants. The frequency of overmentalising errors was associated with positive symptoms, poor verbal inhibition, and high mental flexibility, and the frequency of no ToM errors was associated with negative symptoms, poor verbal inhibition, and low mental flexibility. ToM was found to be a more significant predictor of functional capacity and community functioning than clinical symptoms and neurocognition for both individuals with early psychosis and chronic schizophrenia. Lastly, the VAMA was found to be significantly more sensitive to diagnostic group distinctions than another computerised measure of ToM (viz., Yoni Task). Together, these results indicate that ToM abilities selectively deteriorate with illness chronicity and that type of ToM impairment varies according to clinical symptoms and neurocognitive functioning.

The third study expanded earlier research examining the functional significance of social cognition (Sparks et al., 2010), by exploring the value of cognitive empathy relative to that of ToM, neurocognition, and clinical symptoms in early psychosis and chronic schizophrenia. Results indicated that individuals with early psychosis reported significantly higher cognitive empathy than individuals with chronic schizophrenia. Although cognitive empathy was moderately associated with indices of functional capacity and community functioning for both clinical groups, ToM emerged as the strongest predictor of both domains of social functioning. There was also preliminary evidence that cognitive empathy plays a mediating role in the associations between affective ToM and social functioning.
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In summary, this thesis made a valuable contribution to the assessment of ToM and to existing research examining the nature, clinical, and neurocognitive correlates, and functional significance of ToM and empathy impairments in early psychosis and chronic schizophrenia. Findings of this thesis can be used to reconcile key theoretical debates within the clinical and experimental literature, such as whether ToM is a state or trait marker of schizophrenia, and whether ToM impairments are primary or secondary to general cognitive deficits. Overall, evidence that ToM abilities decline with illness chronicity, and that the type of ToM impairment varies with severity of clinical symptoms and neurocognitive functioning, highlights the value of using multidimensional, sensitive measures when investigating ToM in schizophrenia. Furthermore, evidence of the interplay between cognitive empathy and affective ToM early in the course of schizophrenia suggests that individualised social cognitive interventions may prevent the pervasive deterioration in functional outcomes characteristic of chronic schizophrenia.
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Statement of Originality

This work has not previously been submitted for a degree or diploma in any University. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Allana Canty
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<th>Description</th>
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<tbody>
<tr>
<td>ASD</td>
<td>Autism Spectrum Disorder</td>
</tr>
<tr>
<td>COWAT</td>
<td>Controlled Oral Word Association Task</td>
</tr>
<tr>
<td>DP</td>
<td>Dual processing framework</td>
</tr>
<tr>
<td>DSM</td>
<td>Diagnostic Statistical Manual</td>
</tr>
<tr>
<td>EQ</td>
<td>Empathy Quotient</td>
</tr>
<tr>
<td>FEP</td>
<td>First Episode Psychosis</td>
</tr>
<tr>
<td>fMRI</td>
<td>Functional magnetic resonance imaging</td>
</tr>
<tr>
<td>FPRT</td>
<td>Faux Pas Recognition Test</td>
</tr>
<tr>
<td>HSCT</td>
<td>Hayling Sentence Completion Test</td>
</tr>
<tr>
<td>IRI</td>
<td>Interpersonal Reactivity Index</td>
</tr>
<tr>
<td>LNS</td>
<td>Letter Number Sequencing subtest</td>
</tr>
<tr>
<td>MASC</td>
<td>Movie Assessment of Social Cognition</td>
</tr>
<tr>
<td>mPFC</td>
<td>Medial prefrontal cortex</td>
</tr>
<tr>
<td>PANSS</td>
<td>Positive and Negative Symptom Scale</td>
</tr>
<tr>
<td>PET</td>
<td>Positron emission tomography</td>
</tr>
<tr>
<td>QCAE</td>
<td>Questionnaire of Cognitive and Affective Empathy</td>
</tr>
<tr>
<td>SAT-MC</td>
<td>Social Attribution Task-Multiple Choice</td>
</tr>
<tr>
<td>SFS</td>
<td>Social Functioning Scale</td>
</tr>
<tr>
<td>SI-E/SI-M</td>
<td>Social inference-enriched/social inference-minimal</td>
</tr>
<tr>
<td>SSPA</td>
<td>Social Skills Performance Assessment</td>
</tr>
<tr>
<td>TASIT</td>
<td>The Awareness of Social Inference Test</td>
</tr>
<tr>
<td>ToM</td>
<td>Theory of mind</td>
</tr>
<tr>
<td>ToMM</td>
<td>Theory of Mind Module</td>
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</table>
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TPJ  Temporoparietal junction

UFQ  User-Friendliness Questionnaire

VAMA Virtual Assessment of Mentalising Ability

vmPFC Ventromedial prefrontal cortex
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Acknowledgment of Published and Prepared Papers Included in this Thesis

Section 9.1 of the Griffith University Code for the Responsible Conduct of Research ("Criteria for Authorship"), in accordance with Section 5 of the Australian Code for the Responsible Conduct of Research states:

To be named as an author, a researcher must have made a substantial scholarly contribution to the creative or scholarly work that constitutes the research output, and be able to take public responsibility for at least that part of the work they contributed.

Attribution of authorship depends to some extent on the discipline and publisher policies, but in all cases, authorship must be based on substantial contributions in a combination of one or more of:

- Conception and design of the research project
- Analysis and interpretation of research data
- Drafting or making significant parts of the creative or scholarly work or critically revising it so as to contribute significantly to the final output.

Section 9.3 of the Griffith University Code ("Responsibilities of Researchers"), in accordance with Section 5 of the Australian Code, states:

Researchers are expected to:

- Offer authorship to all people, including research trainees, who meet the criteria for authorship listed above, but only those people.
- Accept or decline offers of authorship promptly in writing.
- Include in the list of authors only those who have accepted authorship.
- Appoint one author to be the executive author to record authorship and manage correspondence about the work with the publisher and other interested parties.
- Acknowledge all those who have contributed to the research, facilities, or materials but who do not qualify as authors, such as research assistants, technical staff, and
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advisors on cultural or community knowledge. Obtain written consent to name individuals.

Included in this thesis are a published paper and a paper which has been prepared for submission (Chapters 8 and 9) which are co-authored with other researchers. My contribution to each co-authored paper is outlined at the front of each relevant chapter. The bibliographic details for these papers are:


**Chapter 9: Canty, A., Neumann, D., & Shum, D.** Theory of mind in early psychosis and chronic schizophrenia. Manuscript prepared for submission.
Chapter 1: Thesis Overview

Individuals with schizophrenia experience profound social impairment which manifests in poor occupational attainment, low recreational engagement, and poor quality partner relations (Langdon, Still, Connors, Ward, & Catts, 2014; Martínez-Domínguez, Penadés, Segura, González-Rodríguez, & Catalán, 2015). Although neurocognitive deficits and clinical symptoms have consistently been linked to poor social functioning in schizophrenia, there is now convincing evidence to suggest that impaired social cognition, and theory of mind (ToM) in particular, may be a more significant contributor to the social difficulties observed in this population (Fett et al., 2011; Mancuso, Horan, Kern, & Green, 2011). Furthermore, ToM has face validity for its association with a variety of clinical features of psychotic illness (e.g., social withdrawal, suspiciousness, and paranoia). Given the preliminary evidence of the functional consequences and clinical significance of reduced ToM performance, there is growing interest into clarifying the nature and extent of this impairment over the course of illness. Growth in this field has likely been limited by the lack of sensitive, ecologically valid measures of ToM, which are suitable for use with adult populations.

There were five aims of the current research: (a) to develop and validate a sensitive, ecologically valid virtual reality measure of ToM (i.e., the Virtual Assessment of Mentalising Ability; VAMA) for use with healthy adults and individuals with early psychosis and chronic schizophrenia, (b) to compare the integrity of ToM processes in early psychosis and chronic schizophrenia, (c) to examine the clinical and neurocognitive correlates of ToM abilities and error types, (d) to examine the functional significance of ToM abilities, and (e) to investigate a social cognitive model of social functioning, in which cognitive empathy is proposed to mediate the relationship between affective ToM and social functioning in schizophrenia. The following paragraphs outline the sequence of chapters.
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Chapter 2 begins with a synopsis of the mental illness ‘schizophrenia’. The chapter describes the diagnostic criteria, clinical course, epidemiology, etiology, and treatment of this disorder. In this review, the significance of social cognition in the disorder becomes apparent. The topic of social cognition is explored further in Chapter 3, in which the domains subsumed under social cognition are described. The chapter also expands on theoretical conceptualisations of ToM, as well as the ontology and neural correlates of mentalising processes. A recurrent point through Chapter 3 is that existing measures of ToM are not well validated. As such, Chapter 4 provides a brief psychometric review of existing ToM measures. Potential new directions for studying and understanding ToM are offered with particular focus on the advantages that simulated models of social processes may offer over existing techniques.

In Chapters 3 and 4 much of the research described is not specific to schizophrenia. Focus narrows in Chapter 5, in which the available literature on the nature, breadth, and functional significance of ToM, as well as the clinical and neurocognitive correlates of ToM - in schizophrenia – is summarised. This chapter is themed around key theoretical debates, such as whether ToM impairment represents a state or trait marker of schizophrenia and whether it is a primary impairment or it is secondary to general cognitive deficits. Towards the end of this chapter, the functional significance of social cognition, relative to clinical symptoms and neurocognition, is discussed. This provides a segway for Chapter 6 to reintroduce empathy and how it is theoretically situated compared to ToM within the broader conceptualisation of social cognition. Subsequently, key concerns within the current landscape of empathy assessment, as well as the neural correlates, integrity, and functional significance of empathy in schizophrenia are discussed. Given the theoretical similarity of ToM and empathy, research examining the hypothesised interaction between these abilities and social outcomes are described. Chapter 7 reviews the major limitations within the
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literature presented in the preceding chapters (viz., Chapters 2 to 6), and integrates these fruitful areas for further research with the aims of the current thesis.

Chapter 8 (Study 1) is a published journal article that describes the development, reliability, and validity of the VAMA in a sample of healthy adults \((n = 62)\). The VAMA situates the test taker in simulated social encounters that take place whilst completing a list of errands at a shopping center. Test takers are required to make inferences about their friends’ mental states. The task assesses different mental state modalities (viz., thoughts, emotions, and intentions) with positive, negative, and neutral valence. The task also includes a range of classical mentalising concepts such as false belief, faux pas, metaphor, and sarcasm. Although the items vary in difficulty, the test was designed to be challenging to ensure detection of subtle difficulties with mental state attribution. The VAMA provides indices of first- and second-order cognitive and affective ToM, and quantifies three types of mentalising errors, which are no ToM, reduced mentalising, and overmentalising. In addition to the VAMA, all participants were administered three other measures of ToM as part of a broader battery assessing neuropsychological and social functioning. Results provided sufficient confirmation that the VAMA was psychometrically sound and ready for further validation within a clinical population.

Chapter 9 (Study 2) is a manuscript that has been prepared for submission to a peer-reviewed international journal. This study uses the VAMA to examine the clinical, neurocognitive, and functional correlates of ToM in early psychosis \((n = 26)\) and chronic schizophrenia \((n = 32)\). In addition to the VAMA, participants were administered another computerized measure of ToM (i.e., the Yoni Task) and measures of neurocognitive abilities and social functioning. Based on Frith’s theoretical framework (2004), this study examined whether different types of ToM impairments have unique associations with specific symptom dimensions. As such, the associations between under- and overmentalising and positive,
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negative, and disorganized symptoms were investigated using corresponding factors from an empirically validated five-factor model of the Positive and Negative Syndrome Scale (PANSS). Findings from this study highlight the value of using sensitive, ecologically valid measures when investigating ToM in schizophrenia.

Sophisticated models have emerged that suggest it is the interplay between multiple social cognitive processes that result in adaptive social functioning in schizophrenia (Brüne, 2005; Ofir-Eyal, Hasson-Ohayon, & Kravetz, 2014). Chapter 10 (Study 3) expands on Study 2 by examining a broader social cognitive model of social functioning in schizophrenia. Specifically, this study was the first to explore the functional significance of cognitive empathy relative to that of ToM, neurocognition, and severity of clinical symptoms in early psychosis and chronic schizophrenia. Further, this study expanded earlier attempts to demonstrate the mediating influence of cognitive empathy on the relationship between affective ToM and social functioning (Ofir-Eyal et al., 2014; Sparks, McDonald, Lino, O’Donnell, & Green, 2010). Findings from this study attest to the intricate and compounding nature of the social cognition construct, and its’ influences on social functioning in schizophrenia.

Chapter 11 amalgamates the results of the aforementioned studies to provide a general discussion of the outstanding theoretical and clinical questions in the schizophrenia and social cognition literature. Methodological limitations of the current research as well as recommendations for future use of the VAMA to explore mentalising abilities in healthy and clinical populations are discussed. Directions for future research highlight the potential value in developing cognitive simulations that provide truly interactive ToM assessment platforms, as well as the need for longitudinal designs to better understand the nature, causes, and trajectory of ToM impairment in schizophrenia.
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Chapter 2: The Nature, Course, and Neurocognitive Deficits of Schizophrenia

The validation of schizophrenia as a clinical disorder has been subject to progression in knowledge of psychology, medicine, biology, and neuroscience (Corrigan & Penn, 2001). As such, changes to the name and defining features of schizophrenia in the various editions of the Diagnostic and Statistical Manual of Mental Disorders (DSM) have reflected the context, viewpoints, and research focus of different eras, and represent a historical depiction of the prevailing trends in psychiatry and psychology. Despite wide-ranging changes to the criteria used to establish a diagnosis of schizophrenia, the descriptions of the symptoms themselves have remained rather stable.

The definition of schizophrenia under DSM-5 (American Psychiatric Association, 2013) identifies six diagnostic criteria (see Table 2.1). The characteristic symptoms of schizophrenia involve a range of cognitive, behavioural, and emotional dysfunctions, but no single symptom is pathognomonic of the disorder. The diagnosis requires the presence of a constellation of signs and symptoms associated with impaired occupational or social functioning, thus the clinical presentation is heterogeneous.

Table 2.1

DSM-5 Criteria for Schizophrenia

<table>
<thead>
<tr>
<th>Diagnostic Criteria</th>
<th>295.90</th>
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<tbody>
<tr>
<td>A. Two (or more) of the following present for a significant portion of time during a 1-month period (or less if successfully treated). At least one of these must be (1), (2), or (3):</td>
<td></td>
</tr>
<tr>
<td>1. Delusions</td>
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<tr>
<td>2. Hallucinations</td>
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<tr>
<td>3. Disorganized speech (e.g., frequent derailment or incoherence)</td>
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<tr>
<td>4. Grossly disorganized behaviour or catatonic behaviour</td>
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<tr>
<td>5. Negative symptoms (e.g., diminished emotional expression or avolition).</td>
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| B. For a significant portion of the time since the onset of the disturbance, level of functioning in one or more major areas, such as work, interpersonal relations, or self-care, is markedly
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below the level achieved prior to the onset (or when the onset is in childhood or adolescence, there is failure to achieve expected level of interpersonal, academic, or occupational functioning).

C. Continuous signs of the disturbance persist for at least six months. This six-month period must include at least one month of symptoms (or less if successfully treated) that meet Criteria A (i.e., active-phase symptoms) and may include periods of prodromal or residual symptoms. During these prodromal or residual periods, the signs of the disturbance may be manifested by only negative symptoms or by two or more symptoms listed in Criterion A present in an attenuated form (e.g., odd beliefs, unusual perceptual experiences).

D. Schizoaffective disorder and depressive or bipolar disorder with psychotic features have been ruled out because either (a) no major depressive or manic episodes have occurred concurrently with the active-phase symptoms, or (b) if mood episodes have occurred during active-phase symptoms, they have been present for a minority of the total duration of the active and residual periods of the illness.

E. The disturbance is not attributable to the physiological effects of a substance (e.g., drug of abuse, a medication) or another medical condition.

F. If there is a history of autism spectrum disorder or a communication disorder of childhood onset, the additional diagnosis of schizophrenia is made only if prominent delusions or hallucinations, in addition to the other required symptoms of schizophrenia, are also present for at least one month (or less if successfully treated).

Note. Adapted from “DSM-5 Diagnostic and Statistical Manual of Mental Disorders”, 2013, American Psychiatric Association, pp. 99-100. Copyright 2013 by the American Psychiatric Association.

The active-phase symptoms of schizophrenia (Criterion A) are often conceptualised as falling into three broad categories: positive, negative, and cognitive. Whereas positive symptoms reflect an excess or distortion of normal functions, negative symptoms involve a diminution or loss of normal functions. Cognitive symptoms are deficits in cognitive abilities such as poor executive functioning (i.e., the ability to understand information and use it to make decisions), trouble focusing attention, and problems with working memory (i.e., the ability to use information immediately after learning it). In addition to these active phase
symptoms, various researchers view schizophrenia as an interpersonal disturbance characterized by problems in understanding the social environment and the individual’s place within it (Ofir-Eyal, Hasson-Ohayon, & Kravetz, 2014). For example, individuals with schizophrenia often exhibit unusual patterns of interaction which are likely caused by misperceptions or confusion about what others want, need, or are trying to communicate. As such, deficits in social cognition have been proposed as another core feature of psychosis (Bora & Pantelis, 2013; Frith, 1992; Green et al., 2008).

Positive symptoms are often categorised as delusions, hallucinations, or bizarre behaviour. Delusions are false beliefs about which a person is firmly convinced and is impervious to contradictory evidence (Tandon, Nasrallah, & Keshavan, 2009). The eight widely recognised types of delusions experienced by individuals with schizophrenia are summarised in Table 2.2. A hallucination is defined as a sensory perception in the absence of external stimuli. Auditory hallucinations are the most common type of hallucinations, reported by 50-70% of individuals with schizophrenia (Tandon et al., 2009). Experiences typically involve hearing voices that comment on the person’s everyday activities in an accusatory, hostile and in some cases, commanding manner. Individuals with schizophrenia may also experience visual hallucinations such as observing people, shapes, colours, and objects that are not physically present. Less common are somatic, tactile, and olfactory hallucinations which can involve physical sensations such as being touched by another person, object, or animal, or smelling an unusual odour.

Individuals with schizophrenia may also behave in unusual or eccentric ways, or transgress social mores. For example, they may talk to themselves, walk backward, laugh suddenly without explanation, make unnatural faces, mimic behaviours, masturbate in public, engage in repetitive behaviours, or maintain a rigid posture for extensive periods of time. Further, individuals may show incongruent affect, whereby the expression of emotions is
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misplaced and/or is not congruent with verbal content. Examples include smiling whilst discussing a sad topic or expressing intense anger when discussing a minor psychological insult.

Table 2.2

**Description of Common Types of Delusions in Schizophrenia**

<table>
<thead>
<tr>
<th>Delusion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persecutory delusions</td>
<td>The belief that they are being conspired or discriminated against, threatened, or intentionally victimised (e.g., the FBI has hidden electronic devices in their surroundings to spy on them).</td>
</tr>
<tr>
<td>Delusions of reference</td>
<td>Individuals inaccurately attach a personal meaning to the actions, remarks and statements of other people, or to objects or events (e.g., belief that a television program is directed specifically at him or her).</td>
</tr>
<tr>
<td>Delusions of control</td>
<td>The belief that an outside force or agency is controlling or manipulating their thoughts, feelings, or parts of their body.</td>
</tr>
<tr>
<td>Thought insertion</td>
<td>The belief that thoughts are not an individual’s own but have been implanted by an external agency.</td>
</tr>
<tr>
<td>Thought withdrawal/Thought broadcasting</td>
<td>The belief that thoughts have been taken out of his or her mind and are passively transmitted to others, often through electronic or telepathic means.</td>
</tr>
<tr>
<td>Delusions of sin or guilt</td>
<td>The belief that they have committed a terrible crime. The origin of these delusions can be a minor error in the past that the individual believes may lead to a major disaster or divine retribution.</td>
</tr>
<tr>
<td>Delusions of grandiosity</td>
<td>The belief that they have extraordinary powers, wealth, fame, or talents (e.g., belief they are a religious saviour).</td>
</tr>
<tr>
<td>Somatic delusions</td>
<td>Preoccupation that a body part is diseased or malfunctions despite objective medical evidence that it is not.</td>
</tr>
</tbody>
</table>


Negative symptoms are generally distinguished as primary or secondary (Peralta, Cuesta, Martinez-Larrea, & Serrano, 2000). Primary negative symptoms are etiologically
The theory of mind in schizophrenia, related to the core pathophysiology of schizophrenia, may precede the onset of psychosis, and usually persist between episodes. These symptoms can include anhedonia, flattening and narrowing of affect, poverty of speech, stereotyped thinking, avolition, and reduced social activity. Such symptoms impair conversational content and there is often a reduction in social activity and decreased interest in forming close relationships. Secondary negative symptoms are the derivative of other symptoms of schizophrenia, comorbid illnesses, medications, or the environment, thus are transient and often diminish in parallel to treatment of the underlying cause (Peralta et al., 2000).

Cognitive symptoms refer to deficient mental processes (e.g., poor attention) and conceptual disorganisation. Cognitive symptoms are a cardinal and enduring feature of schizophrenia and are often the cause of chronic disability in this population, present in at least 70% of individuals with schizophrenia (American Psychological Association, 2013; Tandon et al., 2009). The pattern of cognitive alterations involves impairment across most cognitive domains (Green, Kern, & Heaton, 2004; Palmer, Dawes, & Heaton, 2009), and the severity of these deficits is between 1-1.5 SD below the mean of healthy adults (Dickinson, Ramsey, & Gold, 2007). These cognitive alterations can be found at different stages of the illness (Bilder et al., 2000; Mesholam-Gately, Giuliano, Goff, Faraone, & Seidman, 2009) as well as in individuals at ultra-high risk of psychosis (Becker et al., 2010) and first-degree relatives of individuals with schizophrenia (Faraone et al., 1995).

A highly prevalent cognitive symptom includes formal thought disorder, which is a multidimensional construct that describes the persistent underlying disturbance of conscious thought and is recognised largely by its effects on speech and writing. Observable manifestations include derailment, tangentially, incoherence, illogicality in speech, and the use of clanging and neologisms. Further, individuals may experience disturbances in the thought process such as thought blocking, circumstantiality, and concrete and egocentric
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thinking, which can lead to difficulties with proverb interpretation and with overgeneralising social information. Given that these cognitive symptoms likely interfere with accurate interpretations of others’ thoughts, feelings, and intentions, some researchers suggest that social cognitive impairments may be secondary to the cognitive symptoms of schizophrenia (Abdel-Hamid et al., 2009; Hardy-Baylé, Sarfati, & Passerieux, 2003; Sprong, Schothorst, Vos, Hox, & Van Engeland, 2007).

Transition from DSM-IV to DSM-5

The criteria for schizophrenia listed in the 4th Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) have been found to be clinically useful and have high reliability (Tandon et al., 2009). Although its validity is supported by a range of antecedent (e.g., familial aggregation and environmental risk factors) and predictive factors (e.g., diagnostic stability, course of illness, and treatment response; Bromet et al., 2011; Korver-Nieberg, Quee, Boos, & Simons 2011), concurrent validation (e.g., biological markers) is less robust (Kapur, Phillips, & Insel, 2012). Further, the DSM-IV criteria for schizophrenia have high diagnostic stability, with 80-90% of individuals retaining their diagnosis 1-10 years after their first hospital admission (Bromet et al., 2011; Haahr et al., 2008). The core of the DSM-IV diagnostic criteria for schizophrenia was retained in DSM-5, with modest changes proposed principally for the purpose of simplicity and incorporation of new information about the nature of the disorder accumulated over the past two decades (Tandon & Carpenter, 2012).

One of the key changes that occurred during the transition from DSM-IV to DSM-5 was the elimination of schizophrenia subtypes. As described in Table 2.3, the DSM-IV-TR categorised schizophrenia according to five subtypes. Diagnostic conventions such as this have been criticised as imposing arbitrary boundaries (i.e., present or absent) on the symptoms of schizophrenia (Corrigan & Penn, 2001). Further, research suggests that the
classic DSM-IV subtypes of schizophrenia provide a poor description of the heterogeneity of schizophrenia, have low diagnostic stability, and do not exhibit distinctive patterns of treatment response or longitudinal course (Corrigan & Penn, 2001). Instead, a dimensional approach to rating the severity of the core features of schizophrenia was introduced in DSM-5 to capture the important heterogeneity in symptom type and severity expressed across individuals with psychotic disorders (Langeveld et al., 2013; Tandon & Carpenter, 2012; Tandon et al., 2009). Dimensional models of symptom classification emphasise quantitative gradations of psychopathology by describing symptoms according to their prevalence, severity, and duration. Further, unlike categorical approaches, dimensions of psychopathology are not exclusive but complementary and additive. Importantly, categorical and dimensional representations of schizophrenia are not antagonistic. It can be argued that the former is useful for case identification and conceptualisation, and the latter is arguably a more useful paradigm on which to base research and treatment response (Corrigan & Penn, 2001).

Table 2.3

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Definition</th>
</tr>
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</table>
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Residual This classification should be used when there has been at least one episode of active-phase symptoms, but the current clinical picture is without prominent positive psychotic symptoms.


Natural History of Illness

Schizophrenia has a consistent natural history and course of illness which can be divided into four clinical stages (Kneisl & Trigoboff, 2009). These include the premorbid, prodromal, deterioration, and chronic/residual stages. High-risk and longitudinal birth cohort studies of premorbid functioning have identified mild deficits in social, motor, and cognitive functions during childhood and adolescence that may represent premorbid features of the illness (Jones, 1997). For example, subtle motor abnormalities during infancy (Walker & Lewine, 1990) and deficits in social functioning, organizational ability, and intellectual functioning in mid-adolescence (i.e., 16-17 years) have both been reported to be associated with the later expression of schizophrenia (Davidson et al., 1999). These features however, are mild in severity and have low predictive validity as individual markers (Lewis & Lieberman, 2000).

Initial prodome is defined as the period of time from the first change in a person until development of the first acute psychotic episode (Kneisl & Trigoboff, 2009). Prodromal symptoms and behaviours (i.e., those that herald the approaching onset of the illness) may include attenuated positive (e.g., illusions, ideas of reference, magical thinking, and superstitiousness), mood (e.g., anxiety, dysphoria, and irritability), and cognitive (e.g., distractibility and concentration difficulties) symptoms, as well as social withdrawal, and obsessive behaviour. Because these prodromal phenomena often overlap with the mental experiences and behaviours of persons who are developmentally at risk but who do not subsequently develop schizophrenia, they cannot be considered diagnostic. In the majority of
cases, these prodromal manifestations, and subsequent symptoms on which the diagnosis is made, develop gradually. The disorder usually begins in late adolescence and early adulthood with the median age at onset being 23 years in men and 28 years in women. The environmental events that typically occur during these developmental periods (e.g., entering studies, the military, or the workforce, or exposure to drug abuse) may act as stressors on vulnerable neural circuits that exceed their adaptive capacity, thereby producing the behavioural symptoms that signal the onset of the illness (Lieberman, Shetiman, & Kinon, 1997).

The first time an individual experiences acute psychotic symptoms is referred to as first episode psychosis (FEP). Research indicating that schizophrenia is a genetically mediated neurodevelopmental disorder has fostered the belief that individuals who experience psychosis have a pessimistic prognosis. In contrast, recent studies have shown that many patients treated during their first psychotic episode respond well to treatment and achieve some symptom remission and level of recovery, although associated negative and cognitive symptoms can persist (Lewis & Lieberman, 2000). Recurrent episodes, often a result of treatment non-adherence or insufficient treatment, lead to more substantial and lasting neural deterioration (Kneisl & Trigoboff, 2009). Furthermore, treatment effectiveness, as indicated by symptom remission, often reduces with multiple episodes. Through this process of repeated exacerbations and relatively poor remissions, many patients sustain the clinical deterioration that is the hallmark third stage of schizophrenia. This pattern of clinical deterioration is most pronounced in the first 5-10 years of illness and then reaches a plateau (Lewis & Lieberman, 2000) during the end-stage of illness. This final stage is termed chronic schizophrenia and refers to the time in which severely affected patients exhibit persistent symptoms and profound functional disability throughout their remaining lifespan.
Etiology. The contours of schizophrenia etiology are likely to reflect a complex interweaving of genetics, dysfunctional neurochemical systems, and abnormal neurodevelopment. The extensive literature on the epidemiology of schizophrenia provides strong support for genetic factors in the development of schizophrenia. There is some evidence for the involvement of specific genes such as the 5-hydroxytryptamine type 2a receptor gene and the dopamine D3 receptor gene (Bosia et al., 2011). Notwithstanding, the current working hypothesis for schizophrenia causation is that multiple genes of small to moderate effect confer compounding risk through interactions with other congenital (e.g., neuromaturation) and non-genetic risk factors (e.g., stress and drug use; Bosia et al., 2011).

A popular hypothesis is that schizophrenia is caused by the defective transmission of neurochemicals (Bray & Owen, 2001). Pathogenic theories of schizophrenia have their origins in neuropharmacological studies which suggest that the disorder results from abnormalities in monoamine neurotransmission (e.g., the dopaminergic and serotonergic systems). However, recent research has identified that the clinical efficacy of new antipsychotic drugs appears to be partly associated with actions on other neurotransmitter systems, and there is evidence to support the involvement of glutamate and gamma-aminobutyric acid (GABA) dysfunction in schizophrenia. In light of these findings, Bray and Owen (2001) suggest that psychotic disturbances arise as a result of dysfunctional interactions between multiple systems. Notwithstanding, it remains unclear to what extent neurochemical abnormalities in schizophrenia reflect primary rather than secondary pathology, compensatory mechanisms, or environmental influences.

Schizophrenia is also regarded as a neurodevelopmental disorder (Brüne, 2005). The view that schizophrenia stems from abnormal early, perhaps prenatal, brain development is supported by epidemiological evidence of increased obstetric complications and childhood
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neuropsychological deficits in individuals who develop the disorder (Cannon, Jones, & Murray, 2002). Furthermore, volumetric studies have shown increased lateral ventricle size in individuals with schizophrenia, which is present at onset of clinical symptoms and in unaffected adolescents who are of a high genetic risk for the disorder (Cannon et al., 1993). Similarly, there is relatively consistent evidence of cytoarchitectural anomalies (e.g., reduction in axonal and dendritic markers) within frontotemporal brain regions of individuals with schizophrenia (Le Provost et al., 2003). Taken together, these findings suggest that schizophrenia may manifest as a result of classical degenerative changes, neuronal displacement, or a defect in the development and maintenance of synaptic connectivity. Overall, despite some broad clues, the precise biological mechanisms underlying the causes of schizophrenia remain unclear.

**Epidemiology.** Taken together, schizophrenia and schizoaffective disorder constitute the fifth leading cause of disability world-wide (World Health Organisation, 2012) and are responsible for more years lived with disability than all malignancies and HIV combined (World Health Organisation, 2012). Notwithstanding, there is prominent variation in the prevalence and incidence rates of schizophrenia between countries and birth cohorts. Prevalence among adults is often reported to range from 0.5-1.5% worldwide. Global annual incidence rates are often in the range of 0.5-5.0 per 10 000 individuals and the ratio for males:females is estimated to be 1.4:1.0 (McGrath, Saha, Chant, & Welham, 2008). Although the incidence rate is low relative to other mental illnesses (e.g., depression and anxiety), prevalence is high due to chronicity (McGrath et al., 2008). Birth cohort studies suggest some geographic and historical variations in incidence. For example, an elevated risk has been reported among urban-born individuals compared with rural-born individuals, as well as a gradually declining incidence for later-born birth cohorts.
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**Socioeconomic and psychological burden.** The costs of schizophrenia are extensive. The largest financial burden amounts from the direct economic costs of providing care for individuals with schizophrenia. The total financial costs of caring for this population in Australia in 2010 was $722 million, which consisted of 61% hospital costs, 26% community mental health services, 7% specialist care costs, 4% nursing homes, and 2% pharmaceuticals (SANE, 2011). This approximates to $18 000 per person with schizophrenia, which is over six times the spending of an average Australian’s health care. Furthermore, the indirect costs of schizophrenia (i.e., those associated with the loss of productivity due to unemployment, absenteeism, disability, and premature death, burden on caregivers, and legal difficulties) were approximated to be an additional $614 million per annum (SANE, 2011).

A broad spectrum of non-financial costs is also associated with schizophrenia. The stigma attached to the diagnosis can create a maladaptive cycle of discrimination which may lead to social isolation, unemployment, drug abuse, long-term institutionalisation, or even homelessness. These outcomes hinder recovery and community reintegration. The economic and psychological burden of schizophrenia highlights the need to identify individual variables that may mitigate the effects of psychiatric rehabilitation. As such, the clinical research community has been interested in identifying targets for remediation that are associated with psychosocial outcomes. One progressively researched target for remediation is neurocognitive impairments.

**Neurocognitive Impairments in Schizophrenia**

Individuals with schizophrenia consistently demonstrate a profile of moderate to severe deficits across a wide assortment of neurocognitive tasks. The National Institute of Mental Health’s Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) identified seven dissociable domains of neurocognitive impairment in schizophrenia (Green et al., 2004). These include processing speed (Knowles,
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David, & Reinchenberg, 2010), attention/vigilance (Carter et al., 2010), working memory (Lett, Voineskos, Kennedy, Levine, & Daskalakis 2014), verbal learning and memory (Green, 1996), visual learning and memory (McClure et al., 2007), reasoning and problem solving (Orellana & Slachevsky, 2013), and verbal comprehension (Nuechterlein et al., 2004). This profile of neurocognitive impairments has been associated with disruptions of neural circuits encompassing cortical cerebellar and thalamic subsystems (Zaytseva, Korsakova, Agius, & Gurovich, 2013).

The detection of neurocognitive impairments in schizophrenia, alongside disruptions to the cortical networks associated with these abilities, has high test-retest reliability (Heaton et al., 2001). Specifically, deficits in neurocognitive domains have also been documented prior to illness onset (Brewer et al., 2014; Wood et al., 2003), within schizophrenia spectrum disorders (Zaytseva et al., 2013), individuals with FEP (Bilder et al., 2000; Hoff et al., 1999), and unaffected relatives of individuals with schizophrenia (Greenwood et al., 2007). These results have cultured debate about whether cognitive dysfunction is a potential endophenotype (i.e., an observable characteristic with a strong genetic origin) of schizophrenia (Greenwood et al., 2007; Wobrock et al., 2009).

Functional significance of neurocognitive impairments. Cognitive impairments are considered a prime driver of the significant disabilities in everyday functioning experienced by individuals with schizophrenia (Bellack et al., 2007; Couture, Penn, & Roberts, 2006; Green et al., 2008). Research has shown that neurocognitive deficits may explain between 20-60% of variance in social functioning and that it may be a better predictor of social outcomes than other symptoms of the illness (e.g., clinical symptoms; Green et al., 2000; Velligan et al., 1997). Notwithstanding, other studies have reported equal contributions of neurocognition and clinical symptoms to functioning (Kurtz, Moberg, Ragland, Gur, & Gur, 2005; Perlick, Rosenheck, Kaczynski, Bingham, & Collins, 2008). The inconsistency among these findings
likely reflects a number of moderating variables, including patients' chronicity and acuity of illness, study design (i.e., cross-sectional vs. longitudinal, inpatient/outpatient), and perhaps variability across the range of psychometric tests used to assess neurocognition, clinical symptoms, and social functioning.

Three reviews have been conducted to identify the extent to which specific neurocognitive deficits restrict the functioning of individuals with schizophrenia. First, Green (1996) conducted a review of 16 studies and concluded that verbal memory, executive functioning, and vigilance are each uniquely associated with indices of social functioning. This finding was confirmed in a second systematic review of 37 studies that investigated associations between four cognitive domains and a pooled functional outcome measure (Green, Kern, Braff, & Mintz, 2000). Specifically, small to moderate correlations were observed between vigilance \((r = .20, p < .001)\), executive functioning \((r = .23, p < .001)\), secondary verbal memory \((r = .29, p < .001)\), immediate verbal memory \((r = .40, p < .001)\) and outcome measures (Green et al., 2000). The third review, comprising 18 longitudinal studies, showed that overall neurocognitive performance is related to social functioning more than six months after an initial assessment (Green et al., 2004). This later study corroborates research suggesting neurocognitive deficits are a state marker of schizophrenia (Green et al., 2004).

Expanding on these reviews, several path-analytic studies have been conducted to evaluate the causal relationships among neurocognition, clinical symptoms, social cognition, and social functioning in schizophrenia. Bowie, Reichenberg, Patterson, Heaton, and Harvey (2006) utilized a composite score of neurocognition and reported that neuropsychological performance predicted functional capacity, which in turn predicted three domains of real-world functioning (i.e., interpersonal skills, work skills, and community activities). Subsequently, Bowie et al. (2008) reported that four cognitive factors (viz., attention/working
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memory, processing speed, verbal memory, and executive functioning) have both direct and indirect effects on real-world outcomes via functional competence and/or social competence. More recently, ToM has been found to mediate the relationship between neurocognition and poor functional outcome in individuals with chronic schizophrenia (Addington, Girard, Christensen, & Addington, 2010) and that neurocognitive deficits predispose this group to worse psychiatric symptoms through the impairment of social cognition (Lam, Raine, & Lee, 2014). Although not definitive, these findings provide important insight into the neurocognitive correlates of social functioning in schizophrenia.

Treatment of Schizophrenia

Psychopharmacological treatment approaches for schizophrenia. Antipsychotic drugs have been the mainstay of treatment for schizophrenia since the 1950s (Ellenbroek, 2012). They can be classified according to their biochemical structure (e.g., butyrophenones, phenothiazines, and thioxanthenes), the doses necessary for an antipsychotic effect (i.e., high-potency vs. low-potency antipsychotic drugs), and most common within the literature their risk of producing movement disorders (i.e., 'typical' vs. 'atypical' antipsychotic drugs). Typical antipsychotics, otherwise termed first generation antipsychotics, were introduced in the 1950s and include chlorpromazine (Thorazine) and haloperidol (Haldol). Several new forms of antipsychotic medication termed second generation or ‘atypical’ antipsychotics were introduced in the 1990s and have a relatively lower propensity to cause acute extrapyramidal side effects and tardive dyskinesia. The best known of the atypical drugs include clozapine (Clozaril), risperidone (Risperdal), olanzapine (Zyprexa), quetiapine (Seroquel), and amisulpride (Solian). The primary pharmacological action of both typical and atypical antipsychotic drugs is their antagonistic effect on the D2 dopamine receptors in cortical and limbic areas of the brain (Ellenbroek, 2012).

Antipsychotic medications act to reduce or ideally eliminate active phase positive
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symptoms. Early non-systematic reviews showed that keeping individuals with schizophrenia on antipsychotic drugs after successful treatment of the acute episode substantially lowers relapse risk (Davis, 1975; Gilbert, Harris, McAdams, & Jeste, 1995). For example, Gilbert et al. (1995) found that maintenance treatment of individuals with schizophrenia using antipsychotic medication reduced relapse risk from 53.2% to 15.6% within a period of approximately 9.7 months. Nonetheless, the side-effect burden of these medications can be considerable, as antipsychotic drugs often produce movement disorders, sedation, and weight gain. Therefore, individuals with schizophrenia often face a trade-off between protection against further psychotic episodes and adverse effects. With the exception of clozapine and possibly some other second-generation antipsychotic drugs, there is little reliable evidence that one of these agents is more effective than another (Cochrane, Petch, & Pickering, 2012).

Further, a minority of individuals with schizophrenia (i.e., approximately 25%) do not improve on typical antipsychotic medication (Conley & Kelly, 2001). Another 30-40% of individuals may only be considered partial responders whereby their condition improves but they do not achieve a full remission of symptoms. Researchers have not been able to identify reliable differences between patients who improve on medication and those who do not (Cochrane et al., 2012).

It is important to note that antipsychotic medications target positive symptoms and often do not attenuate other symptom dimensions of schizophrenia. Negative symptoms, including restricted affect, avolition, apathy, and anhedonia may be unaffected by antipsychotics or improve minimally. The same is true for cognitive impairments, including deficits in memory, attention, and executive functioning (Harvey & Keefe, 2001). This limitation is important because functional outcomes (i.e., the ability of patients to maintain employment, fulfil family responsibilities, engage in education, and to socialize) are more related to negative and cognitive symptoms than to acute phase positive symptoms (Green,
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1996; Kirkpatrick, Fenton, Carpenter, & Marder, 2006). As such, new research has begun to examine social cognitive interventions for individuals with schizophrenia with the intention of improving social functioning and quality of life.

**Social cognitive treatment approaches for schizophrenia.** Early proof-of-concept studies (e.g., Corrigan, Hirschbeck, & Wolfe, 1995; Silver, Goodman, Knoll, & Isakov, 2004) have shown that social cognitive deficits in schizophrenia are malleable and that their improvement coincides with better social functioning (Mazza, De Rizzo, Surian, Roncone, & Casacchia, 2001). A recent meta-analysis of the efficacy of controlled social cognitive treatments indicated medium to large effect sizes for affect perception and small to medium effect sizes for ToM. No significant effects were identified for interventions targeting social perception and attributional bias (Kurtz & Richardson, 2012). Although this work is encouraging, it remains in its infancy and further research is needed to confirm the contributions of social cognitive domains (viz., ToM and empathy) to social functioning in early and late stages of schizophrenia. Such research would likely benefit from the availability of sensitive, ecologically valid, and reliable measures of social cognition suitable for use with clinical populations.

In summary, this chapter has provided a general overview of schizophrenia, including recent changes to the diagnostic criteria and the four stages that comprise the natural course of illness. Evidence supporting the genetic, neurobiological, and neuroanatomical causes of psychotic illness was described, along with the most recent research on the epidemiology and economic costs of schizophrenia. Research detailing the profound neurocognitive impairments commonly observed in schizophrenia was summarised, along with current psychopharmacological and social cognitive approaches to treating schizophrenia. The following chapter elaborates the definition of social cognition, with a predominant focus on ToM.
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Social cognition refers to a collection of advanced cognitive functions that involve detecting and manipulating interpersonal cues to construct representations of the relation between oneself and others (Montag et al., 2011). Ever since the conceptualisation of this construct approximately 30 years ago, it has been associated with at least four distinct social domains. These include emotion recognition and perception, attribution bias, empathy, and ToM. These domains capture the way in which the field is currently represented within the literature and are each supported by neuro-architectural models of social cognition (Ochsner, 2008).

Emotion recognition and perception are the most well researched domains of social cognition (Brüne, 2005). These processes refer to an individual’s capacity to accurately infer the emotions of others (Brüne, 2005). Archetypical research in this area examines the ability to intrinsically link perceptual representations of the face to knowledge about the emotion being signalled (Hooker & Park, 2005). Recent research has begun to isolate the components of communication in which emotion recognition can manifest. Prevailing areas have included the recognition of affect expressed through vocal intonations, physical gestures, and contextual behaviour (Hooker & Park, 2005). Overall, research investigating the nature and integrity of emotion recognition and perception has significantly contributed to the understanding of social competence in both healthy and clinical paediatric and adult populations (Brüne, 2005).

Compared to the well-established domain of emotion recognition and perception, attribution bias is a burgeoning field of social cognitive research. Attribution biases are perceptual errors that influence an individual’s interpretation about the cause of an event (Cohen, Nienow, Dinzeo, & Docherty, 2009). Attritions are generally conceptualised as
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falling along multidimensional axes which includes ‘internal-external’ and ‘personal-situational’ aspects. This model suggests that an individual typically distinguishes between external personal attributions (i.e., causes are attributed to other people), external situational attributions (i.e., causes are attributed to situational factors), and internal attributions (i.e., causes attributed to oneself). Attribution abnormalities such as showing an attentional bias towards material that is both threat related and associated with negative self-representations have been identified in several clinical populations (e.g., post-traumatic stress disorder, depression, and schizophrenia). Furthermore, accurate working models of oneself and one’s surroundings have been found to subserve the ability to function adaptively in social and occupational settings (Cohen et al., 2009).

Empathy, another central component of social cognition, refers to an individual’s ability to understand and respond to the emotional experiences of others (Decety & Jackson, 2004). Automatic affective reactions consistent with the observed experiences of others has been described as affective empathy (e.g., feeling the heartache of a friend who recently separated from their partner). Cognitive empathy refers to the capacity to engage another person’s emotional perspective to genuinely understand their subjective experience (e.g., understanding that a friend would have mixed feelings about leaving a partner). Theorists suggest that although these processes are significantly correlated, cognitive and affective empathy are distinct constructs (Shamay-Tsoory et al., 2007; Shamay-Tsoory, Tomer, Goldsher, Berger, & Aharon-Peretz, 2004). This dissociation is supported by evidence that these two types of empathy are differentially affected in several psychiatric disorders. For example, antisocial personality disorder has been linked with intact cognitive empathy but a lack of affective empathy (Blair, 2005). In contrast, it has been theorized, but not conclusively shown, that autism spectrum disorders (ASD) and schizophrenia are associated with low cognitive empathy but intact affective empathy (Baron-Cohen, 1995; Langdon,
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Coltheart, Ward, & Catts, 2001; Montag et al., 2011). Nonetheless, empathy deficits have been consistently linked with pervasive social abnormalities (e.g., social isolation and interpersonal conflict) in each of these populations (Davis, 1994).

The aforementioned domains of social cognition are complemented by a collection of sophisticated conceptual processes that allow individuals to cognitively represent and reason about the beliefs, intentions, and behavioural dispositions of the self and others (Brüne, 2005). This cognitive skill, termed ToM (otherwise referred to as mentalising or mental state attribution/inferencing), provides the cognitive apparatus for predicting and explaining human behaviour within a social environment. Furthermore, it enables social fluidity and coordination, and it interacts with other fundamental concepts on which individuals rely to conceptualise their social world (e.g., emotion recognition and empathy; Corrigan & Penn, 2001; Ofir, Hasson-Ohayon, & Kravetz, 2014).

ToM is a multidimensional construct (Amodio & Frith, 2006). One prominent distinction is between cognitive and affective subprocesses (Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010). Cognitive ToM refers to the ability to infer others’ beliefs and intentions (e.g., understanding that someone may hold a false belief). In contrast, affective ToM requires an additional appreciation of the listener’s emotional state to infer what a person is feeling (e.g., inferring a colleague has been offended by a rude joke). Supporting this dissociation, Shamay-Tsoory and colleagues found selective deficits of affective ToM, as opposed to cognitive ToM, in various patient groups (brain injury, Shamay-Tsoory et al., 2004; Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006; schizophrenia, Shamay-Tsoory et al., 2007). Using these findings, and the theoretical argument that affective inferencing is largely contextual, it has been suggested that cognitive ToM is a prerequisite for affective ToM (Kalbe et al., 2007; Singer, Critchley, & Preuschoff, 2009). Cognitive and affective processes can be further divided into first- and second-order components. Whereas
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First-order ToM involves inferring the thoughts and feelings of another person, second-order ToM refers to reasoning about what one person (i.e., other than the self) thinks a third person is thinking or feeling (Shamay-Tsoory et al., 2007).

Although further research examining any of the aforementioned social cognitive domains could advance the social cognition literature in general, there is particular value in concentrating the current research on ToM. ToM, in comparison to more empirically mature domains of social cognition (e.g., emotion recognition and perception), offers many unchartered avenues of empirical investigation. For example, limited research has explored the nature and extent to which specific components of ToM change over the course of mental illness and developmental disorders. Furthermore, although there is some evidence to suggest that ToM accounts for unique variance in social functioning beyond that of other cognitive and social abilities (e.g., emotion recognition and perception; Brüne, 2005), this pattern of findings requires replication. Similarly, few studies have examined differences in the types of ToM impairment observed in populations thought to experience difficulties with mentalising (Fretland et al., 2015; Montag et al., 2011), nor is there conclusive evidence of the clinical and neurocognitive correlates of ToM abilities.

In light of the aforementioned gaps, the social cognition literature could be advanced by contributing sophisticated research on the nature, correlates, and functional significance of ToM. Such research has clinical implications for rehabilitative settings, whereby ecologically valid test scores that are contextualised within the broader conceptualisation of specific mental illnesses could inform personalised social cognitive training programs. Enriched rehabilitative efforts could, in turn, improve community engagement and quality of life, and reduce the economic and social burden of mental illness.
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Theoretical Conceptualisations of Theory of Mind

There are five prominent models of ToM processes. These include the ToM Module (ToMM; Schnoll & Leslie, 1999), theory-theory perspective (Perner, 1991), simulation theory (Brüne, 2005), Hardy-Baylé’s concept (Hardy-Baylé, Sarfati, & Passerieux, 2003), and the continuity model of ToM (Abu-Akel & Bailey, 2000). Consistent with Fodor’s (1983) concept of a modular organization of the human mind, Schnoll and Leslie (1999) proposed the existence of a dissociable neural region responsible for ToM termed the ToMM. Like other domain-specific cognitive capacities that purportedly operate on a select class of information (e.g., working memory), the ToMM arguably processes information restricted to social inference. Accordingly, this model suggests that ToM is acquired by the maturation of neural network devoted to a domain-specific constellation of representational skills, thus implies that the development of ToM abilities is static and inflexible (Brüne & Brüne-Cohrs, 2006).

In contrast to the ToMM, which omits the role of environmental inputs and subjective states, the theory-theory perspective proposed by Perner (1991) represents a meta-representational model of ToM. According to this perspective, the ability to attribute mental states relies on theoretical reasoning involving tacitly known causal laws. These causal laws relate external stimuli to inner states (e.g., perceptions), motivational inner states (e.g., desires and beliefs) to cognitive inner states (e.g., decisions), and inner states to behaviour. As such, this model suggests that ToM is the result of an evolving general-purpose scientifically derived algorithm. Despite their largely unique conceptual frameworks, the ToMM and theory-theory perspective both suggest that mentalising is implicit and developmentally linked (Brüne, 2005).

Distinct from the detached theory-theory perspective, simulation theory suggests that attributing mental states to oneself allows replication and mimicking of another’s mental life
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and in turn permits mental state inferences. This model is procuring support from the observation that monkeys and humans possess a highly advanced system of visuo-motor neurons (viz., mirror neurons) that are active when certain hand or mouth movements are observed in others (Brüne, 2005).

In addition to the generic theories of ToM described above, two prominent teams of scholars have each constructed models to explain ToM impairments in schizophrenia. Hardy-Baylé et al. (2003) proposed that impaired ToM in schizophrenia is related to executive functioning deficits. In particular, patients with highly disorganized thought, language, and communication skills are predicted to perform most poorly on ToM tasks because they are unable to integrate and personalise contextual information, which in turn compromises their capacity to adequately assign mental states to others. The interplay between ToM and executive functioning described by this model directly contrasts a key premise of the ToMM - that these dissociable processes are subserved by distinct neural regions.

Abu-Akel and Bailey (2000) propose that ToM impairment in schizophrenia falls along a continuum. According to this model, deficits can manifest as (a) a holistic impairment of ToM with the inability to metacognitively reason about one’s own, and others’ mental states, (b) an ability to represent mental states without ability to apply this knowledge, and (c) hyper ToM (i.e., overmentalising) whereby the individual overgenerates hypotheses about others’ mental states.

The two schizophrenia-specific models conform best with the simulation theory of ToM, in that both models imply that disturbances in the ability to cognitively re-enact others’ mental episodes may explain ToM impairment. Although all of the above theoretical conceptualisations have gained preliminary empirical support, it remains unclear which one best explains the expression of ToM in healthy and clinical populations (Langdon, Coltheart, Ward, & Catts, 2001).
Ontogeny of Theory of Mind

The origin of ToM research can be traced to developmental psychologists who were interested in the acquisition of mentalising abilities in childhood and how these abilities influenced a child’s social and emotional development (Lyons & Koenig, 2012). Understanding the ontogeny of ToM abilities in the context of social cognition research in healthy and clinical populations is important for two reasons. First, tasks which were devised by developmental psychologists to monitor the acquisition of ToM in childhood are often adapted by researchers for use with adult populations (e.g., Sally-Ann False Belief Task, Wimmer & Perner, 1983). Consequently, the performances of adult clinical populations are often compared to the abilities expected of young children, and in turn classified as ‘healthy’. This assessment approach neglects that mentalising processes continue to mature and thus fail to assess the breadth of sophisticated inferencing abilities demonstrated by healthy adults (Brüne, 2005). Second, results of prior research have not confirmed the implicit assumption that ToM development prior to the manifestation of clinical disorders (e.g., schizophrenia) has been normal, as opposed to the abnormalities observed in children with ASD. As such, findings concerning the ontogeny of ToM in healthy populations may not be generalizable to other clinical populations (Lyons & Koenig, 2012).

Baron-Cohen (1995) proposed an ontogenetic model of ToM maturation based on an evolutionary concept. According to his model, early in development infants selectively pay attention to eyelaye stimuli. At approximately 18 months, children are able to associate ‘seeing’ with ‘knowing’, to use protodeclarative pointing gestures, and to engage in pretend play. At the same time, the child starts to recognize itself in a mirror. At age 3 to 4 years, children begin to distinguish between their own and other’s beliefs, an ability commonly illustrated by measures of first-order false belief. At 6 to 7 years, children learn to understand higher order representations (e.g., second-order cognitive ToM). Relative to cognitive ToM,
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demonstrations of affective ToM emerge and continue to develop in early adolescents. A faux pas is somewhat more difficult to comprehend because it involves the capacity to understand a situation in which one character should have kept information from another but did not. Comprehension of faux pas is unstable before approximately 10 years of age, with girls able to understand faux pas somewhat earlier than boys (Baron-Cohen, 1995). Subsequent research has provided support for Baron-Cohen’s (1995) model of ToM development in healthy children (Peterson, Slaughter, & Paynter, 2007). Although the literature consistently suggests that ToM abilities are compromised in several clinical adult populations (e.g., schizophrenia, ASD, and brain injured), substantially less is known about the pace at which these abilities deteriorate or to what degree impairments are evident in children and adolescents prior to illness onset.

Neural Correlates of Theory of Mind

Imaging research has identified potential neural underpinnings of emerging ToM impairments in adolescents. Structural magnetic resonance imaging investigations suggest reductions in amygdala-hippocampal complex volumes in adolescents at risk of developing schizophrenia (Keshavan et al., 2002; Lawrie, Whalley, Job, & Johnstone, 2003; Seiferth et al., 2009). Another study with adolescents diagnosed with early onset psychosis (i.e., prior to 19 years) found abnormal activations in several brain regions thought to support ToM (e.g., hippocampal regions; Seiferth et al., 2009). This initial evidence suggests that neural abnormalities precede illness onset and indicate that the emergence of social cognitive deficits may follow a distinct neuro-developmental trajectory.

Data on the cerebral representation of ToM supports a neural dissociation between cognitive and affective ToM (Brüne, 2005; Brüne et al., 2008; Kalbe et al., 2010). A number of neuroimaging studies with healthy adults have implicated the left medial prefrontal cortex (mPFC) as being important for first-order cognitive ToM (Brunet, Sarfati, Hardy-Baylé, &
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Decety, 2000; Fletcher et al., 1995; Gallagher, Jack, Roepstorff, & Frith, 2002). Similar findings have been observed within clinical populations. Brüne et al. (2008) demonstrated that the individuals with schizophrenia, relative to healthy controls, showed significantly reduced activation in medial inferior frontal and temporal regions during a first-order cognitive ToM task. Distinct left-hemispheric activation (viz., inferior prefrontal areas and the paracingulate gyrus) has also been observed in research assessing cognitive ToM in individuals with ASD (Baron-Cohen et al., 1999). Given the potential role of the paracingulate gyrus in ToM performance, it is noteworthy that this brain region has been shown to be asymmetric in patients with schizophrenia (Le Provost et al., 2003), although a direct link between the paracingulate gyrus and ToM performance has not been demonstrated in this population. These findings allude to an association between the integrity of left hemispheric cortical regions and cognitive ToM.

Preliminary evidence has emerged to suggest that affective ToM relies on inputs from the right hemisphere. A positron emission tomography (PET) study of affective ToM in healthy adults found specific activation of the right mPFC and temporal cortices using a picture story faux pas paradigm (Brunet et al., 2000). Expanding these findings, Brunet, Sarfati, and Hardy-Baylé (2003) used PET to examine the neuroanatomical basis of ToM in individuals with schizophrenia. Contrary to expectation, no significant activation was observed in patients’ right mPFC during the affective ToM task. However, high levels of activation were observed in the left occipitotemporal regions and the posterior part of the superior temporal sulcus during a cognitive ToM task in both healthy adults and individuals with schizophrenia, which is consistent with earlier results (e.g., Baron-Cohen et al., 1999; Brüne et al., 2008).

In an attempt to explain the somewhat heterogeneous and widely distributed anatomical regions implicated in ToM, attention has turned to identifying extraneous
variables that predict unique patterns of neural activation during ToM tasks. Based on a meta-analysis of over 200 fMRI studies of social cognition, Van Overwalle (2009) proposed that ToM relies on two primary regions, being the mPFC and the temporoparietal junction (TPJ). Identification and representation for temporary mental states (e.g., intentions and desires of other people) is suggested to engage the TPJ. Inferences about more enduring dispositions or traits of the self and others (e.g., goals) were reliably found to engage the mPFC.

Unique patterns of activation within the prefrontal cortex have also been attributed to the use of similar and dissimilar others during ToM tasks (Mitchell, Macrae, & Banaji, 2006). Whereas a ventral region of the mPFC was found to respond to mentalising about a similar other, a dorsal region of the mPFC was involved in mentalising about a dissimilar other (Mitchell et al., 2006). Nevertheless, there is evidence to suggest that the neural regions implicated in processing knowledge about the self are similarly called upon when processing knowledge about others (e.g., Frith & Frith, 2001; Platek, Keenan, Gallup, & Mohamed, 2004; Rabin, Gilboa, Stuss, Mar, & Rosenbaum, 2010). Consistent with simulation theory, these findings suggest that other-oriented processing integrally involves self-processing. These findings also highlight the importance of incorporating both transient and more stable characteristics (e.g., within characters), as well as similar and dissimilar others, within ecological ToM task designs.

In a substantive review, Carrington and Bailey (2009) considered whether task design and presentation modality (viz., verbal vs. nonverbal) influenced the location and extent of neural activation during ToM tasks. Results suggested that an integrated functional network involving distinct core (i.e., consistently activated) and peripheral (i.e., activation influenced by task modality) brain regions support ToM processes. The core regions identified included the mPFC, orbitofrontal cortex and TPJ, superior temporal sulcus, and posterior cingulate cortex. Consistent with Hardy-Baylè et al.’s (2003) model of ToM, recruitment of neural
systems subserving other elements of cognition, such as autobiographical memory (Calarge, Andreasen, & O’Leary, 2003) or executive control (Saxe, Schulz, & Jiang, 2006), may also support ToM performance (i.e., peripheral), depending on the specific task parameters. There has been some evidence for modality-dependent ToM processing as evidenced by a laterality effect in brain activity. Whereas text-based ToM tasks were associated with left lateralized mPFC activity (Fletcher et al., 1995; Gallagher et al., 2002; Goel, Grafman, Sadato, & Hallett, 1995; Happé et al., 1996), findings from studies using non-verbal pictorial or cartoon-based ToM tasks consistently implicate the right mPFC (Brunet et al., 2000; Gallagher et al., 2002). Nonetheless, Saxe and Wexler (2005) found that verbal tasks were primarily related to right TPJ activity.

In summary, this chapter introduced the four domains commonly associated with the social cognition construct. The primary focus of this chapter was describing contemporary models that distinguish between core and peripheral ToM sub-processes and account for individual variation in mentalising styles. The typical course of ToM development in healthy children was described along with research that has provided a preliminary blueprint of the cortical networks thought to subserve cognitive and affective ToM sub-processes. However, the generalizability of findings supporting theoretical models and the cognitive architecture of ToM may be limited due to the varying nature, sensitivity, and content of existing ToM measures. Improving the measurement of ToM has the potential to stimulate advances in ToM research in healthy adults and clinical populations. The psychometric properties of existing ToM measures, as well as potential new directions for studying and understanding ToM are the focus of the next chapter.
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Chapter 4: Measurement of Theory of Mind

Equivocal findings regarding ToM impairment in early psychosis and chronic schizophrenia may reflect the varied scope, sensitivity, psychometric strength, and theoretical basis (e.g., social cognitive vs. social perceptual) of the diverse range of ToM measures used in the individual studies. In fact, the National Institute of Mental Health workshop on ‘Definitions, Assessment, and Research Opportunities’ concluded that existing measurement approaches are impeding progress in the study of ToM in schizophrenia (Green, Oliver, Crawley, Penn, & Silverstein, 2005). Given the importance of ToM in daily interactions and the prevalence of ToM impairments in some clinical populations, it is important for researchers to critically consider the tasks used to measure and investigate this construct.

The aim of this chapter is to expand earlier reviews (e.g., Brüne, 2005; Green et al., 2005; Söderstrand, Almkvist, Psykologiska, Stocholms, & Samhällsvetenskapliga, 2012) by providing a brief psychometric review of existing ToM measures. The review will examine properties commonly considered to be strong indicators of reliability and validity. These include internal consistency, test-retest reliability, construct validity (viz., factor structure and convergent/discriminant validity), and sensitivity to group differences (Shum, O’Gorman, & Myors, 2013). Summarising the range of approaches that are available sets the landscape for discussing the benefits and limitations of specific assessment methods. Potential new directions for studying and understanding ToM are offered with particular focus on the advantages that simulated models of social processes offer over existing techniques.

An extensive literature search was conducted in the electronic databases PsycINFO, Social Sciences Citation Index, and Google Scholar (January 1995 to July 2015) using the following key words: theory of mind, mentalising, and social cognition (01/08/15). Additional measures were identified by checking the reference lists from identified reviews on the topic, test manuals and related publications, and citation searches of original scale
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descriptions. Based on prior reviews of social cognition measures (Brüne, 2005; Neumann, Chan, Boyle, Wang, & Westbury, 2015; Pinkham et al., 2014; Sprong et al., 2007) several criteria were utilised to select tasks. First, only measures that were constructed or extensively revised in the past 25 years were selected for review (i.e., post 1990). This time frame was selected because little ToM research, which is consistent with current conceptualisations of mentalising processes, was conducted prior to 1990. Second, tasks were required to have some evidence of utility for English speaking adult populations (i.e., means for healthy adults reported). Further, variations of widely cited false belief stories and picture sequences that were developed for the purpose of individual studies and have not been explored in more than two accounts of peer-reviewed research were excluded. These tasks were excluded because there is no available information about their psychometric properties, nor is there evidence that they demonstrate additional novelty or value above that of the tasks on which they are based. Table 4.1 details 15 measures that were excluded according to the aforementioned criteria.

Table 4.1

<table>
<thead>
<tr>
<th>Reason for Exclusion</th>
<th>Excluded Measures</th>
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<tr>
<td>Based on earlier measures without showing additional novelty.</td>
<td>Cartoon Picture Stories (Brüne &amp; Bodenstein, 2005); Individual false belief stories (Perner &amp; Wimmer, 1985; Baron-Cohen, Leslie, &amp; Frith, 1985; Baron-Cohen, 1989); Mentalistic Interpretation Task (Channon &amp; Crawford, 2010).</td>
</tr>
<tr>
<td>No evidence of utility for English speaking adult populations</td>
<td>Social Cognition Rating Tools in Indian Setting (SOCRATIS; Mehta et al., 2014).</td>
</tr>
<tr>
<td>Developed for child research and demonstrates ceiling effects for adult</td>
<td>Sally-Anne False Belief Task (Winmer &amp; Perner, 1983); Animations Task (Abell, Happé, &amp; Frith,</td>
</tr>
</tbody>
</table>
The measures included for review are grouped into a taxonomy (see Figure 4.1) that distinguishes between social cognitive, social perceptual, and ecological subdomains. Example items from the reviewed measures are provided in Appendix A (see end of thesis). The distinction between social cognitive and social perceptual ToM draws upon the theory proposed by Tager-Flusberg and Sullivan (2000), who conceived these components as functionally and neurologically distinct. These theorists proposed that the social cognitive aspect of ToM (i.e., mental state reasoning) requires reliance on shared world knowledge as well as assimilation of factual/contextual aspects about individuals (e.g., what they know or what they have done) to infer mental states. The parallel social perceptual aspect of ToM (i.e., mental state decoding) involves inferring mental states via physical and emotionally laden cues, such as kinetics and facial expressions. A key distinction between these subdomains is that social cognitive ToM draws upon additional cognitive functions (e.g., language), whereas social perceptual ToM may be related to more automatic affective systems (Tager-Flusbert & Sullivan, 2000).
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The third subdomain, ecological measures of ToM, reflects the paradigm shift which is being witnessed in social cognitive neuroscience. That is, attention is diverting away from diagnostic evaluations designed to identify specific impairments in social cognition in favour of research which considers the functional implications of test results (Dziobek, 2012; Montag et al., 2011). Franzen and Wilhelm (1996) proposed a two-tier definition of ecological validity. The first tier, verisimilitude, refers to the topographical similarity of the data collection method and task content to an activity in the test taker’s natural environment. Veridicality, on the other hand, refers to the extent to which task performance predicts real-world outcomes. This greater emphasis on ecological assessments has paralleled a time in which many neuropsychologists have recognised the limitations of many conventional tests of social cognition and are seeking new approaches to measurement (Dziobek, 2012; Green et al., 2005).
Figure 4.1. Taxonomy of ToM tasks developed/reviewed between January 1995 and July 2015 suitable for use with adult populations.
Social Cognitive Tasks

To assess the social cognitive aspect of ToM, researchers commonly present test takers with short written or verbal descriptions accompanied by picture sequences of characters in social scenarios. Test takers are asked questions about the mental states of the characters or prompted to make predictions about the characters’ behaviours based on these inferred mental states (Happé, 1994; Havet-Thomassin, Allain, Etcharry-Bouyx, & Le Gall, 2006). Tasks of this nature often impose considerable demands on working memory and in the case of verbal or text-based tasks, linguistic processing. For example, in interpreting a story describing a scenario in which a character tells a white lie, test takers must process the language of the story and hold the relevant information in working memory while that information is integrated with prior knowledge. Consideration of these demands become especially important when investigating the ToM of individuals who may have language disorders or deficits in working memory, as poor task performance may be better accounted for by cognitive, rather than social cognitive deficits. Further, many social cognitive tasks position the participant as a passive observer of static social stimuli (e.g., Happé, 1994; Brüne, Abdel-Hamid, Lehmkämper, & Sonntag, 2007) and provide unrealistically long and reflective response windows. As such, these tasks do not simulate the temporal demands of formulating appropriate responses in real-life social interactions. As a consequence of these two features, social cognitive tasks have the potential to overestimate test taker’s real-world ToM abilities.

Traditional false belief vignettes. Tasks in this category typically assess first-order cognitive ToM as evidenced by the ability to understand that someone can act according to beliefs that misrepresent reality. In second-order tasks, test takers are assessed on their ability to comprehend the false belief that one character holds about the thoughts of another character. There are two common types of false belief tasks: verbal stories and pictures.
sequences. Verbal false belief stories require test takers to answer questions about the thoughts and intentions of a character portrayed in a written story, sometimes with accompanying pictures. Non-verbal false belief picture sequencing tasks assess test takers’ ability to complete a series of animations based on mental state inferences (Brüne & Bodenstein, 2005; Langdon et al., 1997).

**False Belief Story Task.** Six short stories are used to assess test takers’ ability to understand states of false belief (three stories) and of a person’s intention to deceive another (three stories; Corcoran et al., 2009; Frith & Corcoran, 1996; Moore et al., 2006; Shryane et al., 2008). Stories are typically read to test takers while they are shown a series of cartoon drawings depicting story events. For each story the participant is asked a first- and second-order question. Verbal responses are coded as correct or incorrect and are used to provide scores of first- and second-order cognitive ToM (Shryane et al., 2008). No evidence on the internal consistency or test-retest reliability of this measure has been documented.

**Factor structure.** Shryane et al. (2008) found a three-factor model with separate factors for first- and second-order deception but only a single factor for false belief understanding.

**Convergent and discriminant validity.** Corcoran and Frith (2003) reported significant moderate correlations \( r = .63, p = .01 \) between the False Belief Story Task and the Hinting Task (Corcoran et al., 1995) in a sample of individuals with schizophrenia. Corcoran et al. (2009) reported a moderate correlation between the False Belief Story Task and Langdon et al.’s (1997) False Belief Picture Sequencing Task \( r = .41, p < .001 \).

**Sensitivity.** The first-order deception and the single false belief factors have been found to be sensitive to ToM impairments in samples where the skill is thought to be compromised (e.g., individuals high in persecutory delusions, Shryane et al. 2008; schizophrenia spectrum disorders, Corcoran et al., 2009; schizophrenia, Langdon et al., 1997; Langdon, Coltheart, Ward, & Catts, 2002).
**Happé’s Strange Stories.** This is a measure of first-order cognitive ToM whereby test takers read 24 short vignettes (Happé, 1994). There are 12 story types with two items assessing each type. The 12 story types include lie, white lie, joke, pretend, misunderstanding, persuasion, appearance/reality, figure of speech, sarcasm, forgetting, double bluff, and contrary emotions. Six control stories are also given to test takers. Each story is accompanied by a picture and two test questions concerning comprehension (i.e., was it true, what __ said?) and justification (why did __ say that?). Responses that include descriptions of mental (test items) or physical states (control items) are scored as correct. Only one score is given per story, with credit given to the most accurate answer. No evidence of internal consistency, test-retest reliability, or the factor structure of this measure has been reported.

**Convergent and discriminant validity.** Performance on Happé’s Strange Stories has been found to significantly correlate with other tests of ToM, including the Silent Film ($r = .66, p < .001$; Devine & Hughes, 2013) and the Movie Assessment of Social Cognition (MASC; $r = .47, p < .05$; Dziobek et al., 2006). Significant moderate correlations have been observed between this measure and full-scale IQ ($r = .54, p < .01$; Scherzer, Leveillé, Achim, Boisseau, & Stip, 2012) and the Vocabulary subtest of the Wechsler Adult Intelligence Scale ($r = .48, p < .05$, Dziobek et al., 2006).

**Sensitivity.** This measure has been shown to discriminate between healthy adults and a number of clinical groups, including individuals with intellectual impairment (Happé, 1994), borderline personality disorder (Górska & Marszal, 2014), brain damage (Happé et al., 1999), schizophrenia (Scherzer et al., 2012) and Huntington’s disease (Snowden et al., 2003). Additionally, Happé’s Strange Stories has been shown to be sensitive to individual differences in ToM abilities in both typically (Devine & Hughes, 2013; Happé, 1994; Meins, Fernyhough, Johnson, & Lidstone, 2006) and atypically developing children (Jolliffe &
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Baron-Cohen, 1999; O’Hare, Bremner, Nash, Happé, & Pettigrew, 2009; White, Hill, Happé, & Frith, 2009).

**Picture sequencing tasks.** During these non-verbal tasks test takers are typically presented with a sequence of cartoon pictures and are required to choose the most logical option to complete the sequence based on the attribution of mental states. The initial pictures generally depict a character performing an action with a particular intention. The intention of this action however, is vague without the final cartoon.

**Picture Sequencing Story Telling Task.** This task is a measure of first-order cognitive ToM in which test takers are presented with four series of four cards involving characters acting on false beliefs (Langdon & Coltheart, 1999; Langdon et al., 1997). There are three story types: social-script stories, mechanical, and false-belief stories. The cards are arranged in front of the test takers in a fixed random order. Test takers are assessed in their ability to arrange the cards into the correct order so they present a coherent story. Each sequence scores two points if the first card is positioned correctly, two points if the last card is positioned correctly, and one point each for the second and third cards being correct. Position scores are often averaged over the four examples of each story type (Langdon & Coltheart, 1999). No evidence of internal consistency or test-retest reliability has been reported for this measure.

**Factor structure.** Corcoran et al. (2011) assessed the validity of the Picture Sequencing Story Telling Task by comparing its factor structure with that of the False Belief Story Task identified by Shryane et al. (2008). The resulting three-factor model (i.e., first-order deception, second-order deception, and single factor for false belief understanding) had excellent fit for the Picture Sequencing Story Telling Task.

**Convergent and discriminant validity.** The correlations between the corresponding factors of the Picture Sequencing Story Telling Task and the False Belief Story Task were all
strong and significant (i.e., first-order deception, $r = .55, p < .01$; second-order deception, $r = .60, p < .01$; false belief understanding, $r = .63, p < .01$).

**Sensitivity.** Although Corcoran et al. (2011) reported no association between schizophrenia symptoms and performance on the Picture Sequencing Story Telling Task after controlling for age and IQ, other research has documented that this task is sensitive to group differences between healthy adults and individuals with schizophrenia and mania (Gavilán & García-Albea, 2011; Langdon, Coltheart, & Ward, 2006; Langdon, Davis, & Coltheart, 2002; Sarfati & Hardy-Baylé, 1999). Abdel-Hamid et al. (2009) found that healthy adults performed at ceiling on a computerised version of this task.

**Picture Stories Inference Intention Task.** The aim of this first-order cognitive ToM task (otherwise known as the Intention Attribution Task) is to derive the intention of a character from a 3-frame comic strip (Sarfati, Hardy-Baylé, Besche, & Widlcher, 1997). Each scenario shows a character performing a simple action to facilitate identification of the intention which motivated it. After viewing the story, test takers are asked to choose which one of three cartoon answer cards is the most logical to complete the comic strip sequence. Thus, to perform the task test takers are required to infer the character's intention in a given context. Responses are scored as correct or incorrect for 30 randomly presented picture sequences. No evidence of test-retest reliability or convergent or discriminant validity has been reported for this measure.

**Internal consistency.** Sarfati, Hardy-Baylé, Besche, et al. (1997) and Sarfati, Hardy-Baylé, Nadel, Chevalier, and Widlocher (1997) reported that the Picture Stories Intention Inferencing Task had good inter-item homogeneity for 28 out of the 30 comic strips, and 15 of 15 comic-strips respectively, but specific values were not reported.

**Factor structure.** Brunet, Sarfati, Hardy-Baylé, and Decety (2000) applied principal components analysis to the data of three activation conditions in an imaging study: (a)
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attribution of intentions (AI), (b) physical causality with characters (PC-Ch), and (c) physical causality condition involving objects (PC-Ob). This analysis extracted two main factors. The first accounted for 49.4% of the variance. Its mean value was positive in the AI and PC-Ch conditions and negative in the PC-Ob condition. The second factor accounted for 27.4% of the variance. Interestingly, this second factor revealed a clear distinction between the AI and the PC-Ch conditions.

*Sensitivity.* The Picture Stories Inference Intention Task has been shown to effectively distinguish individuals with schizophrenia from psychiatric (viz., individuals who met DSM-III-R criteria for a major depressive episode) and healthy controls after controlling for IQ (Sarfati, Hardy-Baylé, Besche, et al., 1997). This result was replicated by Sarfati, Hardy-Baylé, Nadel, et al. (1997) and Sarfati, Hardy-Baylé, Brunet, and Widlocher (1999). Brunet et al. (2000) demonstrated that performance in the AI condition is associated with a complex pattern of activity involving the right mPFC and the inferior PFC. This pattern is distinct from that elicited by the comparison of both physical causality conditions, which was associated with activation in more posterior cortical regions bilaterally. Such results are consistent with previous research which has demonstrated that cognitive ToM is associated with a cerebral pattern of activity involving the mPFC (Brunet et al., 2000; Fletcher et al., 1995; Gallagher, Jack, Roepstorff, & Frith, 2002). Although these results provide convincing evidence of the sensitivity of this task to group differences in ToM, ceiling effects have been observed in healthy adults and individuals with FEP (Achim et al., 2011).

*Visual joke appreciation.* Tasks of this nature are typically non-verbal and assess understanding of slapstick/behavioural jokes as well as humour founded on false belief or deception.

*Cartoon Comprehension Task.* The original version of this first-order cognitive ToM task, otherwise known as the Joke Appreciation Task, was developed by Corcoran et al,
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(1997) and involves two sets of 10 jokes. One set involves slapstick or behavioural humour and the other set can be understood in physical terms, thus serves as a control condition. Seven of the 10 jokes in the first set depict situations of false belief where the main character believes something that onlookers, and therefore the participant, know not to be true. The other three jokes in the set present situations of deception where one character attempts to convince another character of a false belief. Responses are scored as 1 for an appropriate answer and 0 if incorrect. In the case of the ToM cartoons, an appropriate response requires an explanation of the characters’ mental states. For the control condition, sensible physical or behavioural interpretations are deemed acceptable. Eight cartoons from this task were adapted for computer administration by Fernyhough, Jones, Whittle, Waterhouse, and Bentall (2008). No evidence of internal consistency, test-retest reliability or the factor structure for either the original or computerised versions of this measure has been reported.

Convergent and discriminant validity. Langdon, Connors, Still, Ward, and Catts (2014) reported significant moderate correlations between the Cartoon Comprehension Task and a picture sequencing ToM task ($r = .52, p < .01$) and the False Belief Story Task ($r = .47, p < .01$) in a combined sample of individuals with early psychosis and healthy adults.

Sensitivity. This task has been shown to differentiate individuals with acute symptoms of schizophrenia (e.g., paranoid delusions) from remitted patients and healthy controls (Corcoran et al., 1997). However, this task was not found to be sensitive in distinguishing individuals high/low in schizotypy symptoms, nor was it found to correlate with proneness to persecutory delusion-like beliefs (Fernyhough et al., 2008).

Pragmatic speech comprehension. Competent pragmatic communication requires the ability to transcend the literal meanings of words to consider the conversational partner’s beliefs and intentions. Examples of pragmatic content include hints, irony, sarcasm, and metaphor.
**Sarcasm Comprehension Task.** This task is a measure of first-order cognitive ToM and consists of 18 brief scenarios describing a social context and ending with a single remark by one character (Channon et al., 2005). There are 12 items assessing two different types of sarcastic remarks. These include remarks that can be understood by reversal of the direct meaning (6 items), and remarks that are indirectly related to the direct meaning (6 items). These are compared with sincere remarks (6 items), where the social context of the story is congruent with the direct meaning of the remark.

Test takers read the stories and are asked to verbally explain what the character meant by their remark. A score of 2 points is given for verbal responses providing a clear and correct explanation of the action/event. A score of 1 point is given when the answer is correct, but not adequately explained. No points are given when the answer is incorrect or irrelevant. After test takers have read each item and provided a verbal response, they are presented with four alternative interpretations in pseudo-randomised order. These include two correct interpretations (viz., a direct correct interpretation and an indirect but still correct interpretation) and two incorrect interpretations (viz., an irrelevant or a salient literal interpretation of the remark). Test takers are then asked to answer a yes/no non-mentalising question to check understanding of the social context of the story. Crawford and Channon (2010) developed a revised version of this task (i.e., Mentalistic Interpretation Task). No evidence of internal consistency, test-retest reliability, or the factor structure of the original version of this measure has been reported.

**Internal consistency.** Crawford and Channon (2010) reported Cronbach’s alphas between .60 and .70 for the revised version of this task (i.e., Mentalistic Interpretation Task).

**Factor structure.** No information on the factor-structure of this measure has been reported. However, Channon et al. (2007) demonstrated that errors in sarcasm comprehension made by test takers with frontal lesions were not always literal in nature, suggesting this
measure captures two dissociable components in comprehension. These included appreciating that a meaning is not intended literally and understanding the specific meaning in the social context (Channon et al., 2007).

*Convergent and discriminant validity.* Significant moderate correlations have been observed between sarcasm comprehension scores and performance on a mental state inferencing task in a group of individuals with closed head injury \( r = .51, p = .03 \); Channon et al., 2005). Crawford and Channon (2010) reported significant moderate correlations between a social problem solving task and scores for sarcasm interpretation \( \rho = .47, p = .04 \) and control items \( \rho = .53, p = .02 \) on the revised Mentalistic Interpretation Task. Significant moderate correlations were also observed between performance on control items and indices of working memory \( \rho = .60, p = .005 \) and executive functioning \( \rho = .51, p = .03 \). Although this task is considered to be a measure of cognitive ToM, activation in cortical regions thought to be engaged in affective ToM processing has been shown during task completion (e.g., right vmPFC, Channon et al., 2007).

*Sensitivity.* This measure has been shown to be sensitive to the sarcasm comprehension deficits characteristic of individuals with ASD (Channon, Crawford, Orlowska, Parikh, & Thoma, 2014), as well as subtle differences in abilities between individuals with frontal lesions and healthy adults (Channon et al., 2007).

*Attitudinal Subtest of the Aprosodia Battery.* Sarcasm perception is often assessed using the attitudinal subtest of the Aprosodia Battery (Orbelo et al., 2005), which could be conceived as a measure of first-order cognitive ToM. This battery consists of 10 semantically neutral sentences that were recorded by a female speaker in both a sincere and sarcastic manner. These utterances are repeated twice to total 40 stimuli. Test takers are instructed to indicate whether the statements were ‘true’ for a sincere tone of voice or ‘false’ for a sarcastic tone of voice. Correct responses are scored as 1 and incorrect responses are scored as 0. No
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evidence of the internal consistency, test-retest reliability, or the factor structure of this measure has been reported.

Convergent and discriminant validity. Research has demonstrated that performance on the attitudinal subtest significantly correlates with affective prosody ($r = .55, p = .003$) and pitch perception ($r = .40, p < .05$) but is independent of verbal IQ (Leitman, Ziwich, Pasternaki, & Javitt, 2006).

Sensitivity. The attitudinal subtest has been shown to be sensitive to sarcasm perception deficits in older adults (Orbelo et al., 2005), schizophrenia (Leitman et al., 2006; Kantrowitz, Hoptman, Leitman, Silipo, & Javitt, 2014), and individuals with brain damage (Orbelo et al., 2003). Results also indicate that this measure is sensitive to normative variation in ToM abilities in healthy adults, as indicated by the absence of floor and ceiling effects (Kantrowitz et al., 2014; Orbelo et al., 2005).

The Hinting Task. This first-order cognitive ToM task examines the ability of individuals to infer the true intent of indirect speech (Corcoran et al., 1995). Ten short passages present an interaction between two characters and each passage ends with one of the characters vocalising a hint. Test takers are asked what the character providing the hint truly meant. Correct responses to the first inquiry are allocated 2 points. If the first response is inaccurate, a second hint is delivered, which allows test takers to earn partial credit if an accurate response is provided (i.e., 1 point). A Spanish version of this task was developed by Gil, Fernandez-Modamio, Bengochea, and Arrieta (2012).

Internal consistency. Pinkham et al. (2014) reported a Cronbach’s alpha of .73 for individuals with schizophrenia and .56 for healthy adults. Similarly, the Spanish version of this measure has been shown to have low to moderate internal consistency, as evidenced by Cronbach’s alphas of .69 and .64 for individuals with schizophrenia and healthy adults, respectively.
Test-retest reliability. Although good 2 to 4 week test-retest reliability has been reported for the Hinting Task within samples of individuals with schizophrenia \((r = .64)\), a considerably lower correlation was reported for healthy adults \((r = .42)\) who demonstrated practice effects (Pinkham et al., 2014). Further, approximately 7% of Pinkham et al.’s (2014) combined sample scored at ceiling at both time points. Two week test-retest reliability for the Spanish version of this measure was found to be equal or greater than \(r = .70\) for all stories (Gil et al., 2012).

Factor structure. Although there are no reports on the factor structure of the Hinting Task specifically, this measure has been used to assess the factor structure of social cognition. Corbera, Wexler, Ikezawa, and Bell (2013) performed principal component analysis using measures of ToM (i.e., the Hinting Task and Social Attribution Test; Klin, 2000), empathy (i.e., Interpersonal Reactivity Index, IRI; Davis, 1983), emotion recognition, and self-experience of relatedness in patients with schizophrenia and healthy adults. The Hinting Task was found to load on one (viz., the basic social cognition factor) of three factors (viz., interpersonal discomfort and empathy factors).

Convergent and discriminant validity. Corcoran and Frith (2003) found that the Hinting Task significantly correlated with an adapted false belief cartoon task \((r = .63, p = .01)\). Small correlations have been found between the Hinting Task and indices of structured verbal memory \((r = .30, p < .01)\), short-term memory \((r = .42 \text{ to } .43, p < .001)\), processing speed \((r = .31, p < .001)\), executive function \((r = .34, p < .001)\), Greig, Bryson, & Bell, 2004) and autobiographical memory \((r = .42, p = .01)\), Corcoran & Frith, 2003). Further, small to moderate correlations have been found between performance on the Hinting Task and estimated IQ \((r = .49, p < .001)\), Corcoran et al., 1995; \(r = .31, p < .001\), Greig et al., 2004).

Sensitivity. Several studies have demonstrated the ability of this measure to distinguish individuals with schizophrenia from healthy adults after controlling for IQ (Corcoran & Frith,
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2003; Corcoran et al., 1995; Greig et al., 2004).

**Faux Pas Recognition.** Understanding a faux pas requires appreciation of the consequences of embarrassing or tactless remarks in conversational context. These tasks are often used as a measure of first-order affective ToM.

**Faux Pas Recognition Test.** The Faux Pas Recognition Test permits the assessment of both cognitive and affective components of ToM. Test takers are read 10 stories which contain a social faux pas and 10 control stories detailing a minor conflict (Stone et al., 1998). After each story, test takers are asked whether one of the characters said something they should not have said (i.e., a faux pas; affective component). When a faux pas is correctly detected, further clarifying questions are asked to evaluate the test taker’s understanding of the character’s mental states (i.e., why comment was inappropriate, the speaker’s motivation/intention, the truth of the belief; cognitive component) and how the character who was subject to the faux pas would have felt (i.e., empathy). Two additional control items are asked to screen for story comprehension errors. Each correct response is allocated a score of 1. No reports on the factor structure of the Faux Pas Recognition Test are available.

**Internal consistency.** High internal consistency has been reported for this measure, as evidenced by a Cronbach’s alpha of .91 and split-half reliability of $r = .95, p < .01$ (Söderstrand et al., 2012).

**Test-retest reliability.** The measure has demonstrated sound 3-month test-retest reliability in a sample of Chinese individuals with schizophrenia ($r = .83$; Zhu et al., 2007).

**Convergent and discriminant validity.** Small to moderate correlations have been reported between the Faux Pas Recognition Test and the Reading the Mind in the Eyes Test ($rho = .30, p < .05$) and the Dewey Story Test ($r = .28, p < .05$; Söderstrand et al., 2012).

**Sensitivity.** The Faux Pas Recognition Test has been shown to distinguish healthy adults from individuals with damage to the mPFC (Lee et al., 2006), Alzheimer’s Disease...
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(Funkiewiez, Bertoux, de Souza, Lévy, & Dubois, 2012), antisocial personality disorder (Dolan & Fullam, 2004), ASD (Zalla, Sav, Stopin, Ahade, & Leboyer, 2009), and schizophrenia (Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006; Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003; Zhu et al., 2007).

Social Perceptual Tasks

Like social cognitive tasks, social perceptual tasks often utilise reflective, offline designs, and have poor ecological validity (Brüne, 2005; Dziobek, 2012). Test takers are often presented with decontextualized images of faces and animations. Even when stimuli are dynamic in the form of video clips (Dziobek et al., 2011; McDonald et al., 2006), test takers are provided an elongated time frame to observe the stimuli, consider its properties, and make a judgment. By contrast, in daily life, emotional displays are fleeting and are rarely presented in isolation. Rather, redundant clues to mental states are presented in facial expression, vocal inflections, and actions. This combination of presenting isolated social cues and prolonged observation and response time may also lead to an overestimation of real-world abilities. These limitations are of clinical importance because the ability to infer mental states from social cues has been commonly studied as a means to better understand the impact of ToM impairments on social functioning (Croker & McDonald, 2005; Zupan, Neumann, Babbage, & Willer, 2009).

Cue perception. Another way in which people infer the mental states of others is through the perception of various social cues. Although mental states are inherently cognitive, humans have a sophisticated repertoire of behaviours (e.g., gaze cues, facial expressions, and vocal cues) through which they express their mental states. Gaze cues for example, signal the basic direction or object of one’s attention (Bayliss, Frischen, Fenske, & Tipper, 2007; Frischen, Bayliss, & Tipper, 2007), and may be used to resolve linguistic ambiguities in non-literal language like sarcasm.
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**Reading of the Mind in the Eyes.** This measure, otherwise referred to as the Eyes Test, provides an index of first-order affective ToM by measuring the capacity to discriminate the mental states of others from expressions in the eye region of the face (Baron-Cohen, Wheelwright, Skinner, et al., 2001). Test takers view photos of the eye region of different faces and chose the most accurate descriptor for the thought/feeling portrayed. Four possible options are presented with each photo, and a glossary of mental state terms is provided for reference. Responses are either scored as correct or incorrect.

This measure underwent substantial revisions to improve its psychometric properties (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). One such change was increasing the selection of forced choice response options (i.e., from two to four responses) and increasing the number of items from 25 to 36. The task was made more suitable for adults by including items that involved the attribution of a belief or intention and by selecting distractor items of similar valence to the answer, rather than being the semantic opposite. German (Pfaltz, Michael, Meyer, & Wilhelm, 2013), French (Prevost et al., 2014), Italian (Vellante et al., 2013), and Persian (Khorashad et al., 2015) versions have also been developed.

**Internal consistency.** The most recent report of internal consistency for the English version of the Eyes Test was documented by Pinkham et al. (2014) who reported a Cronbach’s alpha of .74 for individuals with schizophrenia and .67 for healthy adults. Prevost et al. (2014) found that the English version of the Eye Test (α = .77), but not the French version (α = .53), had sound internal consistency. Similarly, Söderstrand et al. (2012) reported a Cronbach’s alpha of .64 and moderate split-half reliability (r = .63, p < .01) in a Swedish sample of health adults. For the Italian version of the Eyes Task, Vellante et al. (2013) reported a Cronbach’s alpha of .61.

**Test-retest reliability.** Pinkham et al. (2014) reported strong 2 to 4 week test-retest reliability for the English version of the Eyes Test (viz., r = .75 for individuals with
schizophrenia and \( r = .76 \) for healthy adults). Similar scores were obtained for 1-week test-retest reliability of the English (ICC = .70, 95\% CI = .50 to .80) and French versions (ICC = .70, 95\% CI = .46 to .84; Prevost et al., 2014). High 1-month test-retest reliability for the Italian version has also been reported (ICC = .83, 95\% CI = .75 to .90, Vellante et al., 2013).

**Factor structure.** Confirmatory factor analysis provided evidence for a unidimensional model, with maximal weighted internal consistency reliability of .72 (Vellante et al., 2013).

**Convergent and discriminant validity.** There have been small and inconsistent correlations between the Eyes Test and other measures of ToM. For example, whereas the Spanish version of Eyes Test has been found to correlate with Happé’s Strange Stories \( (r = .45, p = .05) \) and the Faux Pas Recognition Test \( (r = .41 \text{ to } .68 \ p < .01; \ de \ \text{Achával et al.}, \ 2010) \). Dziobek et al. (2006) found that the English version of the Eyes Test did not significantly correlate with an ecologically valid measure of ToM (viz., MASC). This pattern of results is not surprising given the Eyes Test relies on automatic decoding abilities, whereas the other measures of ToM were predominantly social cognitive in nature (de Achával et al., 2010), thus assess slightly different ToM processes.

The Eyes Test has been found to significantly correlate with measures of frontal lobe functioning \( (r = .56, p = .01) \) in schizophrenia and facial recognition in relatives of individuals with schizophrenia \( (r = .56, p = .01; \ de \ \text{Achával et al.}, \ 2010) \). Furthermore, while some studies report that task performance on the Eyes Task is independent of IQ (Baron-Cohen, Wheelwright, Skinner, et al., 2001; Chapman et al., 2006; Kelemen, Kéri, Must, Benedek, & Janka, 2004), others do not (Ahmed & Miller, 2011; Golan, Baron-Cohen, & Hill, 2006; Kenyon et al., 2012).

**Sensitivity.** This test has been shown to distinguish high-functioning adults with ASD from healthy adults (Baron-Cohen, 2009; Baron-Cohen, Wheelwright, Skinner, et al., 2001; Baron-Cohen, Wheelwright, Stone, & Rutherford, 1999). Other studies have shown that
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Healthy adults score significantly higher on the Eyes Test than do individuals with schizophrenia (de Achával et al., 2010; Green, Olivier, Crawley, Penn, & Silverstein, 2005), eating disorders (Adenzato, Todisco, & Ardito, 2012; Harrison, Tchanturia, & Treasure, 2010), and social anxiety (Machado-de-Sousa et al., 2010).

**The Yoni Task.** This is a measure of first- and second-order cognitive and affective ToM (Shamay-Tsoory et al., 2006; Poletti, Enrici, & Adenzato, 2012). The task involves 64 trials depicting a cartoon face named Yoni in the centre of a computer screen, with a smiling, sad, or neutral expression. Yoni’s eyes are either directed straight ahead or towards one of four pictures (i.e., one in each corner of the computer screen) which display other faces, or items from semantic categories such as fruits and modes of transport. Test takers are required to complete a sentence stem (e.g., “Yoni loves ___”) based on the direction of Yoni’s eye gaze and facial expression. Responses are scored as either correct or incorrect. Information about the internal consistency, test-retest reliability, and factor-structure of the Yoni Task is not available.

**Convergent and discriminant validity.** Research indicates that the first- and second-order cognitive and affective ToM subscales of the Yoni Task have small correlations with measures of irony ($r = -.29$ to $-.35, p < .01$) and false belief ($r = .25, p < .05$, Shamay-Tsoory & Aharon-Peretz, 2007).

**Sensitivity.** The Yoni task has been shown to discriminate healthy adults from individuals with ASD (Shamay-Tsoory, 2008), schizophrenia (Shamay-Tsoory et al., 2005) and individuals who are high in psychopathy (Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010). However, Shamay-Tsoory and Aharon-Peretz (2007) found that healthy adults as well as individuals with brain lesions performed at ceiling on the first-order cognitive and affective ToM subscales.
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Observation of animated shapes. An alternative approach to ToM assessment is through coding an individual’s capacity to identify agency in movements of animated shapes (i.e., possessing a mental state motivated by intentions). These tasks assess test takers’ ability to recognize visual stimuli as social phenomena and to extract visual cues from the display to create a social context and make social attributions. Russell, Reynaud, Herba, Morris, and Corcoran (2006) argue that tasks requiring the observation of animated shapes have the advantage of providing a pure measure of cognitive ToM in that they display dynamic stimuli (i.e., unlike traditional story-based tasks) and do not rely on the integrity of other neurocognitive abilities (e.g., working memory and language comprehension).

Social Attribution Test. The Social Attribution Task (SAT-MC) uses a 64 second video of geometric shapes set in motion to portray themes of social relatedness and intentions (Klin, 2000; Klin et al., 2007). Although the 2D shapes do not resemble people, healthy adults have been observed to spontaneously describe the actions in anthropomorphic terms endowing them social intentions, emotions, and personalities (Klin et al., 2007).

A total of 19 questions are asked with four possible responses options: one describing action with correct emotional intent (scored as 1), two describing action with incorrect emotional intent (scores as 0), and one describing object motion without emotional intent (scored as 0). The measure consists of seven subscales, each referred to as an index, which assess across cognitive and affective ToM. The pertinence index assesses the proportion of total propositions which were vague, misattributed, irrelevant, and/or inconsistent. The salience index assesses the proportion of highly salient attributions made. The cognitive ToM index assesses the proportion of total propositions which included mental state terms (e.g., thoughts, intentions). The affective ToM index assesses the proportion of total propositions that contained emotion terms. The animation index captures the overall quality of social attribution ability. The person index captures the extent to which physical, behavioural,
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relationship, or psychological details were used when asked what sort of ‘people’ the stimuli were. Lastly, the problem solving index captures the proportion of correct answers given to direct questions about cartoons. An alternate form of the task, the SAT-MC-II, has been developed for repeat testing (Johannesen, Lurie, Fiszdon, & Bell, 2013). The SAT-MC-II was constructed using the same format and similar geometric stimuli as the original, but object motion was altered to portray a new social drama.

Internal consistency. Results indicate that the internal consistency of the SAT-MC ($\alpha = .56$) is low compared to that of the SAT-MC-II ($\alpha = .81$; Johannesen et al., 2013). Split-half reliability coefficients were comparable to full-scale coefficients at .56 for the SAT-MC and .83 for SAT-MC-II.

Test-retest reliability. Four week test-retest reliability has been demonstrated for the seven subscales of the SAT-MC in a sample of healthy children ($r = .73$ to .88, $p < .01$; Hu, Chan, & McAlonan, 2010).

Factor structure. Although there are no reports specifically on the factor structure of the SAT-MC, this measure has also been used to inform on the factor structure of social cognition, with a significant ($p < .05$) loading on the Basic Social Cognition factor identified by Corbera et al. (2013).

Convergent and discriminant validity. Although the SAT-MC was found to significantly correlate with the Hinting Task ($r = .37, p < .001$) for a combined sample of healthy adults and individuals with schizophrenia, this relationship did not reach statistical significance when assessed within the schizophrenia sample alone ($r = .23, p = .07$; Bell, Fiszdon, Greig, & Wexler, 2010). Notwithstanding, total performance on the SAT-MC has been shown to have small associations with a measure of affect recognition in healthy adults ($r = .28, p < .05$; $r = .40, p < .01$ SAT-MC-II; Johannesen et al., 2010) and individuals with schizophrenia ($r = .37, p = .002$; Bell et al., 2010).
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Task performance has been demonstrated to be independent of attention and vigilance, processing speed, and visual learning abilities (Bell et al., 2010). Nevertheless, tests of executive functioning were found to have modest to large significant correlations with the SAT-MC, producing coefficients in the same range as tests of social cognition (i.e., $r = .47, p < .001$ for Matrix Reasoning; $r = .34, p = .007$ for the Wisconsin Card Sorting Test; $r = .32, p = .01$ for the MATRICS indices of working memory). Further, SAT-MC scores correlated with indices of Vocabulary ($r = .38, p = .003$) and Block Design ($r = .36, p = .004$), which suggests that IQ (although not specifically measured here) may affect performance. Such results may indicate that the SAT-MC places some demand on cognitive abilities that are recruited in social as well as non-social problem solving (Bell et al., 2010).

Sensitivity. Bell et al. (2010) found that overall performance scores accurately classified 75% of outpatients with chronic schizophrenia and healthy community adults. The SAT-MC has also been shown to distinguish normally developing adolescents and adults from individuals with ASD (Klin, 2000), traumatic brain injury (Scheibel et al., 2011), and Prader-Willi Syndrome (Koenig, Klin, & Schultz, 2004).

Ecologically Valid Tasks

These measures typically require test takers to watch video vignettes and answer questions that refer to the actors’ mental states. Alternatively, test takers may be required to observe confederates portraying a social drama and then respond to open ended questions which invite the test taker to express their understanding of their own and others’ mental states. Measures promoting ecological validity integrate life-like stimuli as to simulate being a bystander of real world social scenarios. Accordingly, these measures often engage both social cognitive and social perceptual processes. The value of these tasks, relative to the previously discussed ToM measures, is in their ability to identify limitations in real-world
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abilities, in addition to discriminating clinical from healthy populations or determining the etiology of brain dysfunction (Dziobek et al., 2006).

*Movie Assessment of Social Cognition.* This measure assesses first- and second-order cognitive and affective ToM processes in a simulated real-life social context whilst minimising the distracting stimuli that require retention and integration of information (Dziobek et al., 2006). The MASC draws upon a broad range of social cognitive principles including sarcasm, faux pas, false beliefs, and metaphor. Test takers are assessed across thoughts, emotions, and intentions that require interpretation of verbal (i.e., literal and figurative) and non-verbal (e.g., facial expressions and body language) cues (Dziobek et al., 2006). Responses can be summarised into error categories (i.e., frequency of responses which resemble a complete lack of mental state concept, reduced mentalising, and overmentalising). Responses can also be scored dichotomously (i.e., correct or incorrect) to provide indices of cognitive and affective ToM. Six non-social inferencing control questions are also presented. No reports on the factor structure of this measure are available.

*Internal consistency.* Dziobek et al. (2006) reported a Cronbach’s alpha of .84 for the total scale, with the range in internal consistency if any item is deleted being $\alpha = .82$ to .84.

*Test-retest reliability.* Sound test-retest reliability was observed for a combined sample of individuals with Asperger’s syndrome and healthy controls (ICC = .97) and also for the groups individually (4.6 months Asperger’s syndrome ICC = .92, 3.6 months healthy adults ICC = .89; Dziobek et al., 2006).

*Convergent and discriminant validity.* Dziobek et al. (2006) reported significant correlations between the MASC and Happé’s Strange Stories ($r = .47, p < .05$) in individuals with Asperger’s syndrome, and between the MASC and the Basic Emotion Recognition Task in a group of healthy adults ($r = .72, p < .01$).
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*Sensitivity.* Dziobek et al. (2006) found that the MASC was significantly more accurate in discriminating individuals with Asperger’s syndrome from healthy adults than the Eyes Task (ROC = .13, \( p < .05 \)), the Basic Emotion Recognition Task (Ekman & Friesen, 1976; ROC = .19, \( p < .05 \)), and Happé’s Strange Stories (ROC = .31, \( p < .01 \)). The MASC has also been demonstrated to distinguish healthy adults from individuals with borderline personality disorder (Preißler, Dziobek, Ritter, Heekeren, & Roepke, 2010) and schizophrenia (Montag et al., 2011).

*The Awareness of Social Inference Test.* This measure, also known as the TASIT, comprises videotaped vignettes of everyday social interactions and has three parts, each with alternate forms (McDonald et al., 2006). The emotion evaluation test assesses recognition of spontaneous emotional expressions (happy, surprised, sad, anxious, angry, disgusted, and neutral). The social inference-minimal (SI-M) test assesses the ability to interpret conversational remarks meant literally (i.e., sincere) and non-literally (i.e., sarcastic exchanges). Similarly, the social inference-enriched (SI-E) test assesses the ability to detect and distinguish lies from sarcasm as well as the ability to make judgments about the thoughts, intentions, and feelings of speakers. In both the minimal and enriched social inference tests, the speaker’s demeanour (e.g., vocal tone and facial expression) indicates the intended meaning of the exchange. Performance on the SI-M and SI-E is assessed via four standard questions per item probing for understanding of the emotions, intentions, beliefs, and meanings of the speakers and their exchanges. Participant’s responses are scored as either correct or incorrect.

*Internal consistency.* Pinkham et al. (2014) reported a Cronbach’s alpha of .81 for the total score in their sample of individuals with schizophrenia and \( \alpha = .76 \) for healthy adults.
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Test-retest reliability. McDonald et al. (2006) found that test-retest reliability ranged from $r = .74$ to $.88$ (1 week interval) for the original forms and $r = .62$ to $.83$ (5 to 26 week interval) for the alternate forms in individuals with brain injuries.

Factor structure. Mancuso, Horan, Kern, and Green (2011) examined the factor structure of eight indices derived from five social cognition tasks, including the TASIT, that span the domains of emotional processing, social perception, attributional style, and ToM. Results revealed three factors with relatively low inter-correlations that explained a total of 53.6% of the variance. Scores on the SI-E test loaded on the lower-level social cue detection factor, which included other indices that share a relatively low level reliance on perceiving cues and understanding information directly presented to test takers in the task stimuli. Scores on the SI-M test and other measures that required relatively high-level processes involved in incorporating and utilizing socio-emotional information and knowledge that is not directly present in the stimuli, loaded on the higher-level inferential and regulatory processes factor. No index from the TASIT significantly loaded on the hostile attributional style factor.

Convergent and discriminant validity. Performance on the subscales of the TASIT were associated with an index of face perception ($r = .37$ to $.70$, $p < .05$). Contrary to expectation, only the SI-M test was associated with a story-based measure of second-order ToM ($r = .68$, $p < .05$), whereas measures of first-order ToM and physical inference stories were not related to scores on any part of the TASIT (McDonald et al., 2006).

In a sample of individuals with brain-injury, performance on the subscales of the TASIT were correlated with measures of premorbid IQ ($r = .26$ to $.50$, $p < .05$), processing speed ($r = -.34$ to $-.39$, $p < .05$), mental flexibility ($r = -.35$ to $-.56$, $p < .05$), working memory ($r = .25$ to $.36$, $p < .05$), new learning of social ($r = .33$ to $.69$, $p < .01$) and non-social nature ($r = .31$, $p < .05$ for the SI-M test) and, executive functioning ($r = .29$ to $.78$, $p < .01$, McDonald et al., 2006). Given the dynamic, complex, naturalistic stimuli utilised in the
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TASIT, the interplay of this task with other cognitive abilities is expected. Further, performance on the TASIT was found to be independent of performance on other indices of executive functioning (viz., Wisconsin Card Sorting Test and Controlled Oral Word Association Test, McDonald et al., 2006).

**Sensitivity.** The TASIT has been shown to distinguish healthy adults from individuals with traumatic brain injury (McDonald et al., 2006), high-functioning adults with ASD (Mathersul, McDonald, & Rushby, 2013), and schizophrenia (Chung, Mathews, & Barch, 2011).

**Th.o.m.a.s.** This is a semi-structured interview consisting of 39 open-ended questions that invite the test taker to express their understanding of their own and others’ mental states (Bosco et al., 2009). Questions correspond to four scales. Scale A investigates the test taker’s knowledge of their personal mental states. Scale B assesses the capacity of the test taker to adopt the perspective of another character. Scale C investigates the test taker’s capacity to notice changes in second-order mental states. Scale D investigates the capacity of the test taker to infer the perspectives that others have of their mental state. Each scale is further divided into three subscales. ‘Awareness’ investigates the test taker’s ability to perceive and differentiate beliefs, desires, and emotions in themselves and in the others. ‘Relation’ investigates the test taker’s ability to recognize causal relations between different mental states and between these mental states and resulting behaviours. ‘Realization’ assesses the test taker’s ability to adopt effective strategies to achieve a desired state. Responses are scored by the test administrator between 0 to 4 based on the coherence, detail, and the extent to which the answer is contextualised within a personal example. No information about internal consistency, test-retest reliability, or the factor structure of this measure is available.

**Convergent and discriminant validity.** Bosco et al. (2009) reported significant moderate correlations between a composite measure of ToM (i.e., items from the Sally-Anne
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False Belief Task and Happé’s Strange Stories) and participants’ total scores on Th.o.m.a.s ($r = .54, p = .013$), as well as with scales A, B, and C ($r = .45$ to $65, p < .05$). No significant correlation was found between this composite measure of ToM and scale D ($r = .41, p = .07$). Furthermore, performance on Th.o.m.a.s has been found to correlate with IQ ($r = .48$ to $.70$; Bosco et al., 2009).

Sensitivity. This measure has been demonstrated to effectively distinguish healthy adults from individuals with schizophrenia (Bosco et al., 2009) and individuals with alcohol use disorder (Bosco, Capozzi, Colle, Marostica, & Tirassa, 2014).

Limitations of Current Theory of Mind Assessment

Limited psychometric properties. The psychometric properties of many existing ToM tasks are inadequate or seldom reported (Bora et al., 2009; Corcoran & Frith, 2003; Green et al., 2008; Kohler et al., 2003; Versmissen et al., 2008). For example, Pinkham et al. (2014) showed that the test-retest reliability of both the Hinting Task and TASIT were below benchmark standards (Tabachnik & Fidell, 2012). Given the recent focus on developing treatments to target ToM impairments in clinical populations, the lack of data on the utility of measures for repeated assessment is concerning (Brüne, 2005).

Furthermore, how ToM is assessed is not well standardised (Bora, Yucel, & Pantelis, 2009). Sprong et al. (2007) reported that the lack of consistency in task administration protocols, as well as the heterogeneity of content within false belief tasks may account for the variability in performance detailed in the literature when discussing specific task types. For example, results of some studies are based on a selection of false belief stories or picture sequences drawn from multiple tasks. Nonetheless, reports of low convergent validity between measures may also attest to the breadth of the ToM construct and that tasks may be assessing different aspects of ToM. Measures which lack psychometric rigour and standardised testing instructions can compromise validity and reproducibility of findings and
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limit treatment development and evaluation by rendering it difficult to accurately assess treatment response.

**Online versus offline processing.** Social interactions are dynamic and often ambiguous, whereby those partaking are required to rapidly infer others’ fluctuating intentions and emotions from contextual cues (Klin, 2000). This type of processing occurs in a largely non-reflective manner during which a first-person perspective (i.e., from the inside looking out) is adopted and mentalising is used implicitly and automatically to communicate. In this sense, mentalising is considered ‘online’. Despite this, researchers have primarily used experimental paradigms that require test takers to make explicit ToM inferences from stimuli presented as static images (Baron-Cohen et al., 2001; De Sonneville et al., 2002; Mutlu, Shiwa, Kanda, Ishiguro, & Hagita, 2009), textual stories (Happé, Brownell, & Winner, 1999), or video vignettes (viz., the MASC and TASIT). As such, these tasks have been criticised as assessing an observation-based, reflective, third-person understanding of ToM in artificial social problem-solving situations (Schilbach et al., 2012). When mentalising processes are engaged in this way, they are considered ‘offline’. This format substantially departs from real-life decision making contexts where an individual must constantly consider the impact of their own decisions on others’ mental states. As such, it can be argued that existing ToM tasks lack verisimilitude.

Furthermore, in comparison to multimodal (e.g., auditory and visual) and dynamic real-life social interactions, it is reasonable to suggest that the perception of posed static expressions (e.g., the Eyes Test and Yoni Task) and even fictional video vignettes (e.g., the MASC and TASIT) would be less emotionally arousing and thus associated with reduced cognitive engagement and emotional immersion. Schilbach et al. (2012) argue that accurate mentalising has fundamentally different motivational consequences and underlying neural processes when individuals are socially and emotionally engaged with others compared to
when they are third-person observers. Interacting with others provides individuals with the ability to perform active conversational roles, which might include initiating or responding to episodes of interaction, rather than observing the interaction as a bystander. This active involvement also facilitates shared goals, intentions, and actions among the participants of the interaction, providing individuals with the ability to draw on subjective experiences in making ToM inferences. As test takers are often not engaged in the interactions (e.g., the MASC and TASIT), nor are they required to integrate information from multiple sources to generate a context (e.g., Yoni Task), simplified tasks may misrepresent test takers’ real-life mentalising abilities. The limitations in using third-person paradigms in the study of ToM encourage the development and validation of more ecologically valid experimental tasks.

**Cultural specificity of ToM tasks.** Culture provides a framework for understanding and responding in social interactions. The values and norms within a culture help guide an individual in assigning meaning to social events (Han, 2013). An important feature of ToM is that it is largely context dependent. What and how social information is processed is informed by the context in which interactions occur. For example, people from different cultures may think of and treat others in positions of dominance and subordination differently, and the way individuals interact with the same or opposite gender may vary from one culture to another. Results from cross-cultural studies have been used to identify cultural variations in social cognitive processes, including causal attribution (Choi, Nisbett, & Norenzayan, 1999), self-construal (Markus & Kitayama, 2010), and affect valuations (Tsai, Knutson, & Fung, 2006). Findings of cross-cultural variations in processes that may influence mental state inferences raise clinical issues regarding ToM impairment and its related assessment. Although there have been efforts to examine the utility of some existing measures (viz., the Eyes Test, Hinting Task, Yoni Task, and MASC) for use with other cultures, performance on the ToM tasks reviewed in this chapter may be subject to cross-
The cultural variation. Accordingly, the cross-cultural generalisability of the findings generated using these measures, may be limited (Han, 2013).

**Heavy reliance on neurocognitive abilities.** Although it is generally agreed that social cognition relies on some features of neurocognition (e.g., verbal fluency and working memory), performance on ToM tasks should be relatively independent of basic cognitive ability (Brüne, 2005). This is of concern because there is heterogeneity in the demands that ToM tasks place on neurocognitive processes. Performance on several widely used measures of ToM (e.g., the Faux Pas Recognition Test and Hinting Task), and even ecological measures (e.g., the TASIT and MASC), have shown significant relationships with verbal processes and working memory (Bell et al., 2010; Nuechterlein et al., 2004). Furthermore, several studies have reported strong correlations between performance on verbal ToM measures (e.g., Happé’s Strange Stories) and indices of IQ (Bora et al., 2009; Stanford et al., 2011). As such, neurocognitive deficits and differences in IQ could differentially influence (and interact with) performance on various ToM tasks and in turn, draw into question the construct and external validity of existing measures.

To screen for neurocognitive deficits, a few measures (viz., the Faux Pas Recognition Test, Hinting Task, TASIT, and MASC) include control questions to ensure accurate encoding of the information and in turn, rule out the possibility that poor task performance is attributable to working memory or comprehension deficits. Importantly, verbal content should be matched across the mentalising and control items to ensure such items are engaging similar verbal processes. Adopting an alternate approach, Frith and Corcoran (1996) removed several demanding items from the Strange Stories Tasks because they covaried with performance on a comprehension control item. Although the measure was demonstrated to detect differences between groups \(p < .01\), these changes lowered the ceiling for more able populations.
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Central coherence, which is the capacity to extract meaning from information by understanding the context within which it is presented, and the related concept of executive functioning, have also been presented as alternative explanations for impaired performance on ToM tasks. Some theorists (e.g., Frith & Happé, 1994) argue that ToM and executive functions are dissociable processes, whilst others (e.g., Jarrold, Butler, Cottington, & Jimenez, 2000; Hardy-Baylé, Sarfati, & Passerieux, 2003) suggest that these processes are inextricably linked. Notwithstanding, limiting the verbal nature, as well as the realism of a socially demanding situation, would paradoxically limit the verisimilitude of a measure.

Explicit cues. ToM tasks often include explicit cues that are not available in real-life situations. For example, in most ToM paradigms the problem to be solved is explicitly defined by the question posed. Individuals administered the Faux Pas Recognition Test are asked “Did anyone say something they shouldn’t have said or something awkward?” As such, test takers are prompted to use knowledge about mental states (e.g., Lisa did not know Jill had bought new curtains) and to consider the implications of the inferred mental state (e.g., Jill was offended by Lisa’s remark). Individuals with ASD and schizophrenia have little difficulty with these simple first-order ToM questions (Brüne, 2005; Montag et al., 2011). In real life, however, social situations seldom present themselves in this fashion. Rather, deciding what constitutes socially adaptive behaviour in a given context requires an individual to spontaneously perceive the relevant social elements of the situation, interpret how the social elements create a social context, and appraise how the context qualifies the behaviours of others toward that individual. Thus, performance scores on measures with explicit cues may be artificially inflated and poorly reflect real-world abilities.

Scoring. Another inconsistency between ToM measures and real-life social situations is the dichotomous nature in which ToM is assessed (i.e., correct vs. incorrect). Performance on ToM tasks is often derived using categorical or binary scoring that supposedly captures the
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presence or absence of an accurate mental inference. Categorical scoring, such as that used in
the Eyes Test, Picture Stories Intention Inferencing Task and False Belief Story Task,
provides limited information about variation in impairment other than whether patients have a
functioning capacity of ToM or not. As a result of this scoring approach, the majority of
measures available to assess ToM are deficit based. Treating strengths as clinical peripheries
or by-products reduces clients to diagnostic categories, and creates a power differential which
can be counterproductive to clinical efficacy (Rashid & Ostermann, 2009).

The use of pass/fail indicators of ToM abilities have been criticised for undermining the
complexity of ToM impairment and normative variation in mentalising capacity (Dziobek et
al., 2006). This is evidenced by reports of ceiling effects in healthy adult populations (e.g.,
Recent research has shown that ToM abilities are best classified according to a continuum of
competence and performance (e.g., the continuity model of ToM; Abu-Akel & Bailey, 2000;
Abu-Akel & Shamay-Tsoory, 2011; Montag et al., 2011). Although the MASC can be used to
quantify different types of ToM errors, the scoring key attached to ToM questions is
dichotomous. Ecological measures that assess ToM along a continuum (e.g., from under- to
overmentalising) and provide cumulative scores (e.g., no ToM and overmentalising scored as
0, reduced mentalising scored as 1, and accurate mentalising scored as 2) have the potential
to improve understanding of the breadth of ToM abilities and types of ToM impairments in
several clinical populations.

Narrow scope. With the exception of the Yoni Task, TASIT, and MASC, existing
ToM measures have also been criticised for narrowly targeting specific mentalising skills.
The Yoni Task is the only available measure that provides explicit indices of first- and
second-order cognitive and affective ToM. Rather, most tasks assess first-order cognitive or
affective ToM in isolation (i.e., neglecting second-order processes) or assess only one aspect
of pragmatic speech (e.g., sarcasm, irony, or faux pas). Real-world social interactions involve combinations of social cognitive processes as well as allow for informational redundancies occurring through multiple sources of information and modes of presentation (Bazin et al., 2009; Bellack, Blanchard, & Mueser, 1996). As such, narrow measures can be criticised for lacking verisimilitude.

Concerns regarding the scope of ToM measures can be attributed to the difficulty inherent in balancing the conflicting demands of internal and ecological validity. For example, although Happé’s Strange Stories explores a wide range of mental states such as lying and persuasion, only 25% of the items showed good discriminative power between ToM processes, which in turn suggests the measure has low internal consistency (Frith & Corcoran, 1996). On the other hand, items within the Hinting Task focus specifically on the understanding of social inference in direct speech, which allows for greater internal consistency (Corcoran et al., 1995). As a consequence, however, the Hinting Task is less representative of ToM abilities as they would manifest in everyday life. Brüne (2005) concludes that the problem of verisimilitude cannot satisfactorily be resolved in experimental offline test conditions. Collateral information from well validated ecological measures that overcome the aforementioned limitations of existing ToM tasks has the potential to greatly enhance the validity and clinical utility of social cognitive assessment batteries.

Virtual Reality

Virtual reality is an emerging medium through which to assess cognitive (Canty et al., 2014) and social cognitive (Andrist, Pejsa, Mutlu, & Gleicher, 2012) processes. It is a term used to describe computer-generated artificial environments with distinctive sensory properties that can be explored and interacted with in real time (Kim et al., 2007). Simulated social interactions draw on advancements in the computer sciences to employ complex computational systems that enable the simulation of embodied, situated interactions. As such,
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virtual reality permits the development of protocols which balance the demands of ecological validity with the sensitivity and specificity of conventional neuropsychological assessment instruments.

Virtual assessment platforms offer several advantages over conventional mediums of social cognitive assessment (viz., verbal stories and cartoon sequences). First, virtual platforms simulate real-life stimuli. In contrast to many of the existing measures of ToM described earlier, natural environments are not a composition of static frames and dichotomous response options available to elicit appropriate responses. By contextualising social cognitive content in an interactive, dynamic protocol that closely resembles face-to-face interactions, virtual tasks are more likely to engage online processes, thus provide performance scores which are more representative of real-world abilities. Thus, through providing an immersive environment with auditory and visual cues that are administered independently of the examiner, virtual tasks can precisely manipulate behavioural aspects of social situations and enhance the objectivity and ecological validity of ToM assessment.

Second, virtual environments balance the need to mimic the complexity and multifaceted nature of social situations against the need to isolate competencies for study. Although more theoretically advanced tests of ToM have been introduced in recent years (e.g., the Yoni Task, TASIT, and MASC), most existing measures often only assess singular aspects of mentalising ability (e.g., first-order cognitive ToM), thus do not reflect the dynamic and sophisticated interplay of ToM processes characteristic of real-life discourse. In addition to assessing the cognitive and affective components of ToM, a sophisticated virtual platform has the potential to further dissect these components through assessing both simple (first-order) and complex (second-order) processes, as well as inform on types of ToM impairment. Specifically, sophisticated scoring criteria could be integrated into the virtual platform so that responses to social stimuli are assessed according to Abu-Akel and Bailey’s
Third, the use of virtual reality may be advantageous in rehabilitative settings where the primary objective is treatment planning based on the nature and extent of impairment. One of the primary goals of a clinician who is administering tests of ToM is to determine whether clients have a normal capacity to mentalise and if not, identify the limits of their social competence (Combs et al., 2007). Moreover, clinicians often need to compare what clients expect to be able to achieve within social situations with their actual performance. A substantial difference between predicted and actual performance may suggest a lack of insight, which can negatively impact goal-setting during rehabilitation and reduce the motivation of the client to participate in remediation programs. Thus, tests embedded in virtual environments can help clients explore the limits of their competence in a non-threatening space. Furthermore, virtual environments have the capacity to provide a consistent environment with the potential for infinite repetitions of the same assessment or training task while maintaining the flexibility to alter sensory presentations, task complexity, response requirements, and the nature and pattern of feedback to adapt to a user’s unique impairments (Chan & Chen, 2011). This information can inform the type of rehabilitation required and the degree of recovery that can reasonably be expected. Overall, virtual reality offers a stimulating testing platform that has the potential to accurately mirror the demands of everyday tasks, thus are more likely than existing measures to detect subtle differences in mentalising ability in healthy and clinical populations.

Despite the many advantages of using virtual platforms for the assessment of ToM, there are a number of obstacles that may hinder their widespread application. First, virtual tasks that simulate social interactions, like many existing measures, may involve a high dependence on verbal ability (e.g., understanding dialogue and responding to multiple choice
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questions). However, reducing verbal content, like that done in the SAT-MC (Klin, 2000), may diminish verisimilitude. Possible ways to balance task purity and verisimilitude is to include verbal comprehension items, including an equal number of verbal and non-verbal items, and using picture or video based multiple choice response formats.

Second, only a highly sophisticated cognitive simulation will permit the course of the testing paradigm to be altered according to the spontaneous social feedback offered in complex interpersonal situations (Chan & Chen, 2011). Specifically, social simulations have been criticised for the reliance on pre-scripted and experimenter-controlled protocols. That is, this approach does not allow for the study of ToM processes in complex interactions such as joint action scenarios that require all parties to engage ToM mechanisms in coordinating their actions toward a common goal. Paradoxically, the more flexible the protocol, the more test homogeneity is compromised. As such, flexible platforms may be better suited to rehabilitative settings whereas alternate-forms of less flexible testing platforms may be more suitable for assessment. Another possibility is the inclusion of responses that result in automated redirection to alternate scenarios that reflect the content of their previous response. For example, correctly interpreting and responding to an avatar’s saddened affect may result in the test taker being thanked for their emotional support, whereas misreading an avatar’s affective state may result in the test taker being told that the avatar feels unsupported.

Third, the sensitivity, verisimilitude, and veridicality that virtual reality programs purportedly offer relative to existing measures of ToM needs to be empirically demonstrated. With the exception of the MASC (Dziobek et al., 2006) and the SAT-MC (Klin, 2000), the ability of ToM measures to distinguish between diagnostic groups has seldom been demonstrated. Although diagnostic capability is not often a central focus in the development of ecological tools, how the sensitivity of virtual platforms compares to that of existing tasks is of clinical interest (Chan & Chen, 2011; Dziobek, 2012). For example, ToM measures are
being used to provide information about the rehabilitative needs of patients. Because test scores have the potential to directly influence the extent and type of rehabilitation a patient receives, it is important that ToM measures are sensitive to subtle individual variation, and are predictive of real-world abilities (Dziobek, 2012). Examining the sensitivity and ecological validity of a newly developed virtual reality measure of ToM that overcomes some of the aforementioned limitations of existing measures is a priority of the current research.

In summary, this chapter provided a psychometric review of existing social cognitive, social perceptual, and ecological measures of ToM. Common limitations of these existing measures were discussed. Simulated platforms situate the test taker within an interactive context, thus are presented as a potential solution to the problems associated with existing measures of ToM. The knowledge to be gained from the incorporation of this new methodology has the potential to enhance clinical and theoretical understanding of how individuals reason about the mental state of others, and may also further sciences devoted to improving or compensating for ToM impairments. Importantly, the psychometric quality of existing ToM tasks may be a confounding factor in drawing conclusions about the nature and correlates of ToM in schizophrenia. This cautionary note is reiterated throughout the next chapter, which focuses on the nature, breadth, and functional significance of ToM impairment, as well as the clinical and neurocognitive correlates of ToM performance, in schizophrenia.
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Chapter 5: Theory of Mind in Schizophrenia

This chapter focuses on the integrity and correlates of ToM processes, as well as the unique ways in which deficient mentalising accounts for the social dysfunction characteristic of schizophrenia. Table 5.1 (see end of chapter) summarises the study designs and main results of behavioural ToM research conducted within the schizophrenia population over the past 20 years. Taken together, the results of this research suggest that impairments are reliably present and that impairments in cognitive and affective ToM are dissociable (Montag et al., 2011; Shamay-Tsoory, Aharon-Peretz, & Levkovitz, 2007) and that deficient mentalising is independent of suboptimal neurocognitive functioning (Pollice et al., 2002; Roncone et al., 2002), problems with emotion recognition (Maat, Fett, & Derks, 2012; Sparks, McDonald, Lino, O'Donnell, & Green, 2010), and the presence of general psychopathology (Brüne, 2005). Although there is no dispute regarding the existence of ToM impairments in schizophrenia, their nature, clinical correlates, and functional significance is still unclear (Fett et al., 2011; Mancuso, Horan, Kern, & Green, 2011; Montag et al., 2011). Accordingly, the following subsections expand upon several areas which warrant further empirical attention.

Theory of Mind Impairment: State or Trait Marker of Schizophrenia

Researchers typically subscribe to one of two theoretical polarities to explain the nature of ToM impairment in schizophrenia. The first approach suggests that ToM abilities are a state marker of psychotic illness. This approach can be traced back to 1992 with Frith’s book ‘The Cognitive Neuropsychology of Schizophrenia’, in which he conceptualised schizophrenia as a disorder of the representation of mental states. Frith (1992) suggested that the signs and symptoms of schizophrenia reflect dysfunction within a cognitive system devoted to the recognition and monitoring of one’s own intentions and the attribution of intentions, thoughts, and beliefs to others.
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In his later work, Frith (2004) proposed that specific types of ToM impairments are associated with predominant symptomology. This represents a dichotomous perspective whereby the type and severity of ToM impairments in individuals with schizophrenia is associated with specific symptom clusters and predicts intact abilities in remitted patients. Frith proposed that patients with predominantly negative or disorganized symptoms and early developmental onset of the illness lack a functional concept of mental state (i.e., similar to holistic impairment described by Abu-Akel & Bailey, 2000; no ToM described by Dziobek et al., 2006). Alternatively, patients with paranoid symptoms are proposed to experience difficulty monitoring other peoples’ intentions and acquiring contextual information and in turn, excessively attribute intentions or self-referential meaning to others (i.e., overmentalising). From this perspective, ToM impairments are considered transient or state dependent.

In contrast to Frith’s (2004) hypothesis, research examining the extent to which ToM impairment is pervasive across all phases of illness (viz., acute and remission) has indicated that ToM impairment is still apparent in remission. The results of a meta-analysis demonstrated that the magnitude of ToM impairment may be influenced by acute symptomatology (Bora et al., 2009). Individuals with acute symptoms demonstrated prominent impairment on all ToM tasks while remitted patients (i.e., outpatients or inpatients approaching discharge) had reduced but still significant ToM impairment. Furthermore, Pousa et al. (2008) found that mentalising abilities are affected by residual positive symptoms during remission, and another study found that ToM impairments in individuals with schizophrenia reduce after commencing psychopharmacological treatment (Mizrahi, Korostil, Strakstein, Zipursky, & Kapur, 2007).

Although there is some evidence to suggest that ToM impairments are state dependent (Corcoran & Frith, 2003; Pickup & Frith, 2001; Pousa et al., 2008; Stewart, Corcoran, &
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Drake, 2008), the exact relationship between ToM and clinical symptoms remains unclear (Bora, Yucel, & Pantelis, 2009; Frith, 2004). A major challenge to Frith’s (1992) theory is the approach to subgrouping symptoms. The frequent overlap in symptom clusters makes it difficult to identify individual symptoms, or cluster of symptoms, that are associated with specific types of ToM impairment (Harrington, Siegert, & McClure, 2005). For example, a group of individuals diagnosed with disorganised type of schizophrenia may also present with paranoia and passivity. Another potential confound is the use of inconsistent criteria for categorising positive and negative symptoms (Harrington et al., 2005), as well as for categorising remitted and non-remitted patients (Green, Lee, Wynn, & Mathis, 2011; Pousa et al., 2008). Furthermore, there are few available measures (viz., the MASC) that discriminate between the types of ToM impairment observed in schizophrenia as described by Frith (2004).

The other polarity to which researchers frequently subscribe in explaining the nature of ToM impairment in schizophrenia suggests that difficulties with mentalising are a trait marker of the illness (Herold, Tenyi, Lenard, & Trixler, 2002). This developmental approach draws upon findings indicating that ToM impairments are the result of early abnormal development in social cognitive processes, are apparent prior to illness onset, and persist over time. Specifically, research indicates that difficulties with ToM are observed in remitted patients (Bora, Gökcen, Kayahan, & Veznedaroglu, 2008; Herold et al., 2002; Inoue et al., 2006), non-clinical individuals with high schizotypal traits (Langdon & Coltheart, 2004), healthy delusion-prone participants (Fyfe, Williams, Mason, & Pickup, 2008), and non-psychotic first degree relatives of patients with schizophrenia (Bora & Pantelis, 2013; Irani et al., 2006; Mazza, Di Michele, Pollice, Casacchia, & Roncone, 2008). Evidence of ToM impairments prior to the onset of schizophrenia has been further corroborated in two recent meta-analyses of ToM performance in schizophrenia (Bora et al., 2009; Sprong, Schothorst,
Vos, Hox, & Van Engeland, 2007) and a recent study comparing ToM performance across phases of illness (Green et al., 2012). Notwithstanding, several studies did not find an association between enhanced risk of schizophrenia and ToM impairments (Couture, Penn, Addington, Woods, & Perkins, 2008; Kelemen et al., 2005; Marjoram et al., 2006).

Overall, the relatively consistent finding that ToM impairments in schizophrenia persist after the remission of acute psychosis and are present in early psychosis contradicts earlier reviews (Sarfati et al., 1997) and the theoretical suggestion that ToM impairments are a state marker of schizophrenia (Frith, 1992). Rather, these findings support the notion that ToM dysfunction may be a trait characteristic of schizophrenia. An alternative approach to explaining the nature of ToM impairment in schizophrenia is that mentalising difficulties may include both state and trait components, as evidenced by the presence of mentalising difficulties across the course of illness, and fluctuations in the severity of these impairments with illness acuity. As it stands, the literature is not yet mature enough to warrant firm conclusions to be drawn regarding the state or trait status of ToM impairments in schizophrenia.

Stability of ToM Impairments across Course of Illness

Complementing research exploring whether ToM impairment represents a state or trait marker of schizophrenia, new research has begun to examine the stability of ToM impairments across the course of schizophrenia. Brüne (2003) speculated that declines in ToM may follow the reverse order of ontogenetic acquisition. That is, the ability to understand faux pas and irony may be affected first, whereas comprehension of first-order ToM problems and metaphor may be relatively preserved early in the course of illness (Brüne 2003). With the exception of some cross-sectional research (viz., Green et al., 2012), most of what is known about the extent to which ToM impairment progresses with illness chronicity comes from comparing individual studies. This approach is inherently flawed because
differences in selection criteria for patient samples and measures used to assess ToM, limits the comparability of findings between studies.

Only two studies to date have compared ToM performance of individuals in the prodromal phase of schizophrenia with that of healthy controls (Chung, Kang, Shin, Yoo, & Kwon, 2008; Couture et al., 2008). Although one of these studies reported that individuals in the prodromal phase had impaired performance on false belief tasks (Chung et al., 2008), the second study did not identify significant group differences using the Eyes Test (Couture et al., 2008). This discrepancy in findings may reflect differences in the processes that these measures assess (i.e., social cognitive or social perceptual). There is also the possibility that the difficulties with ToM observed during the prodromal phase of illness may be secondary to other factors such as cognitive deficits. Consistent with this idea, Bora et al. (2009) found that general cognitive deficits and residual symptoms significantly contributed to ToM impairment in individuals at high-risk for psychosis.

Findings based on comparisons with healthy adults suggest that individuals with FEP exhibit impaired performance on a range of ToM tasks. Specifically, these individuals were impaired in their ability to perceive complex mental states (Herold et al., 2009; Ineoue et al., 2006; Kettle, O'Brien-Simpson, & Allen, 2008), including understanding of irony and empathy (Green et al., 2012; Williams et al., 2008). Research concerning the stability of these impairments is mixed. Longitudinal studies have reported both small reductions (Behere, Venkatasubramanian, Arasappa, Reddy, & Gangadhar, 2009; Horan et al., 2012) and no change (Addington, Addington, & Saeedi, 2006; Herbener, Hill, Marvin, & Sweeney, 2005) in ToM impairments following improvement in clinical symptoms in individuals with FEP.

Cross-sectional research comparing the magnitude of ToM impairments observed in individuals at different phases of the illness is scarce. Green et al. (2012) compared individuals with FEP to patients with chronic schizophrenia using the SI-E test from the
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TASIT. Although no significant differences were observed between the clinical groups, both individuals with FEP and chronic schizophrenia were significantly impaired compared to healthy controls. Similar results were reported by Bora et al. (2009) who reviewed studies investigating the ToM abilities of individuals in symptom remission, with individuals with FEP, individuals at high-risk for psychosis, and first-degree relatives of individuals with schizophrenia. Results indicated that ToM abnormalities exist at illness onset, continue throughout the course of schizophrenia, persist into remission and while less severe, are present in high risk populations. Failure to detect subtle variations in ToM performance across the different phases of illness may reflect the low sensitivity of the measures used to assess ToM (Fretland et al., 2015). Furthermore, no cross-sectional research to date has explicitly compared first- and second-order cognitive and affective ToM processes in early and chronic phases of schizophrenia.

Theory of Mind in Chronic Schizophrenia

Several reviews and meta-analyses have confirmed that ToM is disrupted in the chronic phase of illness in schizophrenia (Bora et al., 2009; Fett et al., 2011) with average ToM performance more than one SD below healthy controls (i.e., on measures of first- and second order false belief and deception, comprehension of indirect speech, and intention-inferencing; Sprong et al., 2007). Abu-Akel and Shamay-Tsoory (2011) describe three key component processes of ToM that, if explicitly integrated into future research frameworks, may deepen our insight into the nature of impairments in chronic schizophrenia. These include the abilities to ‘represent’ or conceptualise others’ mental states, to ‘attribute’ mental states to others, and to ‘apply’ cognitive and affective mental states. By reframing ToM abilities in this way, what is known about ToM impairment in chronic schizophrenia can be summarised according to the continuum of competence described in Chapter 3 (Abu-Akel & Bailey, 2000). This may in turn minimise the mischaracterisation of abilities that often arises
when discussing the results of research which is based on measures using a dichotomous approach to assessing the presence or absence of ToM.

**Representation of mental states.** A considerable body of research has considered whether individuals with schizophrenia have a genuine deficit in the ability to conceptualise or represent the mental states of others (i.e., a conceptual deficit; Abu-Akel & Bailey, 2000). First-order false-belief understanding has been a widely used indicator of the ability to represent mental states (Abu-Akel & Shamay-Tsoory, 2011). As described in the taxonomy of ToM tasks provided in Chapter 3, these tasks assess the understanding that beliefs may differ among individuals who have access to different knowledge, thus some people’s beliefs may be falsely represented if they are based on erroneous information. A typical paradigm involves the unexpected transfer of an object from one location to another (Wimmer & Perner, 1983), in which the test taker is asked to predict where Character B will say the object is, given that Character A first put it in one location and then, in Character B’s absence, moved the object to another location. Individuals answering accurately (i.e., that Character B will look in the original location) have been credited with having ToM, and those who answer incorrectly are perceived to lack the ability to represent mental states.

It is a logical deduction that if passing a first-order false-belief ToM task demonstrates basic representational abilities of mental states, and if individuals with schizophrenia have a genuine representation deficit (e.g., such as that observed in individuals with ASD), then we would expect patients with schizophrenia to perform poorly on these tasks. In one of the first studies assessing ToM in schizophrenia, Corcoran, Mercer, and Frith (1995) presented participants with short written passages designed to test understanding of indirect intentional speech. This task requires first-order representational abilities, as indicated by the capacity to identify the intended meaning of statements that included an
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obvious hint. Participants with predominantly negative symptoms and incoherence scored poorer than healthy controls and individuals with predominantly positive symptoms.

Corcoran et al.’s (1995) findings were replicated in a study by Frith and Corcoran (1996), in which first-order false-belief stories were read aloud while participants viewed a series of cartoon drawings presenting the sequence of actions depicted in the stories. Individuals with negative symptoms preformed significantly poorer than healthy controls. In a later study, Mazza, De Risio, Surian, Roncone, & Casacchia (2001) categorised individuals with schizophrenia according to a three-dimensional-symptom model (Liddle, 1987). Subgroups were based on the presence of psychomotor poverty, disorganisation, and reality distortion. Individuals experiencing prominent psychomotor poverty performed poorer than the other two groups on the first-order ToM task. These results seemingly align with Frith’s (1992, 2004) suggestion that individuals with negative or disorganized symptoms lack a functional concept of mental states.

Contradictory results indicate that individuals with schizophrenia only experience difficulty representing the mental states of third persons. Brüne, Schaub, Juckel, and Langdon (2011) demonstrated that individuals with both negative and positive symptomology performed within the normal range on first-order ToM tasks. Similarly, Pickup and Frith (2001) found that individuals with schizophrenia, including those with psychomotor poverty, scored within the normal range on a first-order false belief task, but had difficulty with a second-order false belief task. The result that individuals with predominantly negative symptoms are able to pass basic mentalising tasks but demonstrate difficulty as task complexity increases has been consistently replicated (Abu-Akel & Abushuáleh, 2004; Bosco et al., 2009; Brüne, 2003; Herold et al., 2002; Inoue et al., 2006; Janssen, Krabbendam, Jolles, & van Os, 2003; Marjoram et al., 2005; Stratta et al., 2011).
Similarly, Shamay-Tsoory and colleagues (Shamay-Tsoory et al., 2007; Shur, Shamay-Tsoory, & Levkovitz, 2008) suggest that the conflicting evidence concerning ToM abilities in schizophrenia may be a consequence of the use of different ToM tasks across studies, which variably tap cognitive and affective components of ToM. Shamay-Tsoory, Aharon-Peretz, and Levkovitz (2007) proposed that the negative symptoms of individuals with schizophrenia may be due to a specific impairment in affective ToM rather than a general impairment in ToM. In testing this hypothesis, Shamay-Tsoory et al. (2007) administered a measure of first- and second-order cognitive and affective ToM (viz., the Yoni Task) to individuals with schizophrenia. Although individuals with schizophrenia did not differ from healthy controls on both first-order conditions and second-order cognitive ToM, they were markedly impaired on the second-order affective ToM. In contrast, Shur et al. (2008) demonstrated that individuals with schizophrenia were impaired on tasks that assess understanding across first-order cognitive and affective mental states (e.g., the Faux Pas Recognition Test). These findings indicate that an inability to represent mental states would not reliably describe the mentalising difficulties observed in schizophrenia. Further research, which examines potential underlying causes of ToM impairments, may help clarify individual differences in the types of ToM impairment in schizophrenia.

**Attribution of mental states.** The majority of studies of ToM in schizophrenia have focused on the ability to represent and attribute mental states to others. This is clearly reflected by the almost exclusive availability of ToM tasks that assess one’s ability to attribute mental states to others (e.g., Picture Stories Inference Intention Task). Langdon et al. (1997) examined the ability to attribute mental state to the self and others in individuals with chronic schizophrenia. This was achieved using a recall task that required participants to dissociate subjective mental states from objective realities (i.e., self-mental state attribution), and picture sequencing and story-telling tasks (i.e., other-mental state attribution). Results
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indicated that a subgroup of individuals with schizophrenia were able to correctly attribute mental states to others but demonstrated a reduced ability to attribute mental states to oneself. This result has been echoed in several studies that have consistently shown that individuals with passivity and paranoia experiences have an intact ability to attribute mental states to others (Brüne et al., 2008; Corcoran et al., 1995; Russell, Reynaud, Herba, Morris, & Corcoran, 2006).

Contrary to the above results, Bosco et al. (2009) found that attributing mental states to the self is better preserved in schizophrenia than is attributing mental states to others. Furthermore, Bailey and Henry (2010) suggest that disruption of other-perspective taking, rather than self-perspective inhibition, more likely accounts for ToM impairment in schizophrenia. Collectively, these findings suggest that self and other mental state attribution can be dissociated in schizophrenia, and that the ability to attribute mental states to others can be impaired irrespective of whether attributing mental states to the self is intact. These findings are inconsistent with simulation theory which suggests that disruption of self-attribution would interfere with the attribution of mental states to others.

**Application of mental states.** Abu-Akel and Bailey (2000) argued that not all individuals with schizophrenia can be correctly described as lacking the ability to represent and attribute mental states, but rather vary in their ability to accurately apply mental states. Abnormalities in mental state application can manifest in two forms (Abu-Akel & Bailey, 2000). On the one hand, an individual may be aware of others’ mental states but fail to demonstrate this knowledge due to task-related processing constraints. This is referred to as an application deficit, as opposed to a representation deficit. On the other hand, an individual may be able to apply mental states albeit atypically, whereby an individual exaggerates the content and number of mental state inferences (i.e., overmentalising). This may be further complicated by difficulties in deciding among several competing inferences, which
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consequently could result in an increased likelihood of applying an erroneous hypothesis about another’s mental state.

An emerging body of evidence from research sampling the schizophrenia population supports the dissociation of deficits in the capacity to represent others’ mental states from deficits in application of mental states. One of the first clues about this distinction originated in a study by Bowler (1992). Results indicated that although patients with chronic schizophrenia and Asperger’s syndrome possessed knowledge about others’ minds, as measured by their success on a second-order ToM task, they were deficient in applying this knowledge during interactions with others in everyday contexts (Bowler, 1992). This distinction was further supported by research conducted by McCabe, Leudar, and Antaki (2004). These investigators analysed the conversations between mental health professionals and people with chronic schizophrenia. Results showed that individuals with schizophrenia appropriately reported first- and second-order mental states. However, erroneous beliefs persisted despite recognising that their converser did not share their belief or accept their justification of their beliefs as convincing. Further, recent research by Fretland et al. (2015) found that individuals with schizophrenia produced more ‘reduced ToM’ errors than ‘no ToM’ errors, indicating that schizophrenia can be characterised by difficulties in applying mental states rather than a fundamental lack of mental state concept.

Abu-Akel and Shamay-Tsoory (2011) suggested that the purest evidence of application deficits in schizophrenia would be to show that these individuals ascribe intentions to behaviour that healthy individuals see as mechanical or random. In the study by Fyfe et al., (2008) individuals were required to rate the strength of relationship between two shapes (the contingency task) and, in another, to view and then describe the movement of triangles on a computer screen in ‘random’, ‘physical’, or ‘ToM’ conditions. In both tasks, individuals with paranoid schizophrenia not only perceived meaning when the movements
were random, but also attributed mental states where none was indicated. Similar patterns of responding have been observed in both healthy adults exhibiting delusion proneness (Fyfe et al., 2008) and in other studies with schizophrenia samples (Montag et al., 2011; Russell et al., 2006; Walter et al., 2009). These results provide preliminary support for Frith’s (2004) hypothesis that individuals with predominantly positive symptoms overmentalise.

Application difficulties, as indicated by variations in under- and overmentalising, may also be context dependent (Langdon & Brock, 2008). Evidence has emerged to suggest that individuals with schizophrenia demonstrate a tendency to undermentalise when they are expected to mentalise and overmentalise when mentalising is not required. Results of recent research have indicated that individuals with schizophrenia exhibit both under- and overmentalising (Langdon, 2005; Montag et al., 2011; Russell et al., 2006). Interestingly, in the studies by Langdon (2005), using the visual appreciation joke task, and by Russell et al. (2006) using the SAT-MC, undermentalising was observed in the ToM conditions, and overmentalising was observed in the non-ToM conditions. Collectively, these observations suggest that application errors may be variable within and among individuals with schizophrenia and are likely to be situated along a continuum of absence to excess. This underscores the argument that a deficit account is not appropriate to holistically describe the mentalising abilities of individuals with schizophrenia, and equally importantly, calls for future researchers to use measures that have provisions for quantifying individual variation in mentalising errors.

**Correlates of Theory of Mind in Schizophrenia**

**Neural correlates of theory of mind impairment.** The literature reviewed in Chapter 3 provides convincing evidence of neural abnormalities in the brain regions thought to be associated with ToM in healthy adults and individuals with various psychopathologies. Comprehensive neuroanatomical models of social cognitive impairment which are specific to
schizophrenia, however, are in their infancy. Researchers have typically isolated singular abilities (e.g., emotion recognition and ToM) within neuroimaging studies, which render it tempting to view social cognitive impairments in schizophrenia as separate domains subserved by abnormal functioning of discrete neural regions (i.e., as suggested by proponents of the ToMM). However, there is strong evidence to suggest that multiple neural regions act in concert and share reciprocal connections (Atkinson & Adolphs, 2011; Vuilleumier & Pourtois, 2007). The neural basis of social cognition can therefore be better thought of as a cohesive network that more generally subserves the processing of social stimuli. Similarly, the fact that several of the same neural structures have been found to be implicated during tasks assessing different social cognitive domains further supports the validity of network-based models (e.g., the superior temporal sulcus shows significant activation during tasks of emotion perception, ToM, and attributional style; Mier, Kirsch, & Meyer-Lindenberg, 2010).

One model that offers particular promise for furthering understanding of ToM impairment in schizophrenia is the dual-processing (DP) framework. Instead of focusing on a specific domain of social cognition, this model makes core processing distinctions that span the different domains of social cognition by centering on the type of brain processing that is engaged (Lieberman, 2007). Both automatic and controlled, and internally and externally focused processes are described. The distinction between automatic and controlled processes is most relevant to ToM research in schizophrenia (Lundberg, 2013).

Within the DP framework, automatic social cognitive processing is thought to rely on perceptual, emotional, and physiological systems and take place outside the awareness and control of the individual. In contrast, controlled social cognitive processing is thought to rely on higher order cognitive systems and is associated with wariness, intention, and effort (Brüne, 2005). As implied by its label, controlled processing is under the direction of the
individual and can be interrupted, thus enabling deliberate reasoning, juxtaposition, critical
evaluation, and self-correction. Automatic and controlled processing are thought to be
subserved by distinct neural regions. Automatic social cognitive processing is thought to be
subserved by the amygdala, lateral temporal cortex, and the vmPFC, with the basal ganglia
and dorsal anterior cingulate cortex being less consistently implicated. Controlled social
cognition, on the other hand, is thought to be subserved by the lateral prefrontal cortex
(LPFC) and mPFC, and the lateral and medial parietal cortex. The ventral LPFC likely plays
a role in inhibiting automatic responses, including suppressing the influence of one’s own
experience while one is purposefully considering others’ mental states and down-regulating
amygdala activity (Samson, Apperly, Kathirgamanathan, & Humphreys, 2005). Whereas the
mPFC has been found to be associated with the cognitive estimation of others’ inner states or
ToM, activation in the LPFC is thought to broadly reflect reference to one’s own behaviour
when judging the behaviour of other people (Lieberman, 2007).

According to the DP model, normative and efficient social cognition relies on the
interaction between automatic and controlled systems (Lundberg, 2013). Applying this theory
to schizophrenia would suggest that impaired social cognition is the result of aberrant
automatic inputs combined with unusually weak controlled processing resources. This is
consistent with recent findings which demonstrate that individuals with schizophrenia show
over activation of automatic neuro-circuitry (Anticevic et al., 2012) but under activation of
controlled processing neuro-circuitry (e.g., mPFC; Pinkham, Hopfinger, Pelphrey, Piven, &
Penn, 2008). This interaction likely yields inaccurate automatic responses that remain
uncorrected due to failure to fully engage controlled processing networks. As a basic
example, activation of the superior temporal sulcus and amygdala to a neutral facial
expression may result in the conclusion that someone is angry or intending harm. Reduced
ventral LPFC activation and subsequent controlled processing would preclude adjustment of
this initial impression for situational and contextual information (e.g., “He is distracted by a passing colleague”) and may lead to unfounded social reactions, such as feeling fearful or acting in a hostile manner toward the stimulus individual. From this perspective, overmentalising can be explained by the DP framework, in that over attribution of mental states may be the result of dysfunctional connections within the controlled processing network (i.e., inhibitory control). Thus, abnormal functioning of both automatic and controlled neural networks may play a causal role in the ToM impairments observed in schizophrenia.

As studies demonstrating impaired ToM in schizophrenia continue to emerge, the necessity of investigating the underlying mechanisms of these impairments becomes more important. Examining models like the DP framework however, is limited by the lack of ToM measures that engage the proposed network of automatic and controlled processes. From this perspective, ecologically valid measures of ToM could be used to assess the natural evolution of neural processing that occurs in real-life social situations.

**Theory of mind and clinical symptoms.** Frith’s (1992, 2004) interest in linking schizophrenia symptomatology to social cognitive impairments has been elaborated in the current literature. Several researchers have sought to identify the social cognitive mechanisms responsible for the emergence of psychotic symptoms, the ultimate phenotype for psychosis. Whereas some studies have demonstrated an association between ToM impairment and paranoid delusions (Corcoran et al., 1995, Drury et al., 1998; Frith & Corcoran, 1996) or delusions in general (Greig, Bryson, & Bell, 2004; Mazza et al., 1999; Pousa et al., 2008), others have found no difference between paranoid and non-paranoid groups in ToM performance (Pickup & Frith, 2001; Randall, Corcoran, Day, & Bentall, 2003).

In contrast to the inconsistent evidence surrounding the relationship between ToM and positive symptoms, empirical evidence has sided with Frith’s (1992) original hypothesis
that ToM impairments in schizophrenia are fundamentally linked with negative symptomatology. Negative symptoms have been consistently linked to impoverished mentalising, particularly when the symptomatology resembles that of ASD (e.g., social withdrawal and blunted affect; Corcoran, Cahill, & Frith, 1997; Kelemen et al., 2005; Martino, Bucay, Butman, & Allegri, 2007; Mazza et al., 2001; Pickup & Frith, 2001).

Diverging from earlier research which has predominantly treated ToM as a holistic construct (e.g., Corcoran et al., 1995, Drury et al., 1998; Frith & Corcoran, 1996), recent studies have explored the relationship between ToM subprocesses and clinical symptoms. Shamay-Tsoory, Shur, et al. (2007) explored the relationships between symptom clusters and first- and second-order cognitive and affective ToM. Results indicated that individuals with high levels of negative symptoms demonstrated selective ToM impairment, in that their first-order affective, but not cognitive mentalising, ability was poor. Rather, cognitive ToM significantly correlated with the severity of positive symptoms ($r = .45, p < .05$). A partial confirmation of these findings can also be inferred from the results reported by Mehl, Rief, Mink, Lüllmann, and Lincoln, (2010) who found that the ability to infer others’ intentions (i.e., cognitive ToM) was strongly associated with positive symptoms ($r = .14, p < .05$), whereas affective ToM, and the ability to understand second-order false beliefs, were not associated with positive symptoms.

Expanding the work of Shamay-Tsoory, Shur, et al. (2007), Montag et al. (2011) assessed individuals with paranoid schizophrenia to determine if specific ToM subprocesses and mentalising styles were associated with particular symptom dimensions. Although negative symptoms were associated with both cognitive ($r = -.32, p < .01$) and affective ($r = -.31, p < .01$) ToM, a stronger relationship was observed between positive symptoms and a dysfunction of cognitive ToM ($r = -.35, p < .01$) than for affective ToM ($r = -.23, p < .05$). Furthermore, negative symptoms were associated with undermentalising (i.e., no ToM, $r =$
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.33, \( p < .05 \) and positive symptoms were associated with overmentalising \((r = .38, p < .05)\).

Montag et al.’s (2011) results were replicated by Fretland et al. (2015) who explored the relationship between mentalising styles (i.e., no ToM, reduced mentalising, and overmentalising) and clinical symptoms of schizophrenia. Results indicated a small but significant association between overmentalising and positive symptoms \((\rho = .28, p < .05)\). Although a relationship was not identified between negative symptoms and undermentalising \((\rho = -.07 \text{ to } .16, \text{ns})\), disorganised symptoms correlated with frequency of reduced ToM errors \((\rho = .27, p = .05)\). Taken together, Montag et al. (2011) and Fretland et al.’s (2015) findings may indicate that overmentalising may be more prominent within the cognitive dimension of ToM in individuals who experience predominantly positive symptoms, and that undermentalising may specifically impact affective ToM in individuals who experience predominantly negative symptoms. These relationships are consistent with theoretical formulations (Frith, 2004) of the relationship between ToM and schizophrenia symptomology and are consonant with the proposition that cognitive ToM enables delusional thinking and paranoid ideation (Frith, 1992).

The aforementioned research offers insight into the nature and extent of ToM impairments that may underlie the heterogeneous clinical presentations observed in schizophrenia. Notwithstanding, future research is needed to clarify the relationships between mechanisms of ToM and specific symptom dimensions in schizophrenia. Outcomes of future research in this area could improve understanding of the psychopathological dynamics of schizophrenia and improve efforts to predict the clinical course of the disorder (Couture, Penn, & Roberts, 2006; Montag et al., 2011).

**Theory of mind and neurocognitive ability.** The co-occurrence of cognitive impairment and deficient ToM in schizophrenia, as well as the contiguousness of their relative neural circuitry, has prompted researchers to explore the relationship between these
functions (Bozikas et al., 2011). Previous efforts to demonstrate that impaired ToM in schizophrenia is primary (i.e., independent from cognitive functioning), and the alternative hypothesis that impaired ToM is secondary to general cognitive deficits (Hardy-Baylé, Sarfati, & Passerieux, 2003), has yielded mixed empirical support.

Several studies have assessed the relationship between executive functions and ToM in schizophrenia (Brüne, 2005; Horan et al., 2011; Janssen et al., 2003; Langdon, Davies, & Coltheart, 2002; Mazza et al., 2001). Evidence from this research is divided, with three studies reporting that executive dysfunction (i.e., inhibition and cognitive flexibility) does not adequately explain ToM impairment (Horan et al., 2011; Langdon et al., 2002; Mazza et al., 2001), and the other two reporting moderate contributions (Brüne, 2005; Janssen et al., 2003). Enquiries into the putative relationship between ToM and other components of cognitive functioning in schizophrenia have identified positive correlations between deficient ToM and attention (Drury et al., 1998; Greig, Bryson, & Bell, 2004), autobiographical memory (Corcoran & Frith, 2003; Mehl, Rief, Mink, Lüllmann, & Lincoln, 2010), context processing (Uhlhaas, Phillips, Schenkel, & Silverstein, 2006), verbal fluency (Sarfati, Hardy-Baylé, Besche, & Widlöcher, 1997), and verbal memory (supporting Hardy-Baylé’s concept of ToM; Greig et al., 2004).

In addition to the aforementioned correlations which indicate that ToM processes may be supported by cognitive functions, there is evidence that the ToM impairments observed in schizophrenia do not remain significant after controlling for IQ. Police et al. (2002) found that significant ToM impairments in patients with disorganized symptoms disappeared once verbal intelligence was controlled for. Consistent with this finding, Bora and colleagues (2008, 2009) showed a significant influence of IQ and working memory on ToM impairments in remitted patients. Similarly, research conducted with first-degree relatives of individuals with schizophrenia found that ToM impairments did not persist after controlling for IQ.
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(Pentaraki et al., 2008). These findings suggest that ToM impairment is secondary to general cognitive dysfunction.

In contrast to the above research (viz., Bora et al., 2009; Bora et al., 2009), there is also convincing evidence to suggest that reductions in ToM performance reflect a primary impairment which is independent of cognitive functioning. Abdel-Hamid et al. (2009) found that ToM impairments in individuals with schizophrenia persisted after controlling for IQ and executive functioning. The dissociation of ToM from IQ has also been reported in other studies (Janssen et al., 2003; Pickup & Frith, 2001; Sprong et al., 2007) and several reviews (Brüne, 2005; Couture et al., 2006; Fett et al., 2011; Harrington et al., 2005; Sprong et al., 2007). Particularly, a review of 22 studies exploring the relationship between ToM and functional outcomes established that ToM explains additional variance in social functioning (i.e., social problem solving and social skills) that cannot be accounted for by deficient neurocognitive processes (Couture et al., 2006). Consistent findings are also documented within the early psychosis literature (Addington et al., 2006; Bertrand, Sutton, Achim, Malla, & Lepage, 2007; Koelkebeck et al., 2010; Krstev, Jackson, & Maude, 1999).

Taken together, there is considerable variability within the literature concerning the independence of ToM impairments from cognitive dysfunction in schizophrenia. The heterogeneity of ToM tasks, statistical methods (i.e., regression analyses vs. covariate analyses), as well as the circumscribed cognitive domains used as statistical controls (i.e., IQ vs. executive functions), limits the extent to which findings can be compared. With the exception of Fett et al., (2011) the aforementioned studies lack a coherent conceptualisation of the domains constituting neurocognition. No research to date has explicitly compared the relationship between ToM subprocesses and a holistic battery of cognitive assessments that measure both core (e.g., attention) and more complex (e.g., inhibition) abilities in early and chronic stages of schizophrenia. Indeed, Bora and Pantelis (2013) stated that the extent to
which ToM impairments are reducible to other neurocognitive deficits at earlier stages of psychosis is unclear. It is possible that the deterioration of selective ToM capacity and neurocognitive functioning follow different trajectories in schizophrenia. In parallel, exploring the relationship between mentalising errors and cognitive abilities has the potential to isolate specific processes that may underpin ToM impairment in early psychosis and chronic schizophrenia. Results of such research would help establish whether mentalising impairments in schizophrenia are primary or are an artefact of reduced cognitive functioning.

Theory of mind and social functioning. A key motivation for studying ToM in schizophrenia is to explain the variability in social functioning that is evident among people with schizophrenia. Couture et al. (2006) published the first major review of literature in this area. The review included 23 studies and considered four aspects of social cognition (viz., emotion processing, attribution style, social perception, and ToM), two aspects of functional competence (viz., social skills and social problem solving) and two aspects of functional attainment (viz., social behaviour within a psychiatric inpatient milieu and community functioning). Results were strongest for social perception, with 10 out of 12 studies showing significant relations with competence and attainment measures. Emotion perception showed a consistent, although less robust, relationship to both types of outcome in 9 out of 10 studies. Studies examining the relationships between functional competence and ToM ($n = 4$) and attribution style ($n = 2$) provided initial support for the functional significance of these abilities.

The significant links between social cognition and functional outcome described by Couture et al. (2006) were replicated and extended in a meta-analysis by Fett et al. (2011). This review considered the contribution of three of the social cognitive domains included by Couture et al. (viz., emotion perception, social perception, and ToM) and neurocognition to community functioning. Social cognition accounted for approximately 16% of the variance in
community functioning, which was significantly larger than the 6% of variance accounted for by neurocognition. Comparisons between all neurocognitive and social cognitive domains and community functioning indicated that this difference was specifically due to the strong associations between ToM and community functioning. Furthermore, there is evidence to suggest that ToM may mediate the relationship between neurocognition and poor social functioning in chronic schizophrenia (Addington, Girard, Christensen, & Addington, 2010). These findings are consistent with the suggestion that ToM, despite likely having neurocognitive underpinnings, does explain unique variance in social functioning in chronic schizophrenia (Brekke, Kay, Lee, & Green, 2005; Couture et al., 2006; Pijnenborg et al., 2009; Pinkham, Penn, Perkins, & Lieberman, 2003; Pinkham & Penn, 2006).

Given the promising evidence of the association between ToM and social functioning in chronic schizophrenia, interest has turned to understanding when in the course of schizophrenia these relationships emerge, as well as the longitudinal predictive validity of ToM in predicting social outcomes. Addington et al. (2006) and Williams et al. (2008) documented associations between ToM and functional outcome during the early phase of schizophrenia in community dwelling outpatients. Other cross-sectional (Sullivan et al., 2012) and longitudinal (Horan et al., 2012) research has also found that ToM impairments are more strongly associated with poor social functioning than is neurocognition in early psychosis. In contrast, Langdon, Connors, Still, Ward, and Catts (2014) and Sullivan, Rai, Golding, Zammit, and Steer (2013) found that neither ToM nor neurocognition predicted social functioning in early psychosis. Sullivan et al. (2013) and Langdon et al.’s (2014) findings suggest that other factors, such as severity of negative symptoms, may have a more significant impact on social functioning early in the course of illness. A more detailed understanding of the association between specific ToM abilities (e.g., first-and second-order cognitive and affective ToM) and discrete domains of social functioning (e.g., functional
capacity and community functioning) in early psychosis could be achieved by using more ecological, sensitive, and comprehensive assessments of these constructs.

In summary, this chapter has presented what is known about the nature of ToM impairment in schizophrenia, as well as the clinical, neurocognitive, and functional correlates of ToM abilities. Research exploring ToM abilities across different phases (i.e., acute vs. remission) and stages (e.g., early psychosis vs. chronic) of schizophrenia have yielded mixed results, thus the extent to which ToM impairment represents a state or trait marker of psychotic illness remains unclear. Similarly, although there is evidence to suggest that ToM impairments are primary, rather than secondary to general cognitive deficits, inconsistent results preclude a definitive conclusion. This chapter has also highlighted that social cognition, neurocognition, and clinical symptoms have all been identified as common correlates of social functioning, but that further research is needed to explore the relative contributions of each of these domains in explaining outcomes in early psychosis and schizophrenia (Addington et al., 2006; Brekke et al., 2005; Meyer & Kurtz, 2009; Sergi, Rassovsky, Nuechterlein, & Green, 2006; Vaskinn, Sundet, Hultman, Friis, & Andreassen, 2009). One potential consideration is the added influence of empathy, which is the topic of the next chapter.
### Table 5.1

*Behavioural Research Exploring Relationship Theory of Mind in Schizophrenia Published between 1995 to August 2015*

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>ToM Measures</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corcoran et al. (1995)</td>
<td>55 CS</td>
<td>Hinting Task</td>
<td>Individuals with negative symptoms performed poorly on ToM tasks (IQ controlled). Individuals with passivity symptoms and remitted patients performed similarly to controls.</td>
</tr>
<tr>
<td>Frith &amp; Corcoran (1996)</td>
<td>55 CS</td>
<td>FBST</td>
<td>Individuals with paranoid and behavioural symptoms performed poorer on ToM tasks compared to the other symptom groups and controls.</td>
</tr>
<tr>
<td>Corcoran et al. (1997)</td>
<td>44 CS</td>
<td>Joke Appreciation Task</td>
<td>Joke appreciation was most impaired in individuals with behavioural symptoms. Individuals with passivity and paranoid symptoms performed poorer than controls.</td>
</tr>
<tr>
<td>Langdon et al. (1997)</td>
<td>20 CS</td>
<td>A false belief task+a (picture sequences)</td>
<td>ToM difficulties associated with psychomotor poverty and reality distortion.</td>
</tr>
<tr>
<td>Sarfati et al. (1997)</td>
<td>12 CS</td>
<td>False belief task+a and Intention Attribution Task</td>
<td>Individuals performed poorer on false belief tasks than tasks involving attribution of intentions</td>
</tr>
<tr>
<td>Doody, Götz, Johnstone, Frith, &amp; Cunningham Owens (1998)</td>
<td>28 CS</td>
<td>A false belief task+a (first &amp; second order)</td>
<td>Individuals with comorbid learning disorders performed poorer on second-order, but not first-order false belief tests compared to controls. ToM was associated with negative symptoms.</td>
</tr>
<tr>
<td>Drury, Robinson, &amp; Birchwood (1998)</td>
<td>14 CS</td>
<td>FBST (enacted with props)</td>
<td>Acute, but not remitted, patients performed poorer on ToM tasks compared to controls. Remitted patients with persecutory delusions performed poorer on second-order false belief tasks.</td>
</tr>
<tr>
<td>Mitchley, Barber, Gray, Livingstone, &amp; Brooks (1998)</td>
<td>18 CS</td>
<td>An irony task (verbal stories)</td>
<td>Individuals with schizophrenia were found to be poorer at understanding irony relative to controls (IQ controlled).</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Sample Size</td>
<td>Task Description</td>
<td>Findings</td>
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<tr>
<td>-------------------------------------------------------</td>
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</tr>
<tr>
<td>Sarfati &amp; Hardy-Baylé (1999)</td>
<td>25 CS</td>
<td>Intention Attribution Task</td>
<td>Disorganized patients performed poorer compared to non-disorganized patients and controls on the ToM task.</td>
</tr>
<tr>
<td>Sarfati, Hardy-Baylé, Brunet, &amp; Widlöcher (1999)</td>
<td>26 CS</td>
<td>Intention Attribution Task</td>
<td>Disorganized patients performed poorer on ToM tasks compared to non-disorganized patients and controls. Positive and negative symptoms did not account for the differences.</td>
</tr>
<tr>
<td>Sarfati, Passerieux, &amp; Hardy-Baylé (2000)</td>
<td>25 CS</td>
<td>Intention Attribution Task</td>
<td>Individuals with schizophrenia performed better on verbal ToM measures compared to non-verbal measures.</td>
</tr>
<tr>
<td>Langdon, Coltheart, Ward, &amp; Catts (2001)</td>
<td>30 CS</td>
<td>FBST</td>
<td>Executive planning deficits did not fully account for poor ToM. No association between ToM abilities and positive symptoms were found.</td>
</tr>
<tr>
<td>Mazza, De Rizzo, Surian, Roncone, &amp; Casacchia (2001)</td>
<td>35 CS</td>
<td>FBST</td>
<td>Negative symptoms (psychomotor &amp; disorganised) were associated with metarepresentational capacities in schizophrenia independently of IQ.</td>
</tr>
<tr>
<td>Pickup &amp; Frith (2001)</td>
<td>41 CS</td>
<td>Intention Attribution Task</td>
<td>Patients with behavioural symptoms performed poorer on second-order false belief tasks compared to controls, independent of memory and IQ. Patients with paranoid symptoms performed more poorly than controls but this effect disappeared when IQ was controlled.</td>
</tr>
<tr>
<td>Herold, Tenyi, Lenard, &amp; Trixler (2002)</td>
<td>26 CS</td>
<td>False belief, metaphor, and irony tasks</td>
<td>Individuals with schizophrenia were poorer at interpreting irony compared to controls.</td>
</tr>
<tr>
<td>Langdon et al. (2002)</td>
<td>25 CS</td>
<td>FBST and metaphor and irony tasks</td>
<td>Positive formal thought disorder was associated with poor performance on the FBST. Negative formal thought disorder was associated with poor metaphor understanding.</td>
</tr>
<tr>
<td>Pollice et al. (2002)</td>
<td>44 CS</td>
<td>FBST and Intention Attribution Task</td>
<td>ToM performance correlated with community functioning. ToM strongest predictor of global social functioning, beyond that of low positive and negative symptoms and good verbal ability.</td>
</tr>
<tr>
<td>Roncone et al. (2002)</td>
<td>40 CS</td>
<td>Intention Attribution Task (with cartoons)</td>
<td>ToM performance predicted community functioning in schizophrenia.</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>Task</td>
<td>Findings</td>
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<tr>
<td>Brüne (2003)</td>
<td>23</td>
<td>FBST</td>
<td>Individuals with schizophrenia were not impaired on ToM tasks after controlling for IQ.</td>
</tr>
<tr>
<td>Brunet, Sarfati, &amp; Hardy-Baylé (2003)</td>
<td>25</td>
<td>Intention Attribution Task</td>
<td>Individuals with schizophrenia performed poorer than controls on ToM.</td>
</tr>
<tr>
<td>Corcoran &amp; Frith (2003)</td>
<td>59</td>
<td>Hinting Task</td>
<td>The ToM performance of individuals with schizophrenia was impaired relative to controls and was associated with autobiographical memory.</td>
</tr>
<tr>
<td>Janssen-Krabbendam, Jolles, &amp; van Os (2003)</td>
<td>43</td>
<td>Hinting Task</td>
<td>Individuals with schizophrenia performed poorer on ToM tasks than controls (IQ, age, and education controlled).</td>
</tr>
<tr>
<td>Abu-Akel &amp; Abushua’leh (2004)</td>
<td>24</td>
<td>FBST and FPRT</td>
<td>Violent patients exhibited more difficulties than nonviolent patients in tasks involving empathic inferences, and better abilities in inferring cognitive-mental states.</td>
</tr>
<tr>
<td>Keleman et al. (2005)</td>
<td>52</td>
<td>Eyes Test</td>
<td>ToM impairments were associated with impaired visual perception, as measured by motion detection. ToM performance was found to be independent of IQ.</td>
</tr>
<tr>
<td>Majoram et al. (2005)</td>
<td>15</td>
<td>Hinting Task</td>
<td>ToM performance was found to be associated with positive symptoms, but not negative symptoms.</td>
</tr>
<tr>
<td>Irani et al. (2006)</td>
<td>10</td>
<td>Eyes Test</td>
<td>Deficits in facial recognition were found to be associated with impaired ToM performance in individuals with schizophrenia. This impairment was also present (to a lesser degree) in the patient’s first degree relatives.</td>
</tr>
<tr>
<td>Leitman, Ziwich, Pasternak, &amp; Javitt (2006)</td>
<td>22</td>
<td>APT attitudinal subtest, Voice Emotion Identification Task, Tone Matching Task, and Distorted Tunes Task</td>
<td>Ability to perceive sarcasm was found to be independent of verbal IQ. Patients were found to have difficulty distinguishing sincere from sarcastic statements, and a bias towards accepting statements as sincere when they were not.</td>
</tr>
<tr>
<td>Shamay-Tsoory, Aharon-Peretz,</td>
<td>24</td>
<td>Yoni Task</td>
<td>Individuals with schizophrenia were impaired on affective ToM conditions but</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Task(s) Description</td>
<td>Findings</td>
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<tr>
<td>et al. (2007)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Shamay-Tsoory, Shur, et al.</td>
<td>22 CS</td>
<td>Yoni Task</td>
<td>Individuals with schizophrenia performed poorer on affective than cognitive ToM compared to controls. A significant correlation was observed between the fantasy subscale of the IRI and second-order affective ToM in healthy adults. Empathy did not correlate with ToM for the schizophrenia group.</td>
</tr>
<tr>
<td>Bora et al. (2008)</td>
<td>91 CS</td>
<td>Hinting Task and Eyes Test</td>
<td>ToM impairment was present in remitted patients and associated with neurocognitive abilities. Positive and negative symptoms were related to ToM impairment.</td>
</tr>
<tr>
<td>Kettle et al. (2008)</td>
<td>13 FEP</td>
<td>Eyes Test</td>
<td>Individuals with FEP showed ToM impairment when compared to a healthy control group, but not when compared to psychiatric controls (viz., depression).</td>
</tr>
<tr>
<td>Pousa et al. (2008)</td>
<td>61 CS</td>
<td>Picture-sequencing task(^a) and FBST(^b)</td>
<td>No significant difference in ToM performance was found between the clinical and the healthy control group for either task. ToM deficits in schizophrenia were associated with positive symptoms.</td>
</tr>
<tr>
<td>Abdel-Hamid et al. (2008)</td>
<td>43 CS</td>
<td>Cartoon sequencing task(^b)</td>
<td>ToM and neurocognitive abilities of individuals with schizophrenia were impaired compared to healthy controls. ToM deficits were associated with disorganised but not positive symptoms.</td>
</tr>
<tr>
<td>Bosco et al. (2009)</td>
<td>22 CS</td>
<td>Th.o.m.a.s., FBST, and Happé’s Strange Stories</td>
<td>Individuals with schizophrenia performed poorer on all ToM tasks relative to controls. Individuals with schizophrenia were found to have more preserved first-order ToM when compared with other ToM subprocesses.</td>
</tr>
<tr>
<td>Kern et al. (2009)</td>
<td>50 CS</td>
<td>TASIT</td>
<td>Compared to controls, individuals with schizophrenia performed poorer on sarcasm but not lie scenes. ToM performance correlated with positive, but not negative symptoms or community functioning.</td>
</tr>
<tr>
<td>Pijenborg et al. (2009)</td>
<td>46 CS</td>
<td>FPRT</td>
<td>When the contributions of emotion perception and ToM were examined separately, only ToM contributed significantly to the prediction of community functioning.</td>
</tr>
<tr>
<td>Bell, Fiszdon, Greig, &amp; Wexler</td>
<td>66 CS</td>
<td>SAT-MC and Hinting</td>
<td>Individuals with schizophrenia were impaired on ToM compared to controls.</td>
</tr>
<tr>
<td>(2010)</td>
<td>Task</td>
<td>ToM correlated with affect recognition and executive functioning in schizophrenia.</td>
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<tr>
<td>Koelkebeck et al. (2010)</td>
<td>23 FEP SAT-MC</td>
<td>ToM performance correlated with positive symptoms, as well as cognitive abilities such as verbal reasoning and verbal IQ. ToM performance was not found to be associated with empathic abilities.</td>
<td></td>
</tr>
<tr>
<td>Sparks et al. (2010)</td>
<td>30 CS TASIT</td>
<td>Individuals with schizophrenia performed poorer than controls in identifying emotional states and ability to comprehend counterfactual information in social exchanges, including sarcasm and lies. Impaired sarcasm comprehension was associated with higher empathic personal distress, and lower recreational functioning. Empathy was not associated with functional outcomes.</td>
<td></td>
</tr>
<tr>
<td>Bozikas et al. (2011)</td>
<td>36 CS FBST and a deception task (with cartoon scenarios)</td>
<td>Individuals with schizophrenia performed poorer than controls in identifying emotional states and ability to comprehend counterfactual information in social exchanges, including sarcasm and lies. Impaired sarcasm comprehension was associated with higher empathic personal distress, and lower recreational functioning. Empathy was not associated with functional outcomes.</td>
<td></td>
</tr>
<tr>
<td>Couture, Granholm, &amp; Fish (2011)</td>
<td>178 CS Hinting Task</td>
<td>The relationship between neurocognition and social competence was mediated by ToM.</td>
<td></td>
</tr>
<tr>
<td>Gavilán &amp; García-Albea (2011)</td>
<td>22 CS Picture Sequencing Story Telling Task and Happé’s Strange Stories</td>
<td>ToM significantly correlated with language comprehension ability in individuals with schizophrenia (IQ controlled).</td>
<td></td>
</tr>
<tr>
<td>Gooding &amp; Pflum (2011)</td>
<td>36 PS 30 NS 30 LS Hinting Task and Eyes Test</td>
<td>Individuals with PS performed poorer than individuals with NS and LS controls on the Hinting Task. PS and NS groups performed equivalently on the Eyes Test. Referential thinking was found to be associated with the Eyes, but not with the Hinting Task.</td>
<td></td>
</tr>
<tr>
<td>Green et al. (2011)</td>
<td>50 Prodromal 81 FEP 53 CS TASIT</td>
<td>Performance was impaired across tasks assessing ToM, emotion processing, and social relationship perception in all clinical samples. Group differences in performance were comparable across phase of illness, with no evidence of progression or improvement.</td>
<td></td>
</tr>
</tbody>
</table>
## THEORY OF MIND IN SCHIZOPHRENIA

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hooker, Bruce, Lincoln, Fisher, &amp; Vinogradov (2011)</td>
<td>21 CS</td>
<td>FPRT</td>
<td>Individuals with schizophrenia were found to have impaired ToM relative to controls.</td>
</tr>
<tr>
<td>Kosmidis, Giannakou, Garyfallos, Kiosseoglou, &amp; Bozikas (2011)</td>
<td>28 CS</td>
<td>Verbal false belief and intention attribution tasks(^a) and the FBST</td>
<td>Although first- and second-order false belief and deception performance was impaired in individuals with schizophrenia, attribution of intention was relatively intact. Only some aspects of ToM (i.e., hinting, false-belief and second-order comprehension of deception) were found to be related to measures of social functioning.</td>
</tr>
<tr>
<td>Lysaker et al. (2011)</td>
<td>36 CS</td>
<td>Hinting Task and Eyes Test</td>
<td>ToM and insight were found to be stable across a period of 36 months. No relationship between ToM and insight was identified. Cognitive symptoms were found to be related to ToM performance.</td>
</tr>
<tr>
<td>Montag et al. (2011)</td>
<td>80 CS</td>
<td>MASC</td>
<td>Individuals with schizophrenia performed poorer than controls on cognitive and affective ToM (neurocognition controlled). Individuals with schizophrenia undermentalised more frequently than controls. Scores for overmentalising did not differ between groups, when age, gender, and non-social reasoning were controlled. Negative symptoms were associated with undermentalising and positive symptoms were associated with overmentalising.</td>
</tr>
<tr>
<td>Stanford, Messinger, Malaspina, &amp; Corcoran (2011)</td>
<td>63 CHR, 13 CS</td>
<td>A false belief task(^a), Happé’s Strange Stories, and Eyes Test</td>
<td>No significant difference between CHR patients, CS, and controls were found on measures of first- and second-order ToM. IQ was found to be related to ToM performance. ToM had no relation to explicit memory, prodromal symptoms, social function, or later transition to psychosis.</td>
</tr>
<tr>
<td>Vistoli, Brunet-Gouet, Lemoalle, Passerieux, &amp; Hardy-Baylé (2011)</td>
<td>19 CS</td>
<td>Picture Stories Inference Intention Task</td>
<td>Individuals with schizophrenia showed reduced cortical activation in the right posterior superior temporal sulcus, right TPJ, and the right parietal lobule during first-order ToM.</td>
</tr>
<tr>
<td>Ziv, Leiser, &amp; Levine (2011)</td>
<td>30 CS</td>
<td>False belief task(^a)</td>
<td>Individuals with schizophrenia showed impairments in both ToM performance and emotion recognition, with poorest performance on second-order false belief.</td>
</tr>
<tr>
<td>Bosco, Bono, &amp; Bara (2012)</td>
<td>22 CS</td>
<td>Sally-Ann False Belief Task(^b), false belief tasks (^a), and Happé’s Strange</td>
<td>Individuals with schizophrenia showed impaired ability to recognise communication failures and difficulty correctly attributing intentions. Negative symptoms correlated with ToM impairments and communication failure repair.</td>
</tr>
<tr>
<td>Reference</td>
<td>Sample Size</td>
<td>Task(s)</td>
<td>Findings</td>
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<tr>
<td>-----------------------------------------</td>
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</tr>
<tr>
<td>Das, Lagopoulos, Coulston, Henderson, &amp; Malhi (2012)</td>
<td>20 CS</td>
<td>Intention Attribution Task</td>
<td>Individuals with schizophrenia performed significantly poorer on ToM task compared to controls.</td>
</tr>
<tr>
<td>Green et al. (2012)</td>
<td>50 Prodromal 81 FEP 53 CS</td>
<td>TASIT</td>
<td>Prodromal, FEP, and CS patients showed impaired social cognition (including ToM) when compared with controls. No significant differences in ToM performance were identified between patient groups.</td>
</tr>
<tr>
<td>Horan et al. (2012)</td>
<td>55 CS</td>
<td>TASIT</td>
<td>Social cognition scores showed longitudinal stability in individuals with FEP measured at baseline and at 12-month follow-up. Results indicate that social cognitive impairments are present in FEP and remain stable throughout the course of the illness.</td>
</tr>
<tr>
<td>Jha (2012)</td>
<td>50 CS</td>
<td>FBST and Intention Attribution Task</td>
<td>ToM impairments were found to be independent of deficits in working memory, attention, and comprehension ability.</td>
</tr>
<tr>
<td>Köther et al. (2012)</td>
<td>76 CS</td>
<td>Eyes Test</td>
<td>Individuals with schizophrenia recorded more incorrect answers with higher levels of confidence compared to controls on the Eyes Test. Patients with formal thought disorder demonstrated most impaired ToM.</td>
</tr>
<tr>
<td>Maat et al. (2012)</td>
<td>1032 CS</td>
<td>Hinting Task</td>
<td>ToM and QoL were significantly lower in individuals with schizophrenia relative to controls. ToM but not emotion perception or neurocognition was associated with QoL in individuals with schizophrenia, but only if the patient scored relatively high on the PANSS. This indicates that the relationship between ToM and QoL is mediated by the severity of clinical symptoms.</td>
</tr>
<tr>
<td>Pentaraki et al. (2012)</td>
<td>21 CS</td>
<td>FBST and Eyes Test</td>
<td>Individuals with schizophrenia showed ToM impairments. ToM impairment was associated with IQ and cognitive inhibition. Second-order ToM impairment was found to be independent of IQ and cognitive inhibition.</td>
</tr>
<tr>
<td>Fernandez-Gonzalo et al. (2013)</td>
<td>43 CS</td>
<td>FBST</td>
<td>Neurocognition was not related to first- or second-order ToM performance.</td>
</tr>
<tr>
<td>Giusti, Mazza, Pollice, Casacchia, &amp; Roncone (2013)</td>
<td>20 CS</td>
<td>Happé’s Strange Stories and Eyes Test</td>
<td>Individuals with schizophrenia showed deficits in ToM compared to controls. Meta-cognition, but not ToM performance, was a significant predictor of global</td>
</tr>
</tbody>
</table>

THEORY OF MIND IN SCHIZOPHRENIA
<table>
<thead>
<tr>
<th>Study Authors (Year)</th>
<th>Participants</th>
<th>Methodology</th>
<th>Summary</th>
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<tbody>
<tr>
<td>Karakula et al. (2013)</td>
<td>30 CS</td>
<td>False belief picture stories and emotional recognition task</td>
<td>Social cognition was found to be impaired in the schizophrenia group when compared to controls. No relationship between insight and social cognition was found.</td>
</tr>
<tr>
<td>Smeets-Janssen et al. (2013)</td>
<td>15 Late onset, 15 Early onset</td>
<td>Hinting Task</td>
<td>Early onset patients showed greater ToM impairments compared to the late-onset patients.</td>
</tr>
<tr>
<td>Aggarwal, Khess, &amp; Jahnna (2014)</td>
<td>25 CS</td>
<td>FBST</td>
<td>No significant relationship was observed between ToM impairments and illness duration.</td>
</tr>
<tr>
<td>Balogh, Égerházi, Berecz, and Csukly (2014)</td>
<td>43 CS</td>
<td>Eyes Test</td>
<td>ToM and emotion recognition deficits improved in the clinically stable phase relative to an acute phase, but were still found to be impaired compared to healthy controls. Severity of negative symptoms strongly correlated with emotion recognition and ToM during both acute psychosis and remission.</td>
</tr>
<tr>
<td>Bliksted, Fagerlund, Weed, Frith, &amp; Videbech (2014)</td>
<td>36 FEP</td>
<td>Hinting Task, Intention Attribution Task and TASIT</td>
<td>Individuals with FEP showed impaired ToM in comparison to controls, after controlling for IQ, neurocognitive abilities, and clinical symptoms.</td>
</tr>
<tr>
<td>Cassetta &amp; Goghari (2014)</td>
<td>30 CS</td>
<td>TASIT</td>
<td>Sarcasm comprehension was impaired in individuals with schizophrenia in comparison to controls and unaffected biological relatives (which showed no impairment). ToM performance was correlated with clinical symptoms and global functioning.</td>
</tr>
<tr>
<td>Csukly, Polgar, Tombor, Benkovits, &amp; Rethelyi (2014)</td>
<td>28 S-ND, 30 SZ-D</td>
<td>Eyes Test</td>
<td>Individuals with deficit and non-deficit schizophrenia performed preformed poorer on the Eyes Test compared to controls.</td>
</tr>
<tr>
<td>Fernandez-Gonzalo et al. (2014)</td>
<td>60 FEP</td>
<td>FBST, Hinting Task, and Eyes Test</td>
<td>Executive functioning and clinical symptoms correlated with performance on second-order ToM tasks in individuals with FEP, after controlling for clinical symptoms and antipsychotic dose.</td>
</tr>
<tr>
<td>Konstantakopoulos et al. (2014)</td>
<td>58 CS</td>
<td>FBST, Hinting Task, and FPRT</td>
<td>ToM impairment was associated with insight, after controlling for neurocognitive deficits, and clinical symptoms.</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Task/Score</td>
<td>Findings</td>
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<tr>
<td>----------------------------------------------------</td>
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</tr>
<tr>
<td>Lam, Raine, &amp; Lee (2014)</td>
<td>58 CS</td>
<td>FPRT and Eyes Test</td>
<td>ToM was found to mediate the relationship between neurocognition and positive and negative symptoms.</td>
</tr>
<tr>
<td>Langdon, Connors, Still, Ward, &amp; Catts, (2014)</td>
<td>23 FEP</td>
<td>Picture Sequencing Story Telling Task and Joke Appreciation Task</td>
<td>Individuals with FEP performed poorer on ToM compared to controls (neurocognition controlled). Neither ToM nor neurocognitive ability were found to predict social functioning or QoL. Negative symptoms were the strongest predictor of functional outcomes.</td>
</tr>
<tr>
<td>Langdon, Still, Connors, Ward, &amp; Catts (2014)</td>
<td>23 FEP</td>
<td>Picture Sequencing Story Telling Task, Happé’s Strange Stories, and Joke Appreciation Task</td>
<td>Results indicated that both the Picture Sequencing Story Telling Task and Joke Appreciation Task, but not Happé’s Strange Stories, were sensitive to differences in ToM between individuals with FEP and controls.</td>
</tr>
<tr>
<td>Lysaker et al. (2014)</td>
<td>115 CS</td>
<td>Hinting Task and Eyes Test</td>
<td>Individuals with schizophrenia performed poorer than controls on measures of emotional recognition, mental state decoding (viz., Eyes Test), mental state reasoning (viz., Hinting Task), and metacognition.</td>
</tr>
<tr>
<td>Ofir-Eyal, Hasson-Ohayon, &amp; Kravetz (2014)</td>
<td>90 CS</td>
<td>First- and second-order false belief task and FPRT</td>
<td>Negative links between cognitive empathy and negative symptoms mediated the relation between affective empathy and social quality of life (SQoL). Positive symptoms had a limited negative impact on SQoL and did not play a role in the paths that linked affective empathy to SQoL. Positive and negative symptoms showed strong negative correlations with SQoL and ToM.</td>
</tr>
<tr>
<td>Mehta, Thirthalli, Naveen Kumar, Kumar, &amp; Gangadhar (2014)</td>
<td>60 CS</td>
<td>SOCRATIS (Faux pas, story tasks, metaphor and irony)</td>
<td>Negative symptoms were found to mediate the relationship between ToM and functional status in an Indian sample of individuals with schizophrenia.</td>
</tr>
<tr>
<td>Romeo, Chiandetti, Siracusano, &amp; Troisi (2014)</td>
<td>90 CS</td>
<td>FBST</td>
<td>Impaired sequencing of complex motor actions correlated with ToM.</td>
</tr>
<tr>
<td>Roux, d’Arc, Passerieux, &amp; Ramus (2014)</td>
<td>29 CS</td>
<td>Cartoons used for goal and belief attribution</td>
<td>Individuals with schizophrenia performed poorer than controls on a non-verbal (eye-gaze) ToM task and demonstrated lower performance in belief and goal attribution.</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Task(s)</td>
<td>Findings/Notes</td>
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<tr>
<td>-------------------------------------------</td>
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<tr>
<td>Varga et al. (2014)</td>
<td>19 CS</td>
<td>Metaphor and irony tasks(^a) and Gricean Maxims</td>
<td>No significant differences were observed between high IQ individuals with schizophrenia and controls on metaphor and irony task performance. Individuals with schizophrenia performed poorer than controls on ToM questions during a conversational task.</td>
</tr>
<tr>
<td>Fretland et al. (2015)</td>
<td>52 CS</td>
<td>MASC</td>
<td>Positive symptoms were associated with overmentalising. Disorganised symptoms correlated with reduced ToM at a trend level. Symptoms and IQ were related to ToM performance.</td>
</tr>
<tr>
<td>Ho et al. (2015)</td>
<td>41 FEP</td>
<td>FPRT and Yoni task</td>
<td>Compared with controls, individuals with FEP and their unaffected siblings performed poorer on the FPRT. Individuals with FEP, but not their unaffected siblings, performed poorer than controls on second-order affective ToM on the Yoni Task.</td>
</tr>
<tr>
<td></td>
<td>43 unaffected siblings</td>
<td></td>
<td></td>
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<tr>
<td>Ng, Fish, &amp; Granholm (2015)</td>
<td>193 CS</td>
<td>Hinting Task</td>
<td>ToM mediated the relationship between neurocognition and awareness of impairment.</td>
</tr>
<tr>
<td>Ventura et al. (2015)</td>
<td>77 CS</td>
<td>SAT-MC</td>
<td>ToM impairment observed in recent-onset schizophrenia patients and in remitted patients. ToM was also moderately correlated with neurocognition, negative and positive symptoms, and role functioning. The relationship between ToM and role functioning was mediated by negative symptoms.</td>
</tr>
</tbody>
</table>

Note. \(n = \) clinical participants. CHR = Clinical High Risk. CS = chronic schizophrenia. FBST = False Belief Story Task. FEP = first-episode psychosis. FPRT = Faux Pas Recognition Test. LS = Low schizotypy. MASC = Movie Assessment of Social Cognition. NS = negative schizotypy. PS = positive schizotypy. SA = schizoaffective disorder. SAT-MC = Social Attribution Task – Multiple Choice. SZ-D = deficit schizophrenia. S-ND = non-deficit schizophrenia. TASIT = The Awareness of Social Inference Test. QoL = Quality of life.

\(^a\) Unstandardized task developed for use in individual study.

\(^b\) Task that was excluded from the review in Chapter 4.
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Chapter 6: Empathy in Schizophrenia

Dissecting the architecture of social cognition and exploring the impaired processes that are associated with failures to interact adaptively has advanced clinical understanding of schizophrenia (Montag et al., 2011; Sparks, McDonald, Lino, O’Donnell, & Green, 2010). As described in Chapter 5, poor functional outcomes have been consistently linked with impaired ToM in schizophrenia. However, an emerging literature has expanded beyond examining the functional consequences of isolated components of social cognition (e.g., ToM), to consider the functional significance of a broader emotional deficit, characterised by interlaced impairments in ToM and empathy. Langdon et al. (2008) speculate that individuals with schizophrenia are impaired in their capacity to spontaneously simulate another person’s subjective world. As such, they cannot infer the content of another person’s mind to take appropriate account of that other person’s feelings. Given the intricate relationship between these processes, there is considerable value in extending discussion from ToM to empathy in schizophrenia.

This chapter will summarise theoretical models of empathy with a specific focus on how empathy is conceptually similar, but dissociable from, ToM. In light of the emphasis placed on the ecological assessment of ToM in previous chapters, this current chapter will summarise available measures of empathy. Describing the limitations within the current landscape of empathy assessment contextualises the limited research in schizophrenia which is consistent with contemporary models of empathy. Research examining the integrity and functional significance of empathy processes in schizophrenia is described. A novel social-cognitive model of social functioning is introduced and is used to explain how the interplay between ToM and empathy influence social functioning.

Theoretical Models of Empathy

Empathy and ToM are thought to represent overlapping, but distinct constructs.
Empathy refers to the ability to understand and share the subjective affective experiences of others (Horan et al., 2015; Preston & de Waal, 2002). This differs from the related construct of ToM, which refers to the ability to accurately infer the thoughts, feelings, and emotional states of others. Although the ability to infer an individual’s mental state may be intact (e.g., “Sarah appears disappointed”), genuine understanding (e.g., “I would also feel disappointed if my date cancelled”) and personal affective experiences congruent to the inferred mental state (e.g., “I feel disappointed for Sarah”) may be limited. Several researchers have proposed that empathy may rely on the ability to accurately perceive another’s emotions, beliefs, and motivations in a given situation (Decety & Meyer, 2008; Sparks et al., 2010). The relationship between these processes is supported by neurobiological models of empathy, whereby the perception of an individual’s mental state activates corresponding cognitive representations, which in turn activate somatic and automatic responses which manifest as emotional experiences (Preston & de Waal, 2002).

Empathy, much like ToM, is arguably a multidimensional construct, which includes distinct cognitive and affective components (Decety & Jackson, 2006; Shamay-Tsoory, 2011). According to Decet and Jackson’s (2004) model, empathy consists of three core components: (a) emotion recognition, which refers to the ability to recognise emotions in oneself and others via facial expressions, speech, and behaviour; (b) emotional responsivity (i.e., affective empathy), which refers to relatively automatic processes through which perceived actions and social cues trigger a shared emotional response (e.g., feeling the heartache of a friend who recently separated from her partner); and (c) emotional perspective taking (i.e., cognitive empathy) which refers to engaging in reasoning about and understanding another person’s emotional experience, while maintaining a clear self-other distinction (e.g., appreciating a friend would be anxious about his upcoming job interview). Although the parameters of emotional recognition abilities have been well documented in
individuals with schizophrenia (e.g., Schneider et al., 2006), less is known about the other two components of empathy in this population.

Cognitive empathy and affective ToM are conceptually similar in that each involves processing and responding to the emotional states of others during social interactions (Baron-Cohen & Wheelwright, 2004). Theorists have suggested that the capacity to empathize is contingent on an individual’s ability to contextualise the receiver’s experience through accurate inferences of their emotions, beliefs, and motivations (Frith, 2004; Kalbe et al., 2007; Singer, Critchley, & Preuschoff, 2009). Although an individual may be able to correctly infer mental states, if their ability to demonstrate an empathic response congruent with the inferred context is impaired, interpersonal outcomes may be poor. The relationship between cognitive empathy and affective ToM has been supported by experimental studies showing strong associations between subscales of measures used to assess these processes (Shamay-Tsoory, Tomer, & Aharon-Peretz, 2005; Shamay-Tsoory, Aharon-Peretz, & Levkovitz, 2007; Sparks et al., 2010), as well as results of imaging research that implicate a shared neural network (viz., the mPFC; Brunet, Sarfati, & Hardy-Baylé, 2003; Lee et al., 2006; Lough et al., 2006; Marjoram et al., 2006; Shamay-Tsoory et al., 2005). Furthermore, Bora, Gökçen, and Veznedaroglu (2008) found that evidence of empathy impairment in schizophrenia remained after controlling for ToM ($n_p^2 = .12$). These results support the theoretical dissociation of these constructs, but also indicate that impaired affective mental state decoding may partly explain empathic failure in individuals with schizophrenia.

**Measurement of Empathy**

Although cognitive and affective empathy have been generally considered as key aspects of empathy, neither construct has been particularly well operationalised in the literature. The lack of precise operational definitions for cognitive and affective empathy unavoidably introduces challenges for the assessment of these constructs (Chrysikou &
Several self-report measures which have acceptable indices of reliability and validity are routinely used to assess empathy in individuals with schizophrenia. Notwithstanding, ongoing attempts to develop new and/or refine existing measures, reflects the difficulty in aligning the factor structure of available questionnaires with contemporary conceptualisations and multidimensional models of empathy. For example, the Questionnaire Measure of Emotional Empathy (Mehrabian & Epstein, 1972) was designed to provide an index of affective empathy. In more recent reports, however, the authors suggest that the items on this instrument better reflect general emotional arousal (Mehrabian, Young, & Sato, 1988). Despite attempts to modify this measure (i.e., the Balanced Emotional Empathy Scale, Mehrabian, 2000), it has been criticised for not accurately assessing reactions to others’ mental states and in turn, not providing a pure measure of affective empathy (e.g., ‘I easily get carried away by the lyrics of a love song’). Criticisms have also been made about the scope and construct validity of the Empathy Scale (Hogan, 1969), which was designed to measure cognitive empathy. Results from factor analyses suggest that this scale more likely measures social self-confidence, even temperedness, emotional sensitivity, and non-conformity (Johnson, Cheek, & Smither, 1983) or provides a general index of social skills (Davis, 1994). Even one of the most widely used measures to assess empathy in schizophrenia, the IRI (Davis, 1983), has been criticised for not adequately assessing key processes of empathy (Bora, Gökçen, Kayahan, & Veznedaroglu, 2008).

Although a substantial portion of the empathy research in schizophrenia is based on results from the IRI, a number of concerns have been raised about the compatibility of its subscales with updated models of empathy (Michaels et al., 2014). This measure was not originally developed to distinguish between cognitive and affective components of empathy (Davis, 1983). Indeed, Davis (1983) commented that attempts to align the IRI subscales with these core components of empathy were inappropriate. Despite this, the factor structure of the
IRI, as it is predominantly used in the psychological literature, differs from Davis’ original four-factor model. That is, researchers often arbitrarily combine the IRI subscales to form two factors: cognitive and affective empathy (Chrysikou & Thompson, 2015). Specifically, the Perspective-Taking and Fantasy subscales are often used as measures of cognitive empathy and the Empathic Concern and Personal Distress subscales are often used as measures of affective empathy.

Critics argue that the IRI perspective taking subscale better reflects ToM and overlooks the ability to recognize and understand emotions felt by another person (i.e., cognitive empathy; Decety, 2011; Michaels et al., 2014). The fantasy subscale measures a tendency to identify with the personal distress of fictional characters, thus has been criticised for not accurately capturing self-oriented responses to negative experiences which is an integral process of cognitive empathy. The empathic concern subscale has been criticised for imprecisely assuming empathy and sympathy are interchangeable constructs (Michaels et al., 2014). That is, it primarily measures emotional reactions to the negative experiences of others rather than the tendency to share specific affective states (Decety, 2011; Jolliffe & Farrington, 2004; Michaels et al., 2014). Lastly, the personal distress subscale has been argued to assess self-oriented feelings of anxiety rather than the other-oriented processes involved in sharing emotions (Batson et al., 1991; Jolliffe & Farrington, 2004). Thus, the IRI subscales do not reflect core cognitive and affective processes of empathy (Zaki, Ochsner, & Ochsner, 2012), nor do they account for the ways in which affect and cognition interact to give rise to empathic responses (Hoffman, 2000; Michaels et al., 2014).

The aforementioned concerns about how the IRI subscales are being used within the experimental literature were strengthened by Chrysikou and Thompson (2015), who examined the validity of a two-factor model of the IRI (viz., cognitive and affective empathy). A confirmatory factor analysis showed poor model fit for this two-factor structure. Additional
analyses offered support for the original four-factor model. These findings indicate that the IRI, as it is currently used in the literature, does not accurately measure cognitive and affective empathy (Chrysikou & Thompson, 2015). This conclusion has two key implications for past empathy research. First, cognitive and affective empathy may reflect a theoretically meaningful division of empathy abilities (Davis, 1983; Lietz et al., 2011; Reniers et al., 2011; Zoll & Enz, 2005), yet the two-factor model of the IRI has not provided a valid measure of these constructs. Second, the two-factor model of the IRI has low construct validity, thus conclusions regarding empathic abilities and their neural basis which are based on the results of this measure, may be incorrect or compromised. For these reasons, findings that are based on the two-factor approach to the IRI should be interpreted with caution (Chrysikou & Thompson, 2015).

Another instrument which is commonly used to assess empathy in schizophrenia is the Empathy Quotient (EQ; Bora et al., 2008; Lysaker, Hasson-Ohayon, Kravetz, Kent, & Roe, 2013). The EQ is a self-report measure, which was originally validated for use with individuals with ASD (Baron-Cohen & Wheelwright, 2004). The original version of the EQ was designed to be a 40 item unifactorial scale that assessed a global construct of empathy. The EQ has shown strong internal consistency ($\alpha = .92$) and good 12-month test-retest reliability ($r = .97$, $p < .01$; Baron-Cohen & Wheelwright, 2004). Small but significant correlations have also been identified between total performance on the EQ and the empathic concern and perspective taking subscales of the IRI ($r = .42$ to .48, $p < .05$; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004), providing preliminary evidence of convergent validity. This unifactorial version of EQ has also been shown to be sensitive to empathy deficits in schizophrenia (Bora, Gökçen, & Veznedaroglu, 2008).

Alike other empathy measures discussed thus far, the EQ was not designed to distinguish between cognitive and affective empathy. Recent attempts have been made to
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examine the factor structure of the EQ. Although the results of one study are consistent with a two-factor model (viz., cognitive and affective empathy; Andrew, Cooke, & Muncer, 2008), results of other studies encourage the retention of a unidimensional construct (Guan, Jin, & Qian, 2012; Wakabayashi et al., 2006).

Lawrence et al. (2004) examined the factor structure of the EQ using principal components analysis and found a three factor solution consisting of cognitive empathy, emotional reactivity, and social skills. Confirmatory factor analyses comparing the unifactorial structure with the three correlated factor structure proposed by Lawrence et al. (2004) suggested that the latter structure is a better fit (Muncer & Ling, 2006). Results of recent research consistently identify that the three factor solution has the most optimal fit for the data (Allison, Baron-Cohen, Wheelwright, Stone, & Muncer, 2011; Berthoz, Wessa, Kedia, Wicker, & Grèzes, 2008; Groen et al., 2015; Kim & Lee, 2010). Further, the utility of the three-factor structure has been demonstrated within a schizophrenia population (Didehbani et al., 2012).

Despite evidence of sound psychometric properties, the EQ has received two key criticisms. First, in light of evidence of high correlations between the three factors, some researchers argue that the scale is more sensibly conceived as a unidimensional measure of empathy (Allison et al., 2011). Second, items on the emotional reactivity subscale is composed of questions concerning the willingness of an individual to express emotion, rather than the sensitivity and salience of overt reactions to the subjective experiences of others. Nonetheless, an advantage of the cognitive empathy subscale of the EQ is that it focuses on emotional experiences and perspectives. This differs from other measures (e.g., the IRI) which broadly assess perspective-taking in general contexts. Although the EQ arguably does not provide an index of affective empathy, as defined by Decety and Jackson (2004), it does
provide a psychometrically sound index of cognitive empathy, which aligns with contemporary definitions of this construct (Allison et al., 2011).

In response to the paucity of theoretically congruent, multidimensional measures of empathy, Reniers, Corcoran, Drake, Shryane, and Völlm (2011) developed and validated the Questionnaire of Cognitive and Affective Empathy (QCAE). The QCAE was developed from a pool of items with the strongest face validity from several existing self-report measures of empathy and was refined through extensive psychometric analyses in a large healthy sample. It has five subscales intended to assess cognitive and affective components of empathy. The cognitive empathy component consists of two subscales. Perspective-taking (10 items) assesses the extent to which respondents can take another's perspective or see things from another's point-of-view. Online simulation (9 items) assesses the extent to which respondents make an effort to understand and mentally represent others' emotional states. The remaining three subscales assess affective empathy. Emotion contagion (4 items) assesses the extent to which a respondent engages in self-oriented emotional state-matching from observing the affective states of others. Proximal responsivity (4 items) assesses one's emotional responsiveness to the moods of others with whom they are emotionally or physically close. Lastly, peripheral responsivity (4 items) assesses one's emotional responsiveness to the moods of others in a detached social context (e.g., movie characters). Notably, some of these subscales (viz., emotion contagion, proximal responsivity, and peripheral responsivity) include a small number of items, which draws into question whether the full range of the constructs are being examined.

Recent research conducted by Michaels et al. (2014) raises questions about some of the QCAE subscales in terms of their psychometric properties as assessed in a schizophrenia sample. In light of evidence that individuals with schizophrenia consistently report decreased cognitive empathy on the perspective-taking subscale of the IRI (Achim et al., 2011; Smith et
al., 2012; Sparks et al., 2010), it is noteworthy that individuals with schizophrenia significantly differed from healthy controls on the QCAE online simulation subscale but not on the correlated QCAE perspective-taking subscale. Michaels et al. (2014) suggest that this discrepancy may reflect the limited sensitivity and clinical utility of the latter subscale.

Michaels et al. (2014) also questioned the utility of the peripheral responsibility subscale, which had poor internal consistency ($\alpha = .19$) and small non-significant correlations with other affective empathy subscales of the IRI and QCAE. It also showed strong relations to the fantasy scale on the IRI in healthy controls, indicating that this subscale may better reflect elements of cognitive empathy. In light of current criticism of the IRI’s construct validity, relationships, or lack of, with the QCAE subscales may not provide valid evidence of convergent validity. Lastly, Michaels et al. (2014) questioned the veridicality of the emotion contagion subscale. Processes involved in vicarious sharing of emotions are largely defined as reflexive, thus are difficult to directly assess using self-report. Nonetheless, one advantage of the QCAE emotion contagion and proximal responsivity subscales, when compared to the empathic concern subscale on the IRI, is their primary focus on the vicarious sharing of emotions rather than sympathy.

Concerns about the reliability and construct validity of existing empathy measures, highlight the need for further enquiry into the psychometric properties and clinical utility of available measures. In light of the limitations identified within the current landscape of empathy assessment, consideration should be given to the psychometric quality, theoretical grounding, and clinical utility of relevant subscales when selecting a measure to meet study parameters.

**Neural Circuitry of Empathy**

Imaging studies exploring the neural circuitry of cognitive and affective empathy in healthy adults and schizophrenia support the neural dissociation of these processes. Two
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neuroimaging studies have investigated the neural correlates of cognitive and affective empathy in schizophrenia by applying almost identical versions of a cartoon task. Benedetti et al. (2009) reported associations between activation in the right superior temporal gyrus and affective empathy cartoons, and activation in the right posterior superior temporal gyrus and cognitive empathy cartoons in individuals with schizophrenia. Partly supporting these results, Lee et al. (2010) also reported an association between activation in the right superior temporal gyrus and cognitive empathy cartoons in healthy controls. Interestingly, Lee et al. (2010) also reported that individuals with schizophrenia, relative to healthy adults, had stronger activation in the left insula during affective empathy cartoons (Lee et al., 2010). Consistent with Lee et al., (2010) Singer et al. (2004) observed strong correlations between self-reported affective empathy and activation in the left insula, as well as the amygdala and anterior cingulate cortex. Furthermore, a strong body of research suggests that the mPFC is also engaged during tasks assessing cognitive empathy (Brunet et al., 2003; Derntl et al., 2012; Farrow et al. 2001; Lee et al., 2006; Russell, Rubia, Bullmore, & Soni, 2000; Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003; Smith et al., 2015). Differences in the patterns of activation reported in the aforementioned studies likely reflects the varying emotional valence and verisimilitude of task stimuli used to assess empathy.

The results from neuroimaging and neuropsychological studies discussed in this thesis suggest that the subcomponents of ToM and empathy place demands on an overlapping frontal-temporal network which has been summarised in Figure 6.1. Specifically, performance on affective empathy tasks appears to be more strongly associated with right temporal and amygdala activity than are cognitive empathy and affective ToM tasks, which have been associated with activation in prefrontal regions (Lee et al., 2004). Regions of the prefrontal cortex may also be differentially associated with affective ToM and cognitive empathy. The orbitofrontal cortex and mPFC appear to be preferentially associated with
cognitive empathy (Lee et al., 2006; Shamay-Tsoory et al., 2003), whereas the vmPFC might be more strongly involved in affective ToM (Brunet, Sarfati, Hardy-Baylé, & Decety, 2000). Taken together, these results indicate that ToM and empathy impairments are likely associated with shared cortical and subcortical abnormalities.

Figure 6.1. Brain regions implicated in empathy and ToM. The large rectangle depicts schematically the brain of the observing self and the small rectangles depict neural networks that have some demonstrated specificity for the types of mental processes identified above the diagram. However, as indicated by the arrows between the small rectangles, these systems can be co-activated. AI = anterior insula. AMY = amygdala. IFG = inferior frontal gyrus. mCC = midcingulate cortex. mPFC = medial prefrontal cortex. OFC = orbitofrontal cortex. PCG = paracingulate gyrus. ToM = theory of mind. TPJ = temporoparietal junction. vmPFC = ventromedial prefrontal cortex.

**Empathy Impairment in Schizophrenia**

Although the existence of empathy deficits in early psychosis and chronic schizophrenia is generally accepted, there is limited direct evidence (Lee et al., 2004; Shamay-Tsoory et al., 2007). Bora, Gökçen, and Veznedaroglu (2008) compared the empathic abilities of individuals with chronic schizophrenia with those of healthy controls using a self-report, unidimensional measure of empathy (viz., the EQ). Unaffected relatives or spouses also provided ratings of the clinical participants’ empathic abilities. Notably, there was considerable discrepancy between the self- and relative assessments of the clinical participants’ empathic skills. Whereas individuals with schizophrenia were identified as
having a significant deficit in empathy based on the assessment provided by their relatives, empathy scores on self-reports provided by individuals with schizophrenia were comparable to those provided by healthy adults.

Bora, Gökçen, and Veznedaroglu (2008) research has provided valuable information about the integrity of a unidimensional empathy process in chronic schizophrenia. However, multidimensional models of empathy encourage the examination and comparison of cognitive and affective subprocesses (Michaels et al., 2014). Results from research using the IRI consistently indicate that individuals with schizophrenia report diminished cognitive empathy as indicated by poorer performance, relative to healthy controls, on the perspective-taking subscale. Findings for the fantasy subscale, however, are mixed (Achim et al., 2011; Corbera, Wexler, Ikezawa, & Bell, 2013; Haker, Schimansky, Jann, & Rössler, 2012; Lee, Zaki, Harvey, Ochsner, & Green, 2011; Smith et al., 2012; Sparks et al., 2010). Whereas most studies have reported that individuals with schizophrenia report scores that are similar to healthy controls on the IRI subscales assessing affective empathy, several researchers have found that patients reported diminished empathic concern and/or elevated personal distress in response to negative experiences of others (Shamay-Tsoory et al., 2007; Sparks et al., 2010; Lee et al., 2011; Smith et al., 2012). Given the lack of psychometric support for a two-factor approach to the IRI, conclusions regarding the integrity of cognitive and affective empathy which are based on performance on this measure should be interpreted with caution.

Derntl et al. (2009) assessed empathic abilities in individuals with schizophrenia and healthy adults using experimental paradigms and self-report measures that capture Decety and Jackson’s (2004) three components of empathy (i.e., emotion recognition, emotional reactivity, and perspective-taking). Results indicated a significant empathic deficit in individuals with schizophrenia, reflected in poorer performance than healthy controls across all three experimental tasks. Performance deficits were partly reflected in self-reported
empathy scores. That is, individuals with schizophrenia reported their affective empathy significantly lower than healthy controls on the Questionnaire Measure of Emotional Empathy ($p < .001, d = 1.64$). For the IRI, however, individuals with schizophrenia scored significantly lower on the fantasy subscale but significantly higher on the personal distress subscale when compared with controls. Taken together, these results indicate that individuals with schizophrenia are impaired in their capacity to spontaneously simulate another person's subjective emotional experiences, and that difficulty inferring the emotional content of others’ minds hinders their ability to provide responses which are congruent with other peoples’ feelings (Derntl et al., 2009). Alternatively, individuals with schizophrenia may overcompensate and exaggerate the emotional content they have inferred, and hence experience higher personal distress. Future research which examines cognitive and affective empathy in schizophrenia using theoretically-based and psychometrically sound measures has the potential to improve knowledge of the nature and extent of empathy impairments in this population.

In light of evidence that emotion recognition abilities deteriorate with illness progression (Kucharska-Pietura, David, Masiak, & Phillips, 2005), an interesting question for future research is whether the other components of empathy, as outlined by Decety and Jackson (2004), are affected by illness chronicity. Montag, Heinz, Kunz, and Gallinat (2007) assessed the relationship between duration of illness and self-reported cognitive empathy in schizophrenia and reported a significant decrease in perspective-taking with illness chronicity. This suggests that the cognitive component of empathy is less affected in the early stage of illness. Consistent findings were reported by Achim et al., (2011) who assessed cognitive and affective empathy processes in individuals with FEP and healthy adults, and compared their results with previous studies of empathy in individuals with chronic schizophrenia via meta-analysis. Contrary to results commonly reported for chronic cohorts, cognitive and affective
empathy did not significantly differ between individuals with FEP and healthy adults. Notwithstanding, cognitive empathy was less affected in individuals with FEP relative to individuals with chronic schizophrenia, indicating that this component of empathy may deteriorate with illness chronicity. Consistent with other studies, Achim et al. (2011) found no association between duration of illness and a decline in affective empathy (Montag et al., 2007; Derntl et al., 2009). Further cross-sectional and longitudinal research that compares empathy abilities across early and chronic phases of illness will help clarify the nature and extent of empathy impairments in schizophrenia.

**Functional Significance of Empathy in Schizophrenia**

Persistent social problems and diminished capacity for employment, independent living, and social interaction are well documented in schizophrenia (Bellack et al., 2007). Recovery-oriented treatment programs emphasize interventions to improve the underlying causes of these disturbances in the hope of improving functional outcomes for this population (Glynn, Cohen, Dixon, & Niv, 2006; Harvey & Bellack, 2009). There is increasing interest in determining whether social cognitive deficits may have influences on functioning that are distinct from the influences of other cognitive deficits. Although an association between empathy deficits and poor social functioning has been well documented in individuals with autism (Frith & Frith, 2001) and psychopathy (Abu-Akel & Abushual’leh, 2004), few studies have examined whether empathic disturbances relate to functional outcome in schizophrenia.

Smith et al. (2012) were the first to explicitly examine the extent to which impairments in self-reported empathy predicted poor social functioning, beyond the influences of neurocognitive deficits and psychopathology in schizophrenia. Relative to healthy adults, individuals with schizophrenia reported lower levels of emotional perspective-taking (i.e., cognitive empathy) and empathic concern, but higher personal distress (i.e., affective empathy). Among individuals with schizophrenia, lower perspective-taking, greater
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disorganized symptoms, and deficits in working and episodic memory were correlated with poor functional capacity and community functioning \( (r = .29\) to \( .57, p < .05)\). Perspective-taking explained significant incremental variance in both functional capacity and community functioning after accounting for relevant neurocognitive and psychopathological variables.

Michaels et al. (2014) replicated their earlier findings (Smith et al., 2012) using a recently developed theoretical measure of cognitive and affective empathy (viz., Questionnaire Measure of Emotional Empathy). Individuals with schizophrenia reported significantly lower cognitive empathy than healthy controls. Furthermore, cognitive empathy, but not affective empathy, contributed to incremental variance in social functioning after accounting for the severity of clinical symptoms and neurocognitive functioning in schizophrenia. Taken together, these studies provide preliminary evidence that abnormalities in understanding and sharing the subjective affective experiences of others contributes to poor social functioning in schizophrenia, and encourage further efforts to clarify the functional impact of empathy processes in schizophrenia.

Relationship between Empathy, Theory of Mind, and Social Functioning

Ofir-Eyal, Hasson-Ohayon, and Kravetz (2014) proposed the integrative mediation model to explain how impaired empathy contributes to reduced social functioning in schizophrenia. According to this model, the reductions in social functioning associated with schizophrenia are principally due to disturbances of empathy. One of the indices of this disturbance is a difficulty in identifying the emotions associated with facial expressions (Decety & Jackson, 2004). As indicated in Figure 6.2, ToM capacity and resulting social functioning are based upon the ability to identify interpersonal experiences by means of the affective content embedded in physical expressions of others. Therefore, impaired affect processing is considered a precursor of ToM impairment. This impairment, in turn, can produce the positive and negative symptoms of schizophrenia that limit interpersonal
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functioning (Frith, 2004).


Results of research examining the integrative mediation model in schizophrenia suggest that the negative links between cognitive empathy and negative symptoms mediated the positive relation between affective empathy and social functioning. Positive symptoms had a limited negative impact on social functioning and did not play a role in the paths that linked affective empathy to social functioning (Ofir-Eyal et al., 2014). Other research which has examined the relationships between empathy, clinical symptoms, and social functioning has indicated that cognitive empathy partially mediates the relationship between negative schizotypy and social functioning (Wang et al., 2013).

A major criticism of the research examining the integrative mediation model (viz., Ofir-Eyal et al., 2014) is that measures typically used to assess affective ToM and emotion recognition were used to measure cognitive and affective empathy respectively, despite strong
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theoretical arguments that these are dissociable domains of social cognition. As such, it is unclear whether this model may better account for the relationship between affective ToM (rather than cognitive empathy), and social functioning. Furthermore, in light of parallel findings demonstrating associations between affective ToM and cognitive empathy, another potential criticism of this model is that it neglects to consider how impairments in affective mentalising potentially impede genuine understanding of the emotional experiences of others (viz., cognitive empathy), which in turn reduces the quality of social interactions.

Sparks et al. (2010) attempted to examine the capacity to empathise as a potential mediator of the relationship between a social cognition (viz., emotion recognition and ToM) and social functioning. Individuals with schizophrenia, relative to healthy adults, reported higher levels of personal distress with respect to others’ emotions, significantly lower perspective-taking and empathic concern and were impaired in their ability to comprehend counterfactual information in social exchanges. Impairment in the comprehension of sarcasm was associated with lower personal distress, as well as increased engagement and enjoyment in reactional activities in schizophrenia. Also, emotion perception was associated with increased empathic fantasy and empathic concern, and higher reported overall satisfaction derived from activities. Contrary to expectations, however, empathy could not be explored as a mediator of the relationship between ToM and functional outcomes due to its lack of common associations with functional outcomes measures.

Future research that aims to explore the mediating influence of empathy on the relationship between ToM and social functioning in schizophrenia should consider two key recommendations. First, the measures used by Sparks et al. (2010) to assess empathy and ToM were not designed to provide explicit indices of cognitive and affective subcomponents. Accordingly, use of theoretically-based measures of ToM and empathy will allow for a more detailed analysis of the relationships between empathy and ToM subprocesses. Second, the
measure Sparks et al. (2010) used to assess functional outcomes (i.e., Longitudinal Interval Follow-Up Evaluation – Range of Impaired Functioning Tool) measures a limited range of skills that contribute to social and occupational functioning (e.g., dichotomous outcomes such as whether or not the person is engaged in paid work). As such, the inclusion of comprehensive indices of community functioning, as well as performance-based measures of social abilities would provide a more holistic and sensitive measure of social functioning.

In conclusion, this chapter described modern conceptualisations of empathy and the issues associated with attempts to align the subscales of existing measures with the distinct theoretical components outlined in these models. The cortical regions thought to support empathy were identified, with specific mention of the overlapping regions also thought to subserve ToM. This chapter also summarised what is known about the nature, extent, and functional significance of empathy impairment in early psychosis and chronic schizophrenia. Lastly, recent research that has examined the interplay between ToM and empathy in predicting social functioning was discussed prior to providing recommendations that could advance this field of research.
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Chapter 7: Summary of Literature and Aims of Thesis

In the literature reviewed, several theoretical and clinical questions have been raised and fruitful areas for further research have been highlighted. It is the purpose of this chapter to summarise the variety of intriguing questions which remain open to scientific exploration and describe how this thesis aims to advance understanding of ToM in early psychosis and chronic schizophrenia.

One challenge confronting researchers studying ToM in adults is how to assess this process accurately and reliably in a way that is sensitive to both subtle individual differences and clinical impairment. Several existing ToM tasks (viz., the False-Belief Story Task, Hinting Task, Faux Pas Recognition Test, and Eyes Test) have been used to distinguish clinical populations from healthy controls. However, these tasks have been criticised for lacking sensitivity to more subtle ToM deficits, and normal variation in ToM ability. Furthermore, several existing measures have been criticised for having inadequate or unknown psychometric properties, and lacking ecological validity. Another major limitation of available measures is that they do not allow for the comprehensive assessment of various ToM constructs. The use of simulated social interaction paradigms is a potential solution to the problems associated with existing measures of ToM. As such, the first aim of this thesis, and a central foci of Studies 1 and 2, was to develop and validate a virtual reality measure of ToM that is sensitive to both individual differences in healthy adults (Study 1), but also variation between individuals who with early psychosis and chronic schizophrenia (Study 2). Two main advantages of the VAMA is its ability to assess first-and second-order cognitive and affective ToM using a range of mental state modalities (e.g., false belief, faux pas, and sarcasm), and its provision for quantifying different types of mentalising errors (viz., no ToM, reduced mentalising, and hypermentalising).
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There is a strong body of evidence to suggest that individuals with early psychosis and chronic schizophrenia have impaired ToM. There is dispute, however, over the extent to which ToM abilities deteriorate with illness chronicity. As such, the second aim of this thesis, and a primary aim of Study 2, was to examine differences in ToM abilities between individuals who are early (i.e., within 2 years of illness onset) and later (i.e., within 2-15 years of illness) in their course of illness. The outcomes of this research will contribute to the debate about whether ToM impairments are a state or trait marker of schizophrenia.

Another pertinent question in research on ToM in schizophrenia concerns whether deficits in this domain are primary or are the consequence of other cognitive impairments (viz., attention, executive functioning, working memory, and general intelligence). As such, a key area of empirical interest is whether the differences in ToM abilities observed between healthy adults and individuals with schizophrenia remain once neurocognitive abilities and IQ are controlled. Furthermore, no research to date has examined the neurocognitive processes that may explain specific types of ToM impairment in schizophrenia. Research addressing the neurocognitive underpinnings of ToM impairment would contribute to discussion concerning the validity of the model proposed by Hardy-Baylé’, Sarfati, and Passerieux (2003) that describes the cognitive architecture of ToM, as well as broader theoretical conceptualisations of mentalising abilities (viz., ToMM, theory-theory, and simulation theory).

In addition to the above-mentioned question relating to the specificity of ToM impairments in schizophrenia (viz., primary vs. secondary impairment), several studies have been conducted to test the theoretical models proposed by Frith (1992) and Hardy-Baylé et al. (2003) to identify the ‘core’ symptoms of schizophrenia. These theoretical models propose relationships between specific types of ToM impairment and clinical symptoms, and require further empirical testing. Research that identifies the relationships between core symptomatology and ToM mechanisms in schizophrenia would contribute to evidence in
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relation to the validity of these models. Accordingly, the third aim of this research, and an ancillary aim of Study 2, was to examine the neurocognitive and clinical (viz., psychopathological) correlates of ToM impairment and error types in early psychosis and chronic schizophrenia.

Neurocognition, clinical symptoms, and ToM have all been identified as common correlates of social functioning (Fett et al., 2011). Nonetheless, further research is needed to explore the relative contributions of each of these domains in explaining outcomes in early psychosis and schizophrenia. The literature is not sufficiently mature to allow a conclusion on whether ToM processes are related to both functional capacity and community functioning, nor is there clear evidence of the extent to which these relationships are attenuated when neurocognition and psychopathology are controlled. Accordingly, the fourth aim of this thesis, and another aim of Study 2, was to examine the functional significance of ToM, relative to neurocognition and clinical symptoms in early psychosis and chronic schizophrenia.

The link between ToM and other social cognitive abilities also represents an underexplored field of research. The theoretical similarity between ToM and empathy subprocesses, as well as evidence that these processes rely on contiguous brain regions (Lee, Farrow, Spence, & Woodruff, 2004), encourages empirical examination of the dynamic interplay between domains of social cognition, and their relative and interactive influences on social functioning in schizophrenia. Accordingly, the final aim of this research, and a key aim of Study 3, was to examine whether cognitive empathy has an added contribution above that of ToM, neurocognition, and severity of clinical symptoms in predicting social functioning in early psychosis and chronic schizophrenia. Although research has identified links between these social cognitive processes and social functioning separately (Langdon, Connors, Still, Ward, & Catts, 2014; Michaels et al., 2014), this research represents the first attempt to
explore the relative contributions of both cognitive empathy and ToM to functional capacity and community functioning across early and late stages of schizophrenia. Furthermore, Study 3 sought to evaluate an adapted portion of the integrative mediation model (Ofir-Eyal, Hasson-Ohayon, & Kravetz, 2014) in schizophrenia, whereby cognitive empathy is thought to mediate the relationship between affective ToM and social functioning.

Overall, enhancing the assessment of ToM through the use of simulation technology has the potential to make important contributions to research on ToM. By using this new approach to the assessment of ToM in a population with schizophrenia, further contributions can be made. Most significantly, the present thesis has the potential to provide important information about the nature and progression of ToM impairment in schizophrenia. Moreover, improved clinical and theoretical understanding of the correlates and functional implications of ToM and empathy impairment will likely improve social cognitive interventions, and in turn, enhance the quality of life of individuals with schizophrenia.
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The Grinch puzzled and puzzled until his puzzler was sore, and then the Grinch thought of something he hadn’t before. What if thoughts he thought, can’t be bought from a store? What if mentalising he thought, means a little bit more?
Chapter 8: Foreword

The review of existing ToM measures in Chapter 4 indicated that there are few existing instruments which would be suitable for use with healthy and clinical adult populations. Indeed, there was agreement at the National Institute of Mental Health’s (NIMH) Workshop on ‘Definitions, Assessment, and Research Opportunities’ that the psychometric properties of current social cognitive measures for schizophrenia are generally inadequate or unknown (Green et al., 2008). Current data do not support the recommendation of any single instrument or battery as the ‘gold-standard’ approach to measuring ToM capacity. New research within the schizophrenia literature indicates that there is value in using measures that assess across first- and second-order cognitive and affective ToM and that capture individual differences in mentalising styles (Shamay-Tsoory et al., 2007; Montag et al., 2011). In response to these findings and the recommendations of the NIMH workshop, this candidate developed a virtual reality measure of ToM which overcomes several of the limitations of existing ToM measures (viz., sensitivity, limited scope, dichotomous scoring, verisimilitude, and veridicality). Results of Study 1, which have been published in *Neuropsychological Rehabilitation*, indicate that this task achieves the necessary psychometric qualities that may allow this measure to be useful across a range of samples and research questions.
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Statement of Contribution to Chapter 8 Co-authored Published Article


This chapter includes a published co-authored paper. The bibliographic details of the co-authored paper, including all authors, are: Allana L. Canty, Professor David L. Neumann, Associate Professor Jennifer Fleming, and Professor David H. K. Shum. The candidate’s contribution to the paper involved the conception and development of the VAMA, data collection, data analysis, and writing of the manuscript. The co-authors provided review of drafts and supervisory advice.

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Chapter 8: Study 1

Evaluation of a Newly Developed Measure of Theory of Mind: The Virtual Assessment of Mentalising Ability

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1 To ensure consistency in the terminology used throughout this thesis, the term ‘hypermentalising’ was replaced with ‘overmentalising’ in Chapter 8. Since the publication of this paper, the term ‘overmentalising’ has been used more frequently within the ToM literature. Additionally, in the published version of this manuscript tables and figures are labelled in ascending numerical order (viz., Tables 1-8 and Figures 1-4). To maintain consistency throughout this thesis, the numbering of tables and figures has been adjusted to include the Chapter number (viz., Tables 8.1-8.8 and Figures 8.1-8.4).
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Abstract

This study examined the reliability and validity of the Virtual Assessment of Mentalising Ability (VAMA). The VAMA consists of 12 video clips depicting a social drama imposed within an interactive virtual environment with questions assessing the mental states of virtual friends. Response options capture the continuum of Theory of Mind (ToM) ability (i.e., impaired, reduced, accurate, and overmentalising) and first- and second-order cognitive and affective ToM. Sixty-two healthy participants were administered the VAMA, three other ToM measures, and additional measures of neurocognitive abilities and social functioning. The VAMA had sound internal consistency and high test-retest reliability. Significant correlations between performance on the VAMA and other ToM measures provided preliminary evidence of convergent validity. Small to moderate correlations were observed between performance on the VAMA and neurocognitive tasks which reflects the traditional cognitive architecture that supports ToM processes. Further, the VAMA was found to correlate significantly with indices of social functioning and was rated as more immersive, more reflective of everyday ToM processes, and was afforded a higher recommendation than an existing computer-based ToM task (i.e., the Yoni Task). These results provide potential evidence that the VAMA is an ecologically valid tool that is sensitive to the spread of ability that can occur in ToM subprocesses and may be a valuable addition to existing ToM measures. Future research should explore the validity and utility of the VAMA in larger, more diverse samples of healthy adults, as well as clinical and brain-injured populations.

Key words: Theory of mind, social cognition, virtual reality, ecological validity, assessment.
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Introduction

Theory of Mind (ToM; otherwise termed mentalising) refers to the mental operations that underlie social interactions and includes the ability to attribute mental states (e.g., emotions, thoughts, and intentions) to oneself and others (Brüne, 2005). ToM represents what is uniquely ‘social’ about social cognition in that it provides the cognitive apparatus for human behaviour that can evolve and develop only within a social environment. It enables social fluidity and coordination, and subserves other fundamental concepts by which individuals organise and interact with their social world (e.g., emotion recognition, attributions and empathy; Corrigan & Penn, 2001).

ToM deficits have been found to underpin social impairments in several clinical populations (e.g., brain injury, Muller et al., 2010; schizophrenia, Pollice, Roncone, Falloon, & Mazza, 2002; children with autism, Hale & Tager-Flusberg, 2005). Such deficits can result in reduced community functioning and poor quality of life (Maat, Fett, & Derks, 2012; Pijenborg et al., 2009). Large individual differences exist in the extent and nature of ToM deficits and the resultant impact on social outcomes (e.g., impaired inferential ability, understanding of language pragmatics and vocal inflections, and poor understanding of humour). This suggests that rather than simply applying an existing rehabilitation program to train ToM ability (such as those that have been developed for people with Asperger’s syndrome; Attwood, 1998; and schizophrenia, Sarfati et al., 2000), rehabilitation of social deficits may require comprehensive individual assessments to determine specific ToM processes that are having the greatest impact on individuals’ functioning. Treatment can then be tailored to address and/or compensate for those factors which are identified.

ToM is a multidimensional construct that is proposed to consist of at least two dimensions. Shamay-Tsoory, Harari, Aharon-Peretz, and Levkovitz (2010) distinguished between ‘cognitive’ and ‘affective’ ToM subprocesses, although different terms have been
used for these concepts (see overview in Baron-Cohen & Wheelwright, 2004). Cognitive ToM refers to the ability to make inferences about others’ beliefs and intentions. More simply, it refers to the understanding of the difference between the speaker’s knowledge and that of the listener (e.g., understanding that someone may hold a false belief). In contrast, affective ToM requires an additional appreciation of the listener’s emotional state to infer what a person is feeling (e.g., understanding that an individual may be offended by a rude joke). Another prominent distinction is between ‘first’ and ‘second’ order processes (Amodio & Frith, 2006). Whereas first-order ToM involves inferring the thoughts and feelings of another person, second-order ToM refers to reasoning about what one person (i.e., other than the self) thinks about another person’s thoughts and feelings (Amodio & Frith, 2006).

A growing body of research suggests that models which account for variation in mentalising abilities best explain the expression of ToM in healthy and clinical populations (Langdon, Coltheart, Ward, & Catts, 2001). Abu-Akel and Bailey (2000) suggested a continuum of ToM abilities ranging from (a) an inability to represent mental states (i.e., no ToM), (b) reduced ability to apply ToM knowledge (i.e., undermentalising), and (c) hyper ToM (i.e., overmentalising), which describes the over-generation of hypotheses about other people’s mental states. Montag et al. (2011) explored the utility of this model in differentiating the mentalising approaches used by individuals with paranoid schizophrenia (n = 80) and healthy controls using the Movie for the Assessment of Social Cognition (MASC; Dziobek et al., 2006). Results indicated that individuals with schizophrenia selected significantly more ‘undermentalising’ responses than healthy controls, and this difference was not explained by global cognitive deficits. Scores for ‘overmentalising’ did not differ between groups, when age, gender, non-social reasoning, and memory were controlled. For individuals with schizophrenia, negative symptoms were associated with a lack of a mental state concept, while positive symptoms (e.g., delusions) were associated with overmentalising. Similar
results were found by Fyfe, Williams, Mason, and Pickup (2008) who observed overmentalising in healthy adults exhibiting delusion-proneness, indicating that a hyper-associative cognitive style may have led to an exaggeration of mental state attribution. Taken together, these findings suggest that the continuity models of ToM can provide a more holistic and comprehensive understanding of mentalising abilities as well as valuable insights into the etiology of ToM impairments.

Neuropsychology has begun to shift from a primary focus on diagnostic evaluations designed to identify neuropathological impairments in specific social cognitive domains to a greater emphasis on the functional implications of results and their relationship to an individual’s performance in social contexts (Dziobek, 2012). Problematically, tasks that were designed for use with specific populations (e.g., the Autism Quotient; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) or tasks that measure narrow ToM processes (e.g., Attitudinal Subtest of the Aprosodia Battery, Orbelo et al., 2005; The Hinting Task; Corcoran et al., 1995) are being used to make predictions about real world functioning, despite limited research supporting their veridicality (Dziobek, 2012). Additionally, it has been suggested that tasks that depend on written comprehension (e.g., reading short stories, Faux Pas Recognition Test, Stone, Baron-Cohen, & Knight, 1998), and dichotomous scoring (e.g., the Yoni Task, Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006; the Eyes Test; Baron-Cohen et al., 2001) do not capture the breadth of impairment that can occur in understanding spontaneous complex social situations (Klin, 2000). Other tasks fail to measure variables that are reflective of real-life ToM performance, such as whether the individual is able to focus on relevant aspects of social situations and is capable of assimilating various pieces of social information (Social Attributions Task; D’Zurilla & Maydeu-Olivares, 1995; Klin, 2000). As real-world social interactions place demands on multiple social cognitive processes simultaneously, and include informational redundancies occurring through multiple
sources of information and modes of presentation (Bazin et al., 2009; Bellack et al., 1996), the aforementioned restrictions limit the ecological validity of the respective tasks. Accordingly, tasks designed to simulate everyday ToM processes may be more effective in determining the extent to which an intervention improves an individual’s performance in real-life contexts.

Two ToM tasks have been designed with ecological validity as a primary consideration. These include the MASC (Dziobek et al., 2006) and The Awareness of Social Inference Test (TASIT; McDonald et al., 2006). These tasks imbed audio and visual social information (e.g., facial expressions, body language, and emotional prosodies) in a rich social context. Specifically, the MASC involves watching a short film and answering questions referring to the actors’ mental states. This measure has a number of merits in that it is sensitive to ToM deficits in several clinical populations (e.g., schizophrenia, Montag et al., 2011; Asperger’s syndrome, Dziobek et al., 2006), assesses ToM along a continuum (e.g., genuinely impaired ToM to overmentalising), and has preliminary evidence of sound reliability and validity (Dziobek et al., 2006; Montag et al., 2011). Although the MASC and other video based measures (viz., the TASIT) represent considerable progress towards improving the ecological validity of ToM assessment, the ToM processes which they are assess are considered ‘offline’ (i.e., utilise a third-person perspective), which consequently limits verisimilitude (i.e., similarity of the data collection method to real-life mentalising processes). Moreover, existing measures of ToM do not provide explicit performance scores across first- and second-order cognitive and affective ToM. Accordingly, collateral information from ecologically valid measures that overcome these limitations has the potential to enhance the validity and clinical utility of social cognitive assessment batteries.

Rapid advances in computer technology have allowed the creation of virtual reality applications which permit a user to interact with a computer-generated environment. The value of virtual reality platforms manifests in the direct involvement of the user’s first person
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to the dynamic nature of the simulated environment that assesses the temporal evolution of mentalising processes (Kandalaft, Didehbani, Krawczyk, Allen, & Chapman, 2013). Furthermore, virtual reality applications have the capacity to provide a consistent environment with the potential of infinite repetitions of the same assessment or training task while offering the flexibility to adjust task complexity, response requirements, and the nature and pattern of feedback to a user’s unique impairments.

Kim et al. (2009) were amongst the first to create a virtual reality measure of ToM for use with individuals with euthymic bipolar disorder. Participants were required to attribute possible reasons for expressed emotion (i.e., happy, angry, and neutral) of virtual humans (i.e., avatars) while viewing their facial expressions. In the ToM component, avatars talked about their experience to participants without identifying the context. During the control component, however, participants were given clear information from which they could easily derive the context underpinning the avatar’s affective experiences. Participants were asked to judge a short sentence that suggested a potential reason for the avatar’s emotion as either ‘true’ or ‘false’ by clicking a mouse button. For healthy controls, greater activation was observed in the right anterior cingulate cortex, inferior frontal, and insular cortex during emotional conditions compared to neutral conditions. Relative to healthy controls, individuals with bipolar disorder showed reduced activations in the right inferior frontal cortex, premotor cortex, and insula during emotional conditions. Kim et al. (2009) did not observe brain activation in the ventromedial prefrontal cortex, which has been shown to be implicated in cognitive ToM (Amodio & Frith, 2006; Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010). Taken together, these results suggest that Kim et al.’s (2009) measure is better placed to assess affective ToM rather than both the intended affective and cognitive paradigm. The dichotomous response format also does not capture the range of mentalising strategies that
can be employed. Further, the use of a two dimensional environment and avatars resulted in a limited degree of realism.

The current study reports on the development and evaluation of a novel virtual reality task that is capable of providing comprehensive profiles of ToM abilities. The Virtual Assessment of Mentalising Ability (VAMA) assesses the range of mentalising ability (i.e., impaired, reduced, accurate, and overmentalising) within first- and second-order cognitive and affective ToM. Specifically, the current study sought to determine the degree of convergent validity between the VAMA and other measures of ToM. Furthermore, we aimed to demonstrate that the VAMA relies on the traditional cognitive architecture that supports ToM processes by exploring the cognitive correlates of task performance. Small associations between performance on the VAMA and indices of neurocognitive processes (e.g., mental flexibility, verbal knowledge) was expected because task performance relies, in part, on the participant’s capacity to alternate between task demands and recall verbal content (Greig, Bryson, & Bell, 2004; Shamay-Tsoory et al., 2010). We also sought to explore the VAMA’s relationship with real world social performance, as well as to obtain participants’ subjective ratings of the realism and enjoyment of their testing experience. Importantly, this work represents one of the first attempts within the clinical and experimental literature to use virtual reality technology in ToM assessment. Nonetheless, the VAMA was designed to supplement, rather than replace, existing measures of ToM.

Based on these aims, it was hypothesised that (a) adequate internal consistency and test-retest reliability would be found for the VAMA’s subscales; (b) VAMA scores would significantly correlate with performance on other measures of ToM; (c) VAMA scores would have modest relationships with performance on neurocognitive measures, particularly with indices of mental flexibility and verbal ability; (d) VAMA scores would be strongly and positively correlated with measures of social functioning; and (e) participants would rate the
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VAMA as significantly more immersive and reflective of everyday ToM processes than an existing measure of ToM (viz., the Yoni Task).

Method

Participants

Sixty-five healthy adults (25 males & 40 females, mean age = 25.98 years, SD = 7.01; mean years of education = 14.19 years, SD = 1.93) who reported no history of drug or alcohol dependency, neurological disease, brain or central nervous system (CNS) injury, intellectual impairment or developmental disability, were recruited from the general community and a local university. Participants were also required to report no current use of psychotropic medication (i.e., minimum of six months), be aged between 18-55 years and be proficient in English. The sample consisted of 54 individuals who identified as Caucasian, 6 as Asian and 5 as Indian. Participants nominated their interest to take part in the study after reading advertisements available in a public library or through the Griffith University School of Applied Psychology Research Participant Pool. Participants were individually screened for psychopathology using the Mini Modified Screen (OASAS, 2001). Three participants were excluded as they disclosed a current mood disorder (n = 2) and a CNS injury (n = 1). All participants provided informed written consent before the study and the research protocol was approved by the Griffith University Human Research Ethics Committee (see Appendix B at end of thesis).

Measures

VAMA: Theoretical Considerations. The VAMA uses a virtual interface to simulate the demands of real life social interactions. The task involves an ongoing and ToM component. The ongoing component requires participants to navigate a virtual shopping centre and complete a pre-specified list of errands (e.g., post a letter at the post office). Music, animated advertisement boards, and background chatter are included during the ongoing task.
to facilitate immersion. Distracting background stimuli are not present during the ToM component.

The ToM component involves responding to questions about a series of social interactions that occur between the test taker and his/her virtual ‘friends’ as they complete a list of errands. There are 10 ToM interactions (see Figure 8.1) which are followed by four multiple choice questions that correspond to each subscale: first-order cognitive, first-order affective, second-order cognitive and second-order affective ToM. Appendix C (see end of thesis) provides a detailed description of the first interaction and corresponding questions. An overview of the other interactions is included in Appendix D (see end of thesis). Two neutral interactions are presented after the third and eighth ToM interactions. These interactions do not place demands on ToM processes, thus serve as control scenarios.

Figure 8.1. Example of an interaction between the test taker and virtual friends.

The featured characters (viz., Isabel, Aaron, Tiffany, and John) have unique motives for partaking in the social outing. Each develops her/his own dynamics with each of the other characters. Comprehension of friendship and relationship issues are a central theme of the task. Each of the characters display stable characteristics (e.g., outgoing, laid-back, caring.
and selfish) and during the course of the outing each is faced with different situations that elicit emotions and mental states. The relationships between the characters are that of partners, friends, or new acquaintances. The level of intimacy between characters in the interactions was varied to represent different social reference systems on which mental state inferences have to be made. In the design of the script, varying levels of complexity were considered in creating scenes that involve the interaction of two, three, or four characters. This approach allowed for the integration of several social cognition concepts such as false belief, deception, faux pas, humour, sarcasm, and persuasion. Further, to reflect the natural evolution of fluid social interactions, later virtual exchanges were designed to build upon information provided in earlier interactions.

The different mental state modalities that were taken into consideration were feelings (i.e., 20 items), thoughts (i.e., 10 items), and intentions (i.e., 10 items). Questions assessing cognitive ToM provide mental state cues (e.g., ‘thinking’ or ‘intending’), whereas questions assessing affective ToM are emotionally laden (e.g., ‘feeling’). To assess emotions of different valence, scenes were developed in which characters express negative feelings like disgust, anger, jealousy, embarrassment or fear, as well as positive emotions like joy, gratefulness, affection, and ambition. Of the 20 emotional mental state items, 10 are of negative valence and 10 are of positive valence. Each control scenario is followed by a neutral question regarding the conversational content of the characters (e.g., why couldn’t John buy the shirt he wanted?). The number of items per subscale and the frequencies of mental state modalities/assessed emotions approximate distributions considered by other task developers (e.g., Dziobek et al., 2006; Ekman, 1999).

In addition to the above mentioned mental state modalities, the items varied as to their conversational content. Specifically, items were designed to be verbal (20 items) and non-verbal (20 items), with the verbal items to be taken literally (10 items) or not literally (e.g., 10
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items contain figurative speech and other aspects of pragmatics). The non-verbal category includes items which rely on the recognition of facial expressions (10 items), as well as a broader category that requires the additional interpretation of body language and gestures (10 items). To ensure the task’s verisimilitude, individual items cover more than one domain, (e.g., the mental state category of intentions, the inference of facial expressions, and the interpretation of sarcasm).

**VAMA development.** The storyline of the VAMA was written by the first author based on guidelines provided by Ackerman (2003) on the development of screenplays. Key steps involved designing characters, the plot, and a final dialogue form. For the purpose of creating an ecologically valid and contextually based measure of ToM, it was important to develop a complete profile of each character. Accordingly, each character was accompanied by background information, including profession, lifestyle, hobbies, personality traits, and motives. The characters were each assigned basic needs that do not vary over the course of the task (e.g., Aaron is romantically interested in Isabel who does not share these feelings), as well as sub-needs that vary within a character in different situations (e.g., being secretive). These needs represent a foundation for the characters’ mental states which have to be appreciated by test taker. By creating ambiguity between basic and sub-needs (e.g., Aaron dislikes John but wants to help him to get Isabel’s attention), some items pose particularly challenging demands on ToM functioning.

A high quality technical production team was employed to film the scenarios. A professional cameraman and sound engineer assisted with filming and editing within a studio. The raw material of the scenarios was captured on a green screen and converted to a digital format on a computer. Cutting, lighting, and sound post-processing were done using the software Final Cut and Quick Time Pro. The virtual environment was developed by a team of Computer Graphics Artists and Programmers at VRspace Pty Ltd. Artists created the digital
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assets (i.e., shopping centre and characters) using AutoDesk 3D Studio Max and the
Programmers used the Unity3D game engine to develop the functionality of the application.
The filmed segments were superimposed onto the virtual shops, which allowed the
background of the interactions to reflect that of the shop in which the characters are
completing their current errand. Participants completed the task on a Dell M 6700 notebook
computer. Hardware requirements are Windows 7, 3.0 GHz CPU, a dedicated Graphics
Card/an adaptor with at least 2Mb texture memory and 4 Gb RAM. Although not used in the
current study, the assessment system is compatible with virtual-headsets and can be projected
into a 3D environment.

The final version of the video was judged by six subject-matter experts on agreement
between how mental states were intended in the script and how the actual mental states were
depicted by the characters. Only if there was agreement was the item included in the final test
format. As a next step, preliminary open-ended responses were collected from 15 healthy
participants. Responses were used as models to construct answers reflective of the different
anchors on the scale. The response options were also sent to the subject-matter experts to
confirm that their content accurately reflected their corresponding anchor points. Following
some minor adjustments, all response options were included in the final task format.

VAMA administration. The VAMA is automated by the test taker. The testing starts
with the option for the individual to select their gender which controls the voice-over of the
test taker. Participants read through instruction screens that explain they will be accompanied
by friends during a visit to a virtual shopping centre where they complete a list of errands.
They are further instructed that they will be asked about what their friends are thinking and
feeling. Participants have the opportunity to practice navigating through the virtual shopping
centre (see Figure 8.2), entering shops and accessing the centre map (see Figure 8.3) and task
list. Participants can access these windows as frequently as necessary. The four characters are
introduced in the form of photographs, names, and a brief explanation of their relationships with one another. This information is also provided to test takers on plastic cards. The environment is navigated using the keyboard arrow keys. Interactions are automatically presented after a participant completes an errand. To control for memory and general comprehension effects, four control questions are asked prior to and following the VAMA (e.g., which characters are married? which characters work at the same school?). Data from participants who inaccurately respond to the imbedded control scenarios or incorrectly answer pre/post control questions should be interpreted with caution as an understanding of the social dynamics is considered imperative for an accurate indication of ToM ability to be derived from performance scores. Administration of the VAMA takes approximately 30 minutes, which includes a 10 minute tutorial.

Figure 8.2. Example of virtual shopping centre.
**VAMA scoring.** Performance on the VAMA is divided into indices of first- and second-order cognitive and affective ToM. Based on the continuity model of ToM (Abu-Akel & Bailey, 2000), responses were scored using a 3-point scale, whereby ‘0’ denotes ‘impaired mentalising’ or ‘overmentalising’, ‘1’ denotes ‘reduced mentalising’ and ‘2’ denotes ‘accurate mentalising’ (i.e., otherwise known as the cumulative score). The scales can also be scored dichotomously, whereby each accurate ToM response is allocated a score of 1 and all other responses are scored as 0 (i.e., otherwise known as the frequency score). This latter scoring method allowed for performance on the VAMA to be compared to that obtained by other measures of ToM. The individual subscales (i.e., first-order affective, second-order affective, first-order cognitive and second-order cognitive) each has a range of 0 to 10 (i.e., frequency score) and 0 to 20 (i.e., cumulative score). The total ToM scale has a range of 0 to 40 (i.e., frequency score) and 0 to 80 (i.e., cumulative score). Additionally, the measure records the total number of overmentalising responses selected during the task (i.e., 0 to 40). Responses to control scenarios were scored as either correct or incorrect.
ToM tasks and task friendliness. Participants were administered three existing measures of ToM and a newly developed scale to assess task enjoyment and immersion.

The Yoni Task. This computerised task assesses the ability to infer first- and second-order cognitive and affective ToM via analysis of verbal cues, eye gaze, and facial expression (Shamay-Tsoory et al., 2006). The task consists of 87 trials run through E-Prime software. Each trial presents a cartoon face (i.e., Yoni) and four coloured pictures of either objects belonging to a single category (e.g., fruits or transport) or faces. The participant’s task is to use the available cues to identify the stimuli that Yoni is referring to. Two types of cues may be offered: verbal only (i.e., a sentence that appears at the top of the screen), or verbal cue together with eye gaze. There are three conditions: cognitive, affective, and physical. The cognitive and the affective conditions involve mental state inferences. The physical condition requires a choice based on the proximity of Yoni to a stimulus, thus serves as a control condition. Performance is rated for accuracy, whereby higher scores are indicative of better ToM ability. Although the Yoni Task has been found to be sensitive to ToM deficits in the schizophrenia population (Kalbe et al., 2010; Shamay-Tsoory et al., 2007), research exploring its psychometric properties has not been conducted.

The Faux Pas Recognition Test. The Faux Pas Recognition Test (FPRT) measures first-order affective ToM. The task consists of 20 written items (read aloud), 10 of which contain a social faux pas (e.g., a young girl is mistaken for a boy because of her short hair; Stone et al., 1998). Detection of faux pas requires both an understanding of false or mistaken belief and an appreciation of the emotional impact of a statement on the listener (Lough et al., 2006). The task requires participants to determine whether or not a faux pas is present, and if so, why it has occurred. Each scenario is accompanied by five questions regarding the detection and understanding of the faux pas, the intention and belief of the characters, and ability to empathise with the character. Each correct response is assigned a score of one.
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Higher scores are indicative of more advanced faux pas recognition. The measure has demonstrated sound three-month test-retest reliability ($r = .83$) and inter-rater reliability ($r = .76$; Zhu et al., 2007). Furthermore, the FPRT has been found to be sensitive to the spread of ToM ability in the healthy population (e.g., Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003; Zhu et al., 2007).

The Hinting Task. The Hinting Task provides an index of first-order cognitive ToM by assessing an individual's ability to infer 'real' intentions behind indirect speech (Corcoran et al., 1995). It comprises 10 short passages presenting an interaction between two characters that end with one of the characters providing a hint. Participants are then asked to explain the true intentions of the character. A global accuracy score is computed (i.e., scores range from 0 to 20), with higher scores indicative of more developed first-order cognitive ToM ability. Although information about the Hinting Task’s psychometric properties has not been published, there is evidence to suggest that the measure is sensitive to the range of ToM ability in healthy adults (Janssen, Krabbendam, Jolles, & Van Os, 2003; Maat, Fett, & Derks, 2012).

The User-Friendliness Questionnaire. The User-Friendliness Questionnaire (UFQ) is a 15 item self-report questionnaire developed by the first author for the purpose of this study (see Appendix E at end of thesis). The scale allows participants to subjectively rate the degree to which the VAMA and Yoni Task are immersive, include activities that are similar to everyday ToM processes, are interesting, clear, and easy to learn, the extent to which the ToM and ongoing (i.e., for the VAMA) components are difficult, and the extent to which they would recommend each task. The Yoni Task was chosen as a comparison measure as it was most similar to the VAMA in terms of medium (i.e., computer based) and scope (i.e., assesses first- and second-orders cognitive and affective ToM). Responses are provided on a 5-point
Likert scale whereby ‘1’ denotes ‘strongly agree’ and ‘5’ denotes ‘strongly disagree’. Lower scores indicate stronger agreement.

**Measures of neurocognitive abilities.** Neurocognitive measures were selected to provide information about separate cognitive domains as well as overall neurocognitive function. The battery included measures of attention and mental flexibility (Trail Making Test: Part B; Reitan & Wolfson, 1985), verbal fluency (Controlled Oral Word Association Task; COWAT; Benton & Hamsher, 1978), verbal response inhibition (Hayling Test; Burgess & Shallice, 1997), and working memory (Letter Number Sequencing subtest of the Wechsler Memory Scale III; LNS; Wechsler, 2003) and estimated IQ (Wechsler Abbreviated Scale of Intelligence II, Wechsler, 2011).

**Measures of social functioning:** Two approaches were used to assess social functioning: functional capacity and community functioning.

**The Social Skills Performance Assessment.** The Social Skills performance Assessment (SSPA) is a performance-based measure of functional capacity (i.e., social skills). After a one minute practice period, participants initiate and maintain a conversation for three minutes in two situations: (a) greeting a new neighbour, and (b) calling a landlord to request a repair for a leak that has gone unfixed despite a previous request. These scenarios are audio-taped and are scored by a blind rater according to fluency, clarity, focus, negotiation ability, persistence, and social appropriateness of responses. An index of performance is obtained by summing the scores from each of the aforementioned aspects across situations. Higher scores are indicative of more advanced social skills. The measure has been shown to have high inter-rater ($r = .87$) and test-retest reliability ($r = .91$; McClure et al., 2007). Furthermore, this measure has strong convergent validity with the Direct Assessment of Functional Status ($r = .64$ to .70; Patterson et al., 2001).
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The Social Functioning Scale. The Social Functioning Scale (SFS) is a 79-item questionnaire that requires subjective ratings within seven domains of community functioning: social engagement/withdrawal (i.e., time spent alone, initiation of conversations, and social avoidance), interpersonal functioning (i.e., number of friends, relationship status, and quality of communication), independence competence (i.e., ability to perform skills necessary for independent living), independence performance (i.e., performance of skills necessary for independent living), recreation (i.e., engagement in a range of common hobbies and interests), prosocial behaviour (i.e., engagement in a range of common social activities), and employment (i.e., whether or not participant is engaged in structured employment or a structured program of daily activity; Birchwood, Smith, Cochrane, Wetton, & Copestake, 1990). In addition to the standard SFS subscales, two additional subscales were developed by the first author to capture the quality of, and emotional availability within, close friendships and relationships in the workplace (see Appendix F at end of thesis) for the questions that correspond to these subscales. Higher scores on the SFS indicate better community functioning. The measure has been shown to have sound test-retest reliability and internal consistency (Birchwood et al., 1990). Results from the current research indicate that the internal consistency for the two additional scales, close interpersonal relationships ($\alpha = .74$) and occupational interpersonal functioning ($\alpha = .70$), were satisfactory.

Procedure

Following written informed consent and screening procedures, participants were individually administered all measures during a two-hour assessment session. Breaks were taken as required. Tasks were administered in the following order: the VAMA and Yoni Task (counterbalanced), UFQ, FPRT, Hinting Task, neurocognitive assessment battery, SSPA and the SFS. To ensure participants understood the requirements of the computerised ToM tasks,
participants were asked to recall their respective instructions prior to starting. Thirty participants were readministered the VAMA after a 4 week interval (i.e., ± 3 days).

Data Analyses

Internal consistency of VAMA subscales was assessed using Cronbach's alpha. Pearson’s correlations were used to assess the relationships between performance on the ToM measures, and the relationship of VAMA scores with neurocognitive abilities and social functioning. Due to doubts expressed about quantifying test-retest reliability using Pearson’s \( r \) (Weir, 2005), the test-retest reliability of the total and subscales of the VAMA were assessed using interclass correlation coefficients (ICC; Shrout & Fleiss, 1979). Paired samples \( t \)-tests were conducted to assess differences in how participants rated the VAMA and Yoni Task on the UFQ. Where influential outliers were found to affect significance, they were removed from the analysis. Given that the current research is considered exploratory, alpha levels were not adjusted for multiple comparisons. This is not considered to be a problem for the current findings, as most results were significant at \( \alpha < .01 \) and \( \alpha < .001 \), which is typically considered conservative (Tabachnick & Fidell, 2012). Caution will be taken in interpreting the results of analyses significant at \( \alpha < .05 \).

Results

VAMA Response Accuracy

Participants mean response accuracy for the first- and second-order cognitive and affective ToM subscales of the VAMA is provided in Figure 8.4. All participants correctly responded to the control questions. Further, participants’ mean overmentalising score was 3.46 (\( SD = 2.05 \)). This score is consistent with other research that has detected slight variation in the tendency to overmentalise within the healthy population (Sharp et al., 2013). Performance on the other measures of ToM is summarised in Table 8.1. No significant
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differences in response accuracy were identified between males and females on the subscales or total scale of the VAMA.

Figure 8.4. Mean response accuracy on the subscales of the VAMA. Error bars represent + 1 SD.
Table 8.1

*Performance on the Yoni Task, Faux Pas Recognition Test, and Hinting Task*

<table>
<thead>
<tr>
<th>ToM Measures</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yoni Task</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>11.87</td>
<td>0.55</td>
<td>9-12</td>
</tr>
<tr>
<td>First-order affective</td>
<td>11.19</td>
<td>1.11</td>
<td>8-12</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>11.91</td>
<td>0.53</td>
<td>8-12</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>10.91</td>
<td>1.85</td>
<td>4-12</td>
</tr>
<tr>
<td><strong>Faux Pas Recognition Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection</td>
<td>37.77</td>
<td>4.0</td>
<td>19-40</td>
</tr>
<tr>
<td>Understanding</td>
<td>18.66</td>
<td>1.63</td>
<td>13-20</td>
</tr>
<tr>
<td>Intentions</td>
<td>17.08</td>
<td>2.10</td>
<td>13-20</td>
</tr>
<tr>
<td>Belief</td>
<td>18.45</td>
<td>1.50</td>
<td>14-20</td>
</tr>
<tr>
<td>Empathy</td>
<td>18.50</td>
<td>1.45</td>
<td>15-20</td>
</tr>
<tr>
<td><strong>Hinting Task</strong></td>
<td>17.22</td>
<td>2.12</td>
<td>12-20</td>
</tr>
</tbody>
</table>

*Note.* ToM = theory of mind.

**Psychometric Analysis**

**Internal consistency.** Internal consistency for the total scale and four subscales of the VAMA was assessed by calculation of Cronbach’s alpha, which mostly revealed satisfactory values. According to Nunnally and Bernstein (1994) values of $\alpha > .70$ are considered acceptable. Cronbach’s alpha for item to scale consistency was .78 for first-order cognitive ToM, .76 for first-order affective ToM, .84 for second-order cognitive ToM and .69 for second-order affective ToM.

**Test-retest reliability.** Test-retest reliability of the VAMA was assessed over a 4 week interval ($n = 30$). Significant and large correlations were found for the frequency scores of the total and subscales: ToM total ICC = .93, 95% (.85-.96); first-order cognitive ICC = .96, 95% (.91-.98); first-order affective ICC = .98, 95% (.95-.99); second-order cognitive ICC = .95, 95% (.89-.97) and; second-order affective ICC = .99, 95% (.98-.99).
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Convergent validity. No significant correlations were observed between performance on the VAMA and Yoni Task. However, moderate sized relationships were observed between cognitive and affective ToM performance on the VAMA and the FPRT, as well as between first-order ToM performance on the VAMA and the Hinting Task (see Table 8.2; Cohen, 1992).

Neurocognitive correlates. Table 8.3 summarises the correlations between participants’ ToM performance as measured by the VAMA and neurocognitive abilities. Small to moderate sized correlations were observed between estimated IQ and total, first- and second-order cognitive and second-order affective ToM performance (Cohen, 1992). Small to moderate significant relationships were also found between an index of mental flexibility (viz., Trials B) and first- and second-order affective, second-order cognitive, overmentalising and total ToM scores. Verbal fluency was found to have small significant correlations with first-order cognitive and affective ToM. Similarly, small to moderate correlations were observed between verbal knowledge and total, first-order cognitive and second-order cognitive ToM. Participants’ tendency to overmentalise was also found to have small but significant negative relationships with verbal knowledge, mental flexibility, and response initiation/suppression. Lastly, first- and second-order affective ToM were found to have small but significant relationships with response initiation/suppression.

Ecological validity. As seen in Table 8.4, significant correlations were observed between all VAMA scales and total social abilities as measured by the SSPA. Additionally, VAMA subscales were found to have small to moderate correlations with participants’ observed negotiation ability, overall conversational ability, and social appropriateness. Interestingly, significant moderate negative correlations were found between participants’ frequency of overmentalising and their observed social appropriateness and overall conversational ability (Cohen, 1992).
Table 8.5 displays significant moderate to large correlations between performance on the VAMA and participants’ subjective ratings of their community functioning on the SFS (Cohen, 1992). Specifically, ToM subscales positively correlated with participants’ ratings of social engagement and interpersonal functioning within the community, close relationships and occupational settings (Cohen, 1992). Additional relationships were observed between first-order cognitive and affective and second-order affective and participant’s ratings of engagement in recreational activities. First- and second-order cognitive and affective ToM significantly correlated with participants reported capacity to function independently. Moderate significant negative correlations were also observed between participants’ overmentalising scores and reported social engagement, and interpersonal functioning within the community, close relationships, and occupational settings (Cohen, 1992).
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Table 8.2

Correlations between Performance on the Virtual Assessment of Mentalising Ability and Other Measures of Theory of Mind

<table>
<thead>
<tr>
<th>ToM Measures</th>
<th>First-order cognitive</th>
<th>First-order affective</th>
<th>Second-order cognitive</th>
<th>Second-order affective</th>
<th>Overmentalising</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yoni Task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.14</td>
<td>.04</td>
<td>.03</td>
<td>.09</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.16</td>
<td>.01</td>
<td>.20</td>
<td>.15</td>
<td>.21</td>
<td>.21</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.06</td>
<td>.05</td>
<td>.11</td>
<td>.11</td>
<td>.09</td>
<td>.10</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.16</td>
<td>.03</td>
<td>.06</td>
<td>.00</td>
<td>.12</td>
<td>.08</td>
</tr>
<tr>
<td><strong>Faux Pas Recognition Test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection</td>
<td>.19</td>
<td>.11</td>
<td>.16</td>
<td>.04</td>
<td>.11</td>
<td>.19</td>
</tr>
<tr>
<td>Understanding</td>
<td>.27*</td>
<td>.17</td>
<td>.30*</td>
<td>.11</td>
<td>.07</td>
<td>.34*</td>
</tr>
<tr>
<td>Intentions</td>
<td>.35*</td>
<td>.31*</td>
<td>.39**</td>
<td>.27*</td>
<td>-.26*</td>
<td>.51***</td>
</tr>
<tr>
<td>Belief</td>
<td>.15</td>
<td>.12</td>
<td>.06</td>
<td>.07</td>
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<td>.14</td>
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<tr>
<td>Empathy</td>
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<td>.45***</td>
<td>.12</td>
<td>.18</td>
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<td>.18</td>
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<td><strong>Hinting Task</strong></td>
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<td>.21</td>
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<td><strong>Yoni Task</strong></td>
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<tr>
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<td>.09</td>
<td>.04</td>
<td>.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order affective</td>
<td>.16</td>
<td>.01</td>
<td>.20</td>
<td>.12</td>
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* p < 0.05  ** p < 0.01  *** p < 0.001
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<table>
<thead>
<tr>
<th></th>
<th>0.04</th>
<th>0.05</th>
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<td>0.14</td>
<td>0.01</td>
<td>0.05</td>
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*Faux Pas Recognition Test*

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<tr>
<th></th>
<th>0.17</th>
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<th>0.20</th>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Understanding</td>
<td>0.22</td>
<td>0.20</td>
<td>0.34**</td>
<td>0.08</td>
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<td>0.28*</td>
<td>0.37**</td>
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<td>0.12</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
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<td>.43***</td>
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*Hinting Task*  

<table>
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<tr>
<th></th>
<th>0.36**</th>
<th>0.30*</th>
<th>0.07</th>
<th>0.05</th>
</tr>
</thead>
</table>

*Note. ToM = theory of mind.*

*  $p < .05$.

**  $p < .01$.

***  $p < .001$.  

***  $p < .001$. 


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Table 8.3

*Correlations between performance on the Virtual Assessment of Mentalising Ability and Indices of Neurocognitive Ability*

<table>
<thead>
<tr>
<th>VAMA scores</th>
<th>Estimated IQ</th>
<th>Vocabulary</th>
<th>Matrix Reasoning</th>
<th>Digit Span</th>
<th>COWAT</th>
<th>Trails B</th>
<th>LNS</th>
<th>HSCT</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.43**</td>
<td>.38**</td>
<td>.22</td>
<td>.09</td>
<td>.28*</td>
<td>.17</td>
<td>.11</td>
<td>.14</td>
</tr>
<tr>
<td>First-order affective</td>
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<td>.15</td>
<td>.05</td>
<td>.08</td>
<td>.25*</td>
<td>.24*</td>
<td>.14</td>
<td>.20</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.29*</td>
<td>.22</td>
<td>.18</td>
<td>.18</td>
<td>.20</td>
<td>.40**</td>
<td>.12</td>
<td>.09</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.19</td>
<td>.17</td>
<td>.13</td>
<td>.18</td>
<td>.04</td>
<td>.24*</td>
<td>.03</td>
<td>.24*</td>
</tr>
<tr>
<td>Overmentalising</td>
<td>-.21</td>
<td>-.25*</td>
<td>.11</td>
<td>-.13</td>
<td>.01</td>
<td>.25*</td>
<td>-.01</td>
<td>-.26*</td>
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<tr>
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<td>.41**</td>
<td>.35**</td>
<td>.01</td>
<td>.06</td>
<td>.20</td>
<td>.10**</td>
<td>.07</td>
<td>.22</td>
</tr>
<tr>
<td><strong>Cumulative Scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.36**</td>
<td>.29*</td>
<td>.22</td>
<td>.04</td>
<td>.25*</td>
<td>.19</td>
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<td>.17</td>
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<tr>
<td>First-order affective</td>
<td>.15</td>
<td>.07</td>
<td>.05</td>
<td>.09</td>
<td>.20</td>
<td>.33**</td>
<td>.04</td>
<td>.24*</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.29*</td>
<td>.24*</td>
<td>.20</td>
<td>.13</td>
<td>.11</td>
<td>.40**</td>
<td>.08</td>
<td>.07</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.26*</td>
<td>.22</td>
<td>.15</td>
<td>.07</td>
<td>.02</td>
<td>.26*</td>
<td>.07</td>
<td>.24*</td>
</tr>
</tbody>
</table>

*Note. COWAT = Controlled Oral Word Association Task. HSCT = Hayling Sentence Completion Test. LNS = Letter Number Sequencing.  
  * p < .05  
  **p < .01.*
Table 8.4

Correlations between Performance on the Virtual Assessment of Mentalising Ability and the Social Skills Performance Assessment

<table>
<thead>
<tr>
<th>VAMA scores</th>
<th>Total</th>
<th>Interest</th>
<th>Fluency</th>
<th>Clarity</th>
<th>Focus</th>
<th>Affect</th>
<th>Negotiation</th>
<th>Submissive</th>
<th>Overall conversation</th>
<th>Social appropriateness</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-order cognitive</td>
<td>.48***</td>
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<td>.13</td>
<td>.21</td>
<td>.14</td>
<td>.16</td>
<td>.32*</td>
<td>.09</td>
<td>.61***</td>
<td>.74***</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.47***</td>
<td>.09</td>
<td>.01</td>
<td>.02</td>
<td>.08</td>
<td>.04</td>
<td>.14</td>
<td>.08</td>
<td>.46***</td>
<td>.37**</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.78***</td>
<td>.09</td>
<td>.03</td>
<td>.02</td>
<td>.05</td>
<td>.13</td>
<td>.50***</td>
<td>.23</td>
<td>.72***</td>
<td>.16</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.59***</td>
<td>.16</td>
<td>.05</td>
<td>.11</td>
<td>.14</td>
<td>.07</td>
<td>.27*</td>
<td>.05</td>
<td>.57***</td>
<td>.08</td>
</tr>
<tr>
<td>Overmentalising</td>
<td>-.41***</td>
<td>.17</td>
<td>-.01</td>
<td>-.03</td>
<td>.08</td>
<td>.18</td>
<td>-.19</td>
<td>.19</td>
<td>-.45***</td>
<td>-.34***</td>
</tr>
<tr>
<td>Total ToM</td>
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<td>.01</td>
<td>.02</td>
<td>.50***</td>
<td>.17</td>
<td>.92***</td>
<td>.48***</td>
</tr>
</tbody>
</table>

**Frequency Scores**

**Cumulative Scores**

Note. ToM = theory of mind.
*  $p < .05$.
**  $p < .01$.
*** $p < .001$. 
## Theory of Mind in Schizophrenia

Table 8.5

*Correlations between Performance on the Virtual Assessment of Mentalising Ability and Social Functioning as Measured by the Social Functioning Scale*

<table>
<thead>
<tr>
<th>VAMA subscales</th>
<th>Social engagement</th>
<th>Interpersonal functioning</th>
<th>Independence competence</th>
<th>Independence performance</th>
<th>Recreation</th>
<th>Prosocial activities</th>
<th>Close IP relationships</th>
<th>Occupation IP functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-order cognitive</td>
<td>.64***</td>
<td>.67***</td>
<td>.34**</td>
<td>.13</td>
<td>-.34**</td>
<td>.13</td>
<td>.68***</td>
<td>.60***</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.63***</td>
<td>.66***</td>
<td>.28*</td>
<td>.10</td>
<td>-.32*</td>
<td>.16</td>
<td>.45***</td>
<td>.51***</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.53***</td>
<td>.55***</td>
<td>.12</td>
<td>.05</td>
<td>-.07</td>
<td>.18</td>
<td>.44***</td>
<td>.42***</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.62***</td>
<td>.65***</td>
<td>.25*</td>
<td>.09</td>
<td>-.32**</td>
<td>.21</td>
<td>.51***</td>
<td>.58***</td>
</tr>
<tr>
<td>Overmentalising</td>
<td>-.59***</td>
<td>-.69***</td>
<td>.22</td>
<td>.09</td>
<td>.14</td>
<td>.21</td>
<td>-.42***</td>
<td>-.58***</td>
</tr>
<tr>
<td>Total</td>
<td>.59***</td>
<td>.60***</td>
<td>.27*</td>
<td>.07</td>
<td>-.18</td>
<td>.14</td>
<td>.41***</td>
<td>.60***</td>
</tr>
</tbody>
</table>

*Frequency Scores*

*Cumulative Scores*

Note. IP = Interpersonal. VAMA = Virtual Assessment of Social Cognition.

* $p < .05$

** $p < .01$

*** $p < .001$
THEORY OF MIND IN SCHIZOPHRENIA

As can be seen in Tables 8.6 and 8.7, some small to moderate correlations were observed between ToM performance, as measured by the Yoni Task, FPRT, and Hinting Task, and indices of social functioning. Specifically, first-order cognitive ToM as measured by the Hinting Task was found to correlate significantly with participants’ observed clarity and focus in social interactions, and demonstrate appropriate and congruent affect as measured by the SSPA. Additionally, second-order ToM processes as measured by the Yoni task were found to be related to submissiveness and social appropriateness on the SSPA. The ability to detect faux pas, as measured by the FPRT, was correlated with interpersonal functioning within occupational settings as well as recreational engagement, and understanding other’s intentions was found to be significantly correlated with interpersonal functioning in close relationships and occupational settings as measured by the SFS.

Table 8.8 summarises the mean ratings provided by participants on each item of the UFQ. Analyses indicated that when compared to the Yoni Task, the VAMA was rated as significantly more immersive, similar to everyday ToM processes, and as more interesting. Further, the VAMA received significantly higher recommendations for future use than the Yoni Task. The relative difficulty of the ToM components of the VAMA and Yoni Task were not rated as significantly different. Further, no significant differences were identified between the clarity of instructions accompanying the tasks. Notwithstanding, participants rated the Yoni Task as significantly easier to learn than the VAMA.
## THEORY OF MIND IN SCHIZOPHRENIA

Table 8.6

**Correlations between Measures of Theory of Mind and the Social Functioning Scale**

<table>
<thead>
<tr>
<th>ToM measures</th>
<th>Social engagement</th>
<th>IP functioning</th>
<th>Independence competence</th>
<th>Independence performance</th>
<th>Recreation</th>
<th>Prosocial activities</th>
<th>Close IP relationships</th>
<th>Occupation IP functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yoni Task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order affective</td>
<td>.14</td>
<td>.13</td>
<td>.02</td>
<td>.17</td>
<td>.06</td>
<td>.14</td>
<td>.21</td>
<td>.10</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.19</td>
<td>.03</td>
<td>.12</td>
<td>.22</td>
<td>.11</td>
<td>.05</td>
<td>.06</td>
<td>.04</td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.15</td>
<td>.06</td>
<td>.13</td>
<td>.07</td>
<td>.14</td>
<td>.16</td>
<td>.05</td>
<td>.04</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.15</td>
<td>.19</td>
<td>.05</td>
<td>.03</td>
<td>.17</td>
<td>.11</td>
<td>.06</td>
<td>.16</td>
</tr>
<tr>
<td><strong>Faux Pas Recognition Test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection</td>
<td>.18</td>
<td>.22</td>
<td>.14</td>
<td>.12</td>
<td>.06</td>
<td>.13</td>
<td>.06</td>
<td>.32*</td>
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<tr>
<td>Understanding</td>
<td>.08</td>
<td>.06</td>
<td>.02</td>
<td>.07</td>
<td>.22</td>
<td>.08</td>
<td>.12</td>
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<td>.02</td>
<td>.23*</td>
<td>.20</td>
<td>.33**</td>
<td>.33**</td>
</tr>
<tr>
<td>Belief</td>
<td>.01</td>
<td>.09</td>
<td>.02</td>
<td>.08</td>
<td>.06</td>
<td>.03</td>
<td>.10</td>
<td>.07</td>
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<td>.02</td>
<td>.05</td>
<td>.06</td>
<td>.08</td>
<td>.01</td>
</tr>
<tr>
<td><strong>Hinting Task</strong></td>
<td>.06</td>
<td>-.09</td>
<td>.07</td>
<td>.04</td>
<td>.13</td>
<td>.04</td>
<td>.01</td>
<td>.08</td>
</tr>
</tbody>
</table>

*Note. ToM = theory of mind. IP = Interpersonal.

* $p < .05$

** $p < .01$

***$p < .001$
### Table 8.7

**Correlations between Measures of Theory of Mind and the Social Skills Performance Assessment**

<table>
<thead>
<tr>
<th>ToM Measures</th>
<th>Interest</th>
<th>Fluency</th>
<th>Clarity</th>
<th>Focus</th>
<th>Affect</th>
<th>Negotiation</th>
<th>Submissive</th>
<th>Overall conversation</th>
<th>Social appropriateness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yoni Task</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order affective</td>
<td>.03</td>
<td>.02</td>
<td>.01</td>
<td>.06</td>
<td>.13</td>
<td>.01</td>
<td>.04</td>
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<td>.15</td>
<td>.03</td>
<td>.07</td>
<td>.17</td>
<td>.28*</td>
<td>.23</td>
<td>.19</td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.04</td>
<td>.01</td>
<td>.02</td>
<td>.06</td>
<td>.05</td>
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<td>.10</td>
<td>.14</td>
<td>.11</td>
<td>.05</td>
<td>.01</td>
<td>.34**</td>
<td>.23</td>
<td>.26*</td>
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<tr>
<td><strong>Faux Pas Recognition Test</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Detection</td>
<td>.03</td>
<td>.13</td>
<td>.20</td>
<td>.13</td>
<td>.05</td>
<td>.01</td>
<td>.06</td>
<td>.03</td>
<td>.06</td>
</tr>
<tr>
<td>Understanding</td>
<td>.12</td>
<td>.12</td>
<td>.07</td>
<td>.14</td>
<td>.07</td>
<td>.01</td>
<td>.10</td>
<td>.07</td>
<td>.09</td>
</tr>
<tr>
<td>Intentions</td>
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<td>.05</td>
<td>.11</td>
<td>.11</td>
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<td>.21</td>
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<tr>
<td>Belief</td>
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<td>.09</td>
<td>.03</td>
<td>.03</td>
<td>.12</td>
<td>.04</td>
<td>.18</td>
<td>.14</td>
<td>.10</td>
</tr>
<tr>
<td>Empathy</td>
<td>.00</td>
<td>.03</td>
<td>.08</td>
<td>.10</td>
<td>.03</td>
<td>.07</td>
<td>.07</td>
<td>.05</td>
<td>.03</td>
</tr>
<tr>
<td><strong>Hinting Task</strong></td>
<td>.17</td>
<td>.20</td>
<td>.27*</td>
<td>.34**</td>
<td>.26*</td>
<td>.08</td>
<td>.01</td>
<td>.04</td>
<td>.17</td>
</tr>
</tbody>
</table>

*Note. ToM = theory of mind.*

* *p < .05

** *p < .01
Table 8.8

*Mean Responses on User Friendliness Questionnaire for Yoni Task and Virtual Assessment of Mentalising Ability*

<table>
<thead>
<tr>
<th>UFQ Scales</th>
<th>VAMA</th>
<th>Yoni Task</th>
<th>t</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immersion</td>
<td>1.21 (.76)</td>
<td>4.56 (.46)</td>
<td>5.45***</td>
<td>1.21</td>
</tr>
<tr>
<td>Similarity</td>
<td>1.82 (1.37)</td>
<td>3.49 (1.17)</td>
<td>11.48***</td>
<td>0.80</td>
</tr>
<tr>
<td>Interesting</td>
<td>1.62 (.82)</td>
<td>2.69 (1.10)</td>
<td>7.48***</td>
<td>1.38</td>
</tr>
<tr>
<td>Clarity of instructions</td>
<td>1.38 (.55)</td>
<td>1.83 (.89)</td>
<td>1.35</td>
<td></td>
</tr>
<tr>
<td>Easy to learn</td>
<td>1.80 (.91)</td>
<td>1.32 (.50)</td>
<td>4.26***</td>
<td>0.79</td>
</tr>
<tr>
<td>Difficulty of ToM component</td>
<td>3.29 (1)</td>
<td>3.62 (1.07)</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>Difficulty of ongoing component</td>
<td>4.31 (1.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>1.72 (.74)</td>
<td>2.62 (1.11)</td>
<td>6.27***</td>
<td>1.18</td>
</tr>
</tbody>
</table>

*Note.* Numbers in parentheses represent 1 SD. Lower scores indicate stronger agreement. UFQ = User Friendliness Questionnaire. ToM = Theory of Mind. VAMA = Virtual Assessment of Mentalising Ability. ***p < .001

**Discussion**

Results of this research provide preliminary evidence that the VAMA is a reliable and valid measure of ToM in healthy individuals, thereby achieving the study’s primary objective. Further, potential evidence was found to suggest that the VAMA has sound ecologically validity as evidenced by high ratings of verisimilitude as well as its capability to provide comprehensive profiles of mentalising abilities that show relationships with social functioning in a healthy population.

The VAMA had high internal consistency across its first- and second-order cognitive, and first-order affective subscales. Given, the internal consistency of the second-order affective subscale is considered just below adequate (Nunnally & Bernstein, 1994), additional efforts should be devoted to improving the response options to ensure content is consistent with corresponding anchor points. Furthermore, the VAMA was found to be highly stable
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over a four week interval, indicating that the task may be suitable for monitoring treatment
effects.

The results indicated that performance scores on the subscales of the VAMA were
moderately associated with performance on similar scales on the FPRT and Hinting Task.
This supports the idea that the VAMA, in part, measures similar functions as these other ToM
tasks. These results are promising given that the VAMA scenarios were designed to assess
classical ToM concepts and pragmatic language items such as jokes, false belief, hints, and
faux pas which are also assessed by the Hinting Task and FPRT. Consonant with the findings
of Terrien et al. (2014), results from this study suggest that healthy participants performed at
ceiling on the Yoni Task, indicating that this measure lacks the sensitivity necessary to detect
small modulations in the mentalising process. It is not surprising therefore, that the results
suggested that there were no associations between the Yoni Task and VAMA.
Notwithstanding, the restricted diversity and relative high level of functioning in the
participant sample may have limited the variability in performance on the Yoni Task,
therefore its relationship with the VAMA should be further explored with a larger, more
diverse sample. Overall, the observation of convergent results with two other measures of
ToM provides preliminary evidence for the construct validity of the VAMA.

As predicted, small to medium associations were found between performance on the
VAMA and measures of IQ, verbal knowledge, verbal fluency, mental flexibility, and
response inhibition. Such results are logical given the nature of the VAMA’s content.
Second-order ToM processes require an individual to infer another’s interpretations of a third
person’s thoughts, feelings, and intentions, thus requires mental flexibility. Akin, switching
between task demands (i.e., the ongoing and ToM components) may also place considerable
demands on mental flexibility. In keeping with verisimilitude, the task had a strong verbal
component. Accordingly, it is not surprising that performance on the VAMA was correlated
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with indices of verbal fluency and verbal knowledge. Of particular interest, overmentalising scores were negatively correlated with a measure of verbal response inhibition, indicating that difficulty suppressing responses is predictive of the tendency to over generate hypotheses about other peoples’ mental states. This result supports research which has identified that accurate ToM inferences are in part, dependent on the ability to inhibit mental processes associated with response generation (Carlson, Moses, & Breton, 2002). Small relationships were also observed between affective ToM and response inhibition. Such results are consonant with research that suggests affective ToM and inhibitory control processes are both supported by the orbitofrontal cortex (Roberts & Wallis, 2000; Shamay-Tsoory et al., 2010). Notwithstanding, the results indicate that performance on the VAMA is sufficiently independent of other cognitive areas such as attention, visuospatial reasoning, and working memory. Although such results reflect the traditional cognitive architecture that support ToM processes, they are not sufficient to confirm the true discriminant validity of task. Rather, future research which demonstrates the independence of task performance from cognitive domains that should have little to no association with ToM (e.g., visual perceptual ability or remote memory) is needed.

Evidence of associations between ToM performance and neurocognitive abilities are of considerable importance given recent discussions about the ‘purenness’ of existing measures of ToM (Dziobek et al., 2006; Kandalaft et al., 2013). Although simulated interactions such as those used in the VAMA are more reflective of everyday social contexts than static pictures or written stories, it has been argued, rightfully, that they also rely on executive functions and central coherence, thus are not ‘pure’ measures of ToM (Baron-Cohen et al., 1997; Roeyers et al., 2001). The VAMA was designed to minimise demands on executive processes. This was accomplished by including a balance of verbal and non-verbal scenarios and avoiding fast changing scenes and distracting stimuli (e.g., music) during social
interactions. The VAMA’s control questions were also designed to detect deficits in executive functions and central coherence in that they involved the recollection and integration of content from the scenarios without requiring social understanding.

Notwithstanding, future research involving clinical populations that have identified deficits in central coherence and executive functions (e.g., ASD and schizophrenia) is needed to explore the relative contribution of these processes to task performance. The results of such research will help clarify the extent to which the VAMA is a pure measure of ToM (Frith & Happé, 1994; Hughes, Russell, & Robbins, 1994).

Although all measures of ToM showed some relationships with social functioning, the VAMA, as predicted, had stronger and more consistent correlations with self-reported community functioning and an objective assessment of functional capacity. Indices on the VAMA were predictive of social abilities that are thought to rely on intact mentalising abilities, including participants’ capacity to negotiate, engage in a socially appropriate manner, and their ability to maintain engagement in a novel social context. Similarly, VAMA scores consistently correlated with participants’ self-reported levels of social engagement and the perceived quality of interpersonal relationships within the community, close friendships, and occupational settings. As the homogenous sample may have restricted the variability observed within the data, these findings should only be considered potential evidence that the VAMA has more direct relevance to real world social functioning as compared to the other measures of ToM. Nevertheless, such results indicate that VAMA scores have sound veridicality, in that better performance on the task was indicative of greater functional capacity and community functioning. Based on these findings, it seems reasonable to predict that targeting ToM in populations with social impairments (e.g., schizophrenia and Autism Spectrum Disorder; ASD) may help improve their social functioning.
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The VAMA has several potential clinical applications which could be explored in future research. First, the VAMA could be used to examine the mechanisms of ToM that predict social functioning in various clinical groups (e.g., schizophrenia, traumatic brain injury, and ASD). Such information may have important implications for the development of specialised treatments for these patients. Second, the VAMA may be useful in training individuals who display mentalising deficits (e.g., undermentalising) or excesses (e.g., overmentalising) in effectively reading the various components of social interactions (e.g., attending to vocal inflections, body language) with the aim of improving inferences in other’s mental states. With practice in these techniques, clinical groups may experience better social functioning, and as a result, better quality of life. Third, the VAMA may be a viable tool for providing assessment of ToM abilities pre and post intervention. The stability of the VAMA over time suggests this tool may be useful to assess treatment outcomes.

As predicted, participants rated the VAMA as highly immersive and reflective of a real world context in which mentalising processes manifest. Further, participants rated the VAMA as more interesting and afforded the task a higher recommendation than the Yoni Task. Such results emerged despite evidence to suggest that participants rated the VAMA as more difficult, which indicates that task complexity does not diminish task realism and enjoyment. These results provide early support for the verisimilitude of the VAMA and offer encouragement for further use of task in ToM research.

The development of the VAMA has addressed several limitations of existing ToM measures. A unique advantage of the VAMA is that it assesses multiple traditional ToM concepts (e.g., sarcasm, faux pas, and deception), whilst allowing for the separate quantification of key theoretical constructs (i.e., first- and second-order cognitive and affective ToM, overmentalising). Second, neuroimaging research typically employs tasks that are simple, contrived, and devoid of a real-life context. Although these basic designs are
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useful in mapping primary functional areas of the brain, they provide minimal insight into the networked brain activity that corresponds with ToM processes during real life interactions (Kandalaft et al., 2013). Given the VAMA simulates real-life social interactions, the use of this platform during imaging research will likely provide a more holistic representation of the neural network supporting mentalising processes and in turn enhance the ecological validity of ToM research (Kandalaft et al., 2013). Third, by scoring ToM abilities along a continuum, the VAMA overcomes problems with dichotomous scoring (e.g., ceiling effects in task performance; Terrien et al., 2014), in that it is sensitive to the spread of mentalising ability that can occur in healthy populations. Further, overmentalising scores were found to have significant relationships with measures of neurocognitive abilities and social functioning. This result provides a window in the knowledge that could be gained by quantifying aberrant mentalising styles. Taken together, these advantages suggest that the VAMA has promise as an additional tool for further exploring ToM processes.

Despite the many advantages of using virtual reality platforms for the assessment of ToM, there are some obstacles which may hinder the VAMA’s widespread application. First, the VAMA, like many conventional measures of ToM (e.g., the FPRT and Hinting Task), includes a strong verbal component (e.g., understanding dialogue). The paradox remains that by reducing verbal content, verisimilitude may also be weakened. For this reason, the VAMA was developed to include items that require mental state inferences based on both verbal and non-verbal cues. Second, the VAMA does not permit the course of the testing paradigm to be altered according to the test taker’s responses during the interactions. One possible solution is to use internet-based gaming paradigms. However, concerns have been raised about the limited test homogeneity of gaming approaches to ToM measurement (Dziobek, 2012). Third, as the current research used healthy participants, the sensitivity, verisimilitude, and veridicality of the VAMA relative to conventional measures of ToM in clinical populations
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should be empirically demonstrated. This could be achieved by exploring the clinical utility of the VAMA in populations previously found to demonstrate mentalising deficits (e.g., brain injured, ASD, and schizophrenia).

Fourth, although not intended as a normative sample, the composition and size of the current sample limits the generalisability of these validation findings to other groups (e.g., older age groups, individuals from different cultures). In addition, the sample size limited the ability to thoroughly examine the effects of demographic variables on task performance. Age and cultural values can serve as a context in which mental state attributions are made (Montag et al., 2011). Further, gender roles and the use of language (e.g., sarcasm and humour) are likely to vary between generations and cultures (e.g., Eastern and Western). It is likely that the social interactions depicted in the VAMA are more easily understood by individuals of the same age group acculturated within Western native English speaking countries. This is not considered a concern for the current sample because the age of the featured characters of the VAMA reflects the mean age of participants (i.e., mid-twenties to early-thirties) who are predominantly Caucasian and of a Western cultural background. Furthermore, no associations were found between ToM performance on the VAMA and either age or gender. Although there is some evidence to suggest that women perform better than men on ToM tasks (e.g., Baron-Cohen et al., 2001), other research indicates that sex differences in ToM are task-specific (Russell, Tchanturia, Rahman, & Schmidt, 2007).

Further validation of the VAMA will require exploring its utility within large samples of adolescent, mature and older age groups (e.g., cross sectional research), in culturally more diverse samples, and with a more thorough examination of the effect of gender on task performance. Information concerning how the task performs in a wider range of healthy adults would be informative when using the task in clinical populations with older mean ages (e.g., Parkinson’s disease and adults with ASD). Further validation of the measure should
also include examining cross-cultural effects on task performance. The dialogue included in the task does not include colloquial phrases nor do the characters specifically reference Western culture. As such, direct linguistic translations of the task into parallel versions should be considered. Parallel versions of the task have the potential to provide valuable insights into cultural differences in mentalising processes. Combining the VAMA with eye-tracking software for example, may help identify unique differences in the social stimuli to which members of different cultures attend during interactions.

The current research suggests that the VAMA is a valuable addition to existing measures of ToM in that it is sensitive to the spread of ability that can occur in ToM subprocesses and is a potential predictor of social abilities in the healthy adult population. The results of this study should be considered as preliminary evidence of the validity of the VAMA and further research is needed to clarify the influence of demographic variables on VAMA performance. Future research will be devoted to continuing to explore the utility and validity of the VAMA within larger healthy and clinical populations.
References


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The clinician puzzled and puzzled until his puzzler was sore, and then the clinician thought of something he hadn’t before. What if prognosis he thought, isn’t predicted from the neurocognition score? What if prognosis he thought, is predicted by the mentalising score?
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Chapter 9: Foreword

As described in Chapter 5, ToM may help to explain heterogeneity of functional outcome in schizophrenia. At an intuitive level, it is reasonable to assume that ToM abilities enable individuals to interact effectively with their social environment, and impairments in ToM could lead to social misperceptions, resulting in inappropriate interpersonal reactions or social withdrawal. Beyond the replicated bivariate associations, there is increasing support from studies that have used predictive models that suggest that ToM processes contributes unique variance to models of social functioning that is independent of nonsocial cognition (Fett et al., 2011; Mancuso et al., 2011). However, there is still considerable debate regarding whether ToM impairments are primary or are secondary to deficits in basic cognitive processes.

There is also growing interest in how ToM is involved in the formation of specific clinical symptoms (e.g., paranoia), which carries the debate about whether impairments in ToM are a state or trait marker of psychotic illness (Green et al., 2011). ToM impairments have been found to be a proximal determinant of schizophrenia phenomenology, and hence, are viewed as state related (Balogh et al., 2014). At the same time, ToM impairments have been observed in early psychosis (Green et al., 2012; Williams et al., 2008) and appear to be stable across acute and remitted phases of schizophrenia (Bora et al., 2009). Overall, the extent to which ToM impairment is state- or trait remains largely unanswered.

Study 2 (Chapter 9) extends the research presented in Study 1 (Chapter 8) by examining the utility of the VAMA for use with individuals with early psychosis and chronic schizophrenia. Additionally, results of this study are used to respond to outstanding questions concerning the functional significance of ToM impairment, clinical and neurocognitive correlates of ToM subprocesses and mentalising styles, and the extent to which ToM impairment deteriorates will illness chronicity.
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Statement of Contribution to Chapter 9 Co-authored Paper


This chapter includes a co-authored paper which has been prepared for submission to an international peer reviewed journal. The bibliographic details of the co-authored paper, including all authors, are: Allana L. Canty, Professor David Neumann, and Professor David H. K. Shum. The candidate’s contribution to the paper involved conception of the study design, literature review, data collection and analyses, and writing of the manuscript. The co-authors provided review of drafts and supervisory device.

Name of student: Allana L. Canty

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Professor David Neumann (Associate Supervisor)

Professor David Shum (Principal Supervisor)
Chapter 9: Study 2

Theory of Mind in Early Psychosis and Chronic Schizophrenia

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Abstract

Previous research has consistently demonstrated that individuals with schizophrenia perform poorly on ToM tasks. However, the extent to which ToM abilities deteriorate with illness chronicity is unclear. This study aimed to expand understanding of the nature and types of ToM impairment in individuals with early psychosis \( n = 26 \) and chronic schizophrenia \( n = 32 \). Additionally, this study examined the clinical and neurocognitive correlates of ToM mechanisms, as well as the functional significance of mentalising abilities in these populations. Clinical participants and healthy controls \( n = 30 \) were administered the Virtual Assessment of Mentalising Ability which provides indices of first- and second-order cognitive and affective ToM, and distinguishes ‘overmentalising’ from ‘undermentalising’ as part of a larger neuropsychological and social functioning assessment battery. Results indicated that individuals with early psychosis performed significantly poorer than healthy adults on first-order affective and second-order cognitive and affective ToM, but significantly higher than individuals with chronic schizophrenia on all ToM subscales. Whereas a lack of mental state concept was associated with negative symptoms, poor mental flexibility and poor verbal inhibition, overmentalising was associated with positive symptoms, high mental flexibility and poor verbal inhibition. Results also indicated that ToM impairments have a strong relationship with social functioning which is independent of clinical symptoms and neurocognitive abilities. The findings indicate that ToM abilities may selectively deteriorate with illness chronicity. These results also highlight the value of using multidimensional, ecologically valid measures when investigating ToM in schizophrenia.

Key words: Theory of mind, schizophrenia, early psychosis, virtual reality, assessment.
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Introduction

Social cognition is a high priority topic for research in schizophrenia and related psychotic disorders because it may explain poor functional outcomes (Brüne, 2005). Theory of Mind (ToM), a process subsumed under the broader conceptualisation of social cognition, is a multifaceted construct that refers to the cognitive and emotional functions required to understand and predict other peoples’ mental states and behaviour (Mancuso, Horan, Kern, & Green, 2011). Research has demonstrated that ToM consists of neurobiologically dissociable cognitive and affective subcomponents (Shamay-Tsoory, Tomer, Goklisher, Berger, & Aharon-Peretz, 2004; Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006). Whereas cognitive ToM refers to the ability to make inferences about the beliefs and intentions of others (e.g., understanding that someone may hold a false belief), affective ToM requires an additional appreciation of another person’s subjective emotional context to infer how they are feeling (e.g., inferring an individual may be offended by a rude joke). The cognitive and affective components of ToM can be further broken down into first- and second-order processes. Whereas first-order ToM involves inferring the thoughts and feelings of another person, second-order ToM refers to reasoning about what one person (i.e., other than the self) thinks a third person is thinking or feeling (Shamay-Tsoory et al., 2007).

Recent research has also distinguished between different kinds of ToM errors that may explain poor mentalising performance in individuals with chronic schizophrenia (Abu-Akel & Bailey, 2000; Fretland et al., 2015; Montag et al., 2011). ‘Overmentalising’ refers to the tendency to excessively attribute intentions or self-referential meaning to others and therefore predict behaviour on the basis of misconstrued beliefs (Frith, 2004). Montag et al. (2011) identified two aspects of ‘undermentalising’, whereby individuals can lack the capacity to represent mental states (i.e., no ToM), or have difficulties applying social knowledge despite an intact capacity to represent mental states (i.e., reduced ToM). Results
have been mixed as to whether individuals with schizophrenia have a fundamental ToM deficit, similar to that observed in individuals with autism (Couture et al., 2010), or if they experience accuracy problems that manifest as simplistic mental state inferences that are not contextualised (Pickup & Frith, 2001). Few studies have investigated these different ToM error types in schizophrenia (e.g., Fretland et al., 2015; Montag et al., 2011), which is likely, in part, due to a lack of psychometrically sound measures that allow for a detailed assessment and analysis of aberrant mentalising patterns.

**Theory of Mind in Schizophrenia**

Two systematic reviews (Brüne, 2005; Harrington, Siegert, & McClure, 2005) and recent meta-analyses (Bora & Pantelis, 2013; Bora, Yucel, & Pantelis, 2009; Fett et al., 2011; Sprong et al., 2007) have consistently shown that nearly all published studies report ToM impairment in early psychosis and chronic schizophrenia. Although there is little doubt that individuals with schizophrenia perform poorly on ToM tasks, little is known about the trajectory of ToM impairments over the course of illness.

Preliminary results indicated that ToM impairments of individuals with first-episode psychosis (FEP) were comparable to that of individuals with chronic schizophrenia. Green et al. (2011) explored the stability of first-order ToM ability across prodromal, FEP and chronic schizophrenia. Although results indicated impairment at each stage of illness, there was no evidence of a deterioration or improvement over time. Consistently, Bora and Pantelis (2013) and Couture, Penn, Addington, Woods, and Perkins (2008) found that the first-order cognitive and affective ToM impairments observed in individuals with FEP were comparable to that of individuals in more chronic stages of the illness.

A similar pattern of results has been observed in research comparing the ToM performance of individuals who are in a prodromal phase with that of healthy controls. Although Chung, Kang, Shin, Yoo, and Kwon (2008) and Courture et al. (2008) both
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reported that individuals in a prodromal phase of schizophrenia demonstrated significant impairments on first-order cognitive ToM tasks, Courture et al. (2008) did not observe significant difference between these groups on a measure of first-order affective ToM. With the exception of Courture et al., (2008) these findings suggest that first-order ToM impairments may manifest early in the course of illness in schizophrenia and thus cannot be explained by the effects of illness progression, chronicity, and long-term pharmacotherapy.

Contrary to earlier research (viz., Bora & Pantelis, 2013; Couture et al., 2008; Green et al., 2011) which indicates that ToM impairments are a trait marker of schizophrenia, results of recent research suggest that impairments in first-and second-order ToM differentially deteriorate over the course of illness. Ho et al. (2015) were the first to explicitly examine the extent to which first-and second-order cognitive and affective ToM are impaired in individuals with first FEP and their unaffected siblings. Results indicated that individuals with FEP did not significantly differ from unaffected siblings and healthy controls on indices of first-order cognitive ToM, but performed significantly poorer on measures of first-order affective ToM, and second-order cognitive and affective ToM. These results suggest that first-order cognitive ToM, relative to other ToM subprocesses, may be relatively preserved early in the course of illness.

Divergent findings may be attributable to the varied sensitivity of ToM measures to the spread of mentalising ability in schizophrenia (Brüne, 2005). Thus, research introducing novel paradigms should examine the task’s sensitivity to subtle differences in ToM abilities between early and chronic stages of schizophrenia (Dziobek et al., 2006). The use of such measures may help determine if mentalising subprocesses selectively deteriorate with illness chronicity.

**Theory of Mind and Clinical Symptoms**

The literature demonstrating the selectivity of ToM impairments in relation to
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predominating symptoms provides a mixed picture. Some studies suggest that clinical symptoms are dissociable from ToM impairments (e.g., Drury, Robinson, & Birchwood, 1998; Langdon, Coltheart, & Ward, 2006; Pickup & Frith, 2001), whereas others report associations between symptom clusters and specific ToM subprocesses. Specifically, results of recent research (Abdel-Hamid et al., 2009; Montag et al., 2011; Urbach, Brunet-Gouet, Bazin, Hardy-Baylé, & Passerieux, 2013) and meta-analyses (Sprong et al., 2007; Ventura, Wood, Jimenez, & Hellemann, 2013) have suggested moderate relationships between affective ToM and negative symptoms, and between cognitive ToM and positive and disorganised symptoms. A comparatively smaller pool of research documents no relationship between cognitive ToM and positive symptoms (Corcoran et al., 2008; Langdon et al., 1997; Shamay-Tsoory et al., 2007).

Fretland et al. (2015) investigated the associations between ToM error types (i.e., overmentalising, reduced ToM, and no ToM) and positive, negative, and disorganized symptoms. Results indicated that overmentalising was associated with positive symptoms. Although both undermentalising error types (viz., no ToM and reduced mentalising) were not associated with symptoms, frequency of reduced ToM errors showed a nonsignificant trend in which it is was associated with disorganisation. This finding is, in part, consistent with the results of Montag et al. (2011) who found that positive and negative symptoms were associated with overmentalising and a lack of mental state concept (i.e., no ToM), respectively. These results suggest that error types are associated with specific symptom dimensions. This highlights the importance of using ToM measures that are able to discriminate between aspects of over- and undermentalising to more comprehensively understand the relationship between ToM and clinical symptoms in schizophrenia.

Theory of Mind and Neurocognitive Abilities

A key debate within the experimental literature is whether impaired ToM constitutes a
core feature of schizophrenia, as in autism, or whether it reflects the overall cognitive impairment characteristic of this illness. Deficits in multiple cognitive domains are well established in schizophrenia, particularly executive functions, learning and memory, and attention (Bozikas et al., 2005; Bozikas et al., 2006; Heinrichs & Zakzanis, 1998). Such findings have been corroborated by neuroimaging studies, which have revealed structural and neurochemical abnormalities in the cortical and subcortical brain regions (viz., prefrontal and thalamic regions) thought to subserve cognitive abilities (Antonova et al., 2004; Crespo-Facorro et al., 2000). Interestingly, several brain regions that have been associated with cognitive deficits in schizophrenia have also been implicated in mentalising functions in healthy adults (viz., frontal, Fletcher et al., 1995; Goel et al., 1995; and prefrontal, Gallagher et al., 2000; Vogeley et al., 2001 cortices).

Several studies have explored the putative relationship between ToM and cognitive functioning in schizophrenia. These investigations have reported positive correlations between ToM and memory and attention (Drury et al., 1998; Greig et al., 2004), autobiographical memory (Corcoran & Frith, 2003), executive functions (Corcoran & Frith, 2003), context processing (Schenkel et al., 2005; Uhlhaas et al., 2006), and language (Sarfati et al., 1997). Although these findings suggest a relationship between impaired ToM and cognitive dysfunction, the extent to which ToM impairments are a result of cognitive deficits remains unclear. Abdel-Hamid et al. (2009) found that ToM impairment in patients with schizophrenia or schizoaffective disorder persisted after controlling for IQ and executive functioning. The independence of ToM deficits from IQ, executive functions, and memory has been reported in other experimental studies (Bozikas et al., 2011; Janssen et al., 2003; Langdon et al., 2001; Pickup & Frith, 2001), and in a meta-analysis (Sprong et al., 2007). Conflicting results were reported by Brüne (2003) who found that ToM impairments in patients with disorganized symptoms disappeared once verbal intelligence was controlled.
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Although the majority of these studies support the independence of ToM from other cognitive functions, the variability in statistical methods (i.e., regression analyses vs. covariate analyses), as well as in the circumscribed cognitive domains used as statistical controls (i.e., IQ vs. executive functions, memory, or attention), limit the comparability of their findings, and, consequently, impede the establishment of a robust theory concerning ToM and its relationship to basic cognitive functions.

Given the co-occurrence of cognitive impairment and deficient ToM in schizophrenia, as well as the potential overlap or contiguousness of the brain regions supporting these processes, further attempts to dissociate these abilities would help clarify the extent to which ToM deficits are secondary to overall cognitive dysfunction or are related albeit independent. Furthermore, no research to date has examined if deficits or strengths in cognitive functioning contribute to specific mentalising styles.

Theory of Mind and Social Functioning

Individuals with schizophrenia have profound neurocognitive impairments and psychopathological disturbances that are associated with poor social functioning (Fett et al., 2011). Nevertheless, convincing evidence has emerged to suggest that ToM accounts for more variance in social functioning than either neurocognition or clinical symptoms (Fett et al., 2011; Pijnenborg et al., 2009; Pinkham & Penn, 2006). Further understanding of the functional significance of ToM has likely been hindered by the use of narrow assessments of social functioning, within which functional capacity (i.e., observed competencies) has often not been separated from community functioning (i.e., perceived quality of social engagement) despite increased recognition that this is a critical distinction within other clinical populations (e.g., autism; Bowie, Reichenberg, Patterson, Heaton, & Harvey, 2006).

The aims of this research were threefold. The first aim was to examine the nature, breadth and functional significance of ToM by comparing the mentalising abilities of patients
with early psychosis and chronic schizophrenia and addressing core issues identified with previous studies. This was achieved using the Virtual Assessment of Mentalising Ability (VAMA; Canty, Neumann, Fleming, & Shum, 2015), which provides an index of core and peripheral (i.e., first- and second-order cognitive and affective) mentalising abilities, and quantifies three error types (i.e., no ToM, reduced ToM, and overmentalising). It was hypothesised that (a) first-order ToM processes would be intact whereas second-order ToM processes would be impaired in individuals with early psychosis, and that both first- and second-order ToM processes would be significantly impaired in individuals with chronic schizophrenia. It was also expected that these group differences in ToM performance would be independent of cognitive dysfunction.

Second, this study aimed to examine the relationships between clinical symptoms, neurocognitive abilities, and impairments in specific mechanisms of ToM, as well as clarify the functional significance of mentalising abilities beyond that of neurocognition and clinical symptoms. It was hypothesised that (b) overmentalising and undermentalising would be most strongly associated with positive and negative/disorganised symptoms respectively, (c) that, ToM performance would be associated with neurocognitive abilities, and (d) that ToM performance would account for more variance than neurocognitive abilities and clinical symptoms in both community functioning and functioning capacity for individuals with early psychosis and chronic schizophrenia.

The third aim of this study was to expand on a previous study that examined the psychometric properties of the VAMA (viz., Canty et al., 2015) by exploring the sensitivity of the subscales to diagnostic group distinctions. It was hypothesised that the VAMA would be significantly better at discriminating individuals with early psychosis and chronic schizophrenia from healthy controls than another measure of ToM (viz., the Yoni Task).
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Method

Participants

All clinical participants had a DSM-5 diagnosis (APA, 2013) of schizophrenia and were recruited from either an early psychosis intervention or mental health rehabilitation program in Queensland, Australia. Diagnoses of schizophrenia were determined by medical records and consultation with the participants’ treating psychiatrist. Two independent, experienced psychiatrists scored each participant on the Positive and Negative Syndrome Scale (PANSS). Clinical participants were stabilised on atypical antipsychotic medications for at least 1 month prior to participation.

The early psychosis group (13 males and 13 females) included 15 inpatients and 11 outpatients. All participants within this group had experienced their first psychotic episode within two years of participating in this study, with most individuals (viz., 76%) recovering from their first psychotic episode proximal to the time of participation (i.e., within 3 months of their first treatment by mental health services; range 2-18 months). The chronic schizophrenia group (22 males and 11 females) included 15 inpatients and 18 outpatients. Chronic patients had experienced multiple psychotic episodes and were within 2 to 15 years of illness, with most individuals (viz., 83%) having a duration of illness of between 5-7 years.

All clinical participants understood spoken English sufficiently to comprehend testing procedures and exhibited no physical or language impairment that could adversely affect task performance. Individuals with schizoaffective, schizophreniform, and bipolar disorder, IQ

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2 Inpatients in both the early psychosis and chronic schizophrenia groups were residing in rehabilitative care settings, whereby they were responsible for their activities of daily living (e.g., cooking, cleaning, and washing clothes), optionally engaged in structured social activities and hobbies, and were permitted to take overnight leave from the unit. Given the environment in which inpatients resided was not restricted, assessment of their social functioning was considered comparable to that of outpatients.

3 Allocating participants who were within two years of their illness and had only experienced 1-2 episodes of acute psychosis to the 'early psychosis' group is consistent with what has been done in prior research (viz., Green et al., 2011; Addington, Addington, & Saeedi, 2006). The bimodal distribution of illness duration is more compatible with a cross-sectional design than combining patients into a single group and examining the impact of a continuous "illness progression" (viz., duration of illness) variable on ToM.
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less than 70, or histories of neurological disorder or brain injury (viz., epilepsy, brain tumour, and previous head trauma requiring hospitalisation) were excluded. Individuals were also excluded if there was evidence of alcohol and/or substance abuse in the past 6 months and if psychotic symptoms were drug induced. Sociodemographic, clinical variables, and medication dosage in terms of chlorpromazine equivalent (Simonsen et al., 2011) were gathered from medical records.

Thirty healthy adult controls\(^4\) were recruited via advertisements posted on local community notice boards (\(n = 20\)) and a university student volunteer participation scheme (\(n = 10\)). Exclusion criteria included a previously identified DSM-5 diagnosis of a psychotic, mood, anxiety, or personality disorder, and current or past alcohol or substance dependence. Participants were also individually screened for current psychopathology using the Mini Modified Screen (OASAS, 2001). Participants who reported using psychotropic medication ≤ 6 months prior to participation, or had histories of neurological disorder or brain injury, developmental disability, limited fluency in English, or a first-degree relative with a psychotic disorder were also excluded.

The healthy controls, individuals with early psychosis, and individuals with chronic schizophrenia with comparable with respect to education level (\(F(2, 88) = 1.81, p = .17\)) and gender proportion (\(x^2(2, 88) = 2.17, p = .34\)). Consistent with earlier reports on the demographics of cohorts with schizophrenia (Ochoa, Usall, Cobo, Labad, & Kulkami, 2012), individuals with early psychosis were significantly younger than individuals with chronic schizophrenia (\(t(39.85) = 5.09, p < .001\)) and healthy controls (\(t(36.62) = 3.15, p = .003\)).

Healthy controls and individuals with chronic schizophrenia did not significantly differ on

\(^4\)The 30 healthy control participants described in this study are a subset of a larger sample (\(n = 65\)) that also took part in a previously published study (Canty et al., 2015). Those of the 65 healthy controls described in Canty et al. (2015) which were most similar to the clinical participants in terms of age, gender, and IQ were used in the current study. Specifically, two groups of 15 participants were selected; one to reflect the distribution of age (±1 years), gender (1:1; 2:1) and IQ (± 2 IQ points) of the early psychosis group and one to reflect that of the chronic schizophrenia group. This was to ensure that the control group included participants that reflected both clinical groups.
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age \( t(61) = -1.55, p = .13 \). Although individuals with early psychosis did not differ from healthy controls \( t(43.34) = .48, p = .65 \) or individuals with chronic schizophrenia \( t(57) = -1.98, p = .053 \) on estimated IQ, the IQ of individuals with chronic schizophrenia was significantly lower than that of healthy controls \( t(57.75) = 2.94, p = .005 \). Symptom levels and Chlorpromazine equivalents are comparable to other studies using early psychosis and chronic schizophrenia samples (Fretland et al., 2015; Simonsen et al., 2011). The demographic and clinical features of the clinical participants and healthy controls are summarised in Table 9.1. All participants provided informed written consent to a protocol approved by the institutional research ethics committee (see Appendix B at end of thesis).
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Table 9.1

*Descriptive Statistics for Demographic and Clinical Characteristics of Individuals with Early Psychosis and Chronic Schizophrenia*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Early psychosis(^a)</th>
<th>Chronic schizophrenia(^b)</th>
<th>Healthy controls(^c)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>23.19 (2.84)</td>
<td>31.64 (8.97)</td>
<td>28.27 (8.27)</td>
<td>.001</td>
</tr>
<tr>
<td>Education, years</td>
<td>12.19 (2.02)</td>
<td>11.30 (1.70)</td>
<td>11.57 (1.72)</td>
<td>.17</td>
</tr>
<tr>
<td>Estimated IQ (WASI)</td>
<td>99.04 (12.30)</td>
<td>92.79 (11.88)</td>
<td>100.37 (8.44)</td>
<td>.02</td>
</tr>
<tr>
<td>Duration of illness, years</td>
<td>0.62 (1.21)</td>
<td>10.98 (6.16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of onset, years</td>
<td>22.27 (3.11)</td>
<td>20.91 (5.63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of psychotic episodes</td>
<td>1.62 (1.33)</td>
<td>9.13 (8.56)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive symptoms factor</td>
<td>8.00 (3.48)</td>
<td>11.70 (4.48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative symptoms factor</td>
<td>11.76 (4.54)</td>
<td>13.63 (5.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disorganisation symptoms factor</td>
<td>6.16 (2.82)</td>
<td>8.77 (2.88)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorpromazine equivalent (daily)</td>
<td>466.58 (373.49)</td>
<td>627.14 (399.61)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* PANSS = Positive and Negative Syndrome Scale. WASI = Wechsler Abbreviated Scale of Intelligence. Group differences in age, education, and estimated IQ were assessed using one-way ANOVAs and pairwise comparisons. Group differences in gender proportions was assessed using a chi-square analysis.

\(^a\)\(n = 32\).

\(^b\)\(n = 30\).

\(^c\)\(n = 30\).

\(\alpha = .05\).
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Measures

Symptom assessment. Symptom severity was assessed with the PANSS (Kay, Flszein, & Opfer, 1987). Research examining the factor structure of this scale in psychosis samples (Langeveld et al., 2013) have suggested that the five-factor model proposed by Wallwork, Fortgang, Hashimoto, Weinberger, and Dickinson (2012) has a more optimal fit than the original positive, negative, and general symptom clusters. Given these results, the positive (items P1, P3, P5, G9), negative (items N1, N2, N3, N4, N6, G7) and disorganized (items P2, N5, G11) factors were used to represent these constructs (Fretland et al., 2015).

Theory of mind assessment. The VAMA assesses first- and second-order cognitive and affective ToM (i.e., 10 items per scale) using a virtual interface that simulates the demands of real-life social interactions (Canty et al., 2015). The task involves ongoing and ToM components which are automated by the test taker. The ongoing component requires participants to navigate a virtual shopping centre and complete a list of errands (e.g., post a letter at the post office). The ToM component involves responding to four multiple-choice questions each time a social interaction occurs between the test taker and his/her virtual ‘friends’ (i.e., 10 interactions). Based on the theoretical distinctions offered by Abu-Akel and Bailey (2000), Frith (2004), and Montag et al. (2011), multiple choice response options include content that reflects an accurate interpretation of the interaction, a conceptual deficit (viz., no ToM), difficulty applying mental state knowledge (viz., reduced mentalising), and exaggerated mental state attribution (viz., overmentalising). For the purpose of this study, the scales were scored dichotomously, whereby each accurate ToM response was allocated a score of 1 and all other responses were scored as 0. Scores can range for 0 to 40, with higher scores indicative of better performance. The total number of no ToM, reduced mentalising, and overmentalising responses that participants select is also recorded by the VAMA (i.e., 0 to 40).
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Two neutral interactions are presented after the third and eighth ToM interactions and are followed by questions that require non-mental state reasoning (e.g., “what size shirt did John want to try on?”). These serve as control questions to check accurate encoding of task content and ability to undertake the VAMA. Responses to control scenarios were scored as either correct or incorrect.

The VAMA begins with the option for the test taker to select their gender which, in turn, alters the tone of their avatar’s voice. Administration of the VAMA takes approximately 30 mins including a 10 min introductory tutorial. The VAMA has been found to have strong construct validity, internal consistency, and four week test-retest reliability in a sample of healthy adults (Canty et al., 2015).

The Yoni Task (Shamay-Tsoory et al., 2006) assesses the ability to infer mental states via analysis of verbal cues, eye gaze, and facial expressions. Each trial presents a cartoon face (i.e., Yoni) and four coloured pictures of either objects belonging to a single category (e.g., fruits or transport) or faces. The test taker’s task is to use the available cues to identify the stimuli that Yoni is referring to. Two types of cues may be offered: verbal only (i.e., a sentence that appears at the top of the screen), or a verbal cue combined with an eye gaze cue (see Figure 9.1). There are four conditions: cognitive, affective, inference (i.e., gloating and envy), and physical. The cognitive, affective, and inference conditions involve first- and second-order mental state inferences. The physical condition requires a choice based on the physical proximity of Yoni to a stimulus and serves as a control condition. Performance is rated for accuracy (i.e., correct/incorrect), whereby higher scores are indicative of better ToM performance. Although the Yoni Task has been found to be sensitive to ToM deficits in the schizophrenia population (Kalbe et al., 2010; Shamay-Tsoory et al., 2007), research exploring
its psychometric properties has not been conducted.\footnote{Although conclusions regarding the sensitivity of the VAMA to diagnostic group distinctions relative to other measures would be strengthened by use of measures with established psychometric properties, the Yoni Task is the only existing measure that provides explicit indices of first- and second-order cognitive and affective ToM.}


\textbf{Neurocognitive assessment\footnote{Given the multifaceted nature of cognitive functioning, tasks were selected to provide a broad assessment of the cognitive domains that may account for the types of ToM impairment observed in schizophrenia (Fretland et al., 2015).}.} Commonly used measures with adequate psychometric properties were selected to provide information about separate cognitive domains including attention (Digit Span subtest of the Wechsler Adult Intelligence Scale IV, Wechsler, 2008), mental flexibility (Trail Making Test: Part B; Reitan & Wolfson, 1985), verbal fluency (Controlled Oral Word Association Task; COWAT; Benton, Varney, & Hamsher, 1978), verbal response inhibition (Hayling Sentence Completion Test; Burgess & Shallice, 1997), working memory (Letter Number Sequencing subtest of the Wechsler Memory Scale III;
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LNS; Wechsler, 2003), and estimated IQ (i.e., as measured by the Vocabulary and Matrix Reasoning subtests from the Wechsler Abbreviated Scale of Intelligence II; Wechsler & Hsiao-pin, 2011).

Social functioning assessment. The Social Functioning Scale is a 79-item questionnaire that requires subjective ratings within seven domains of community functioning: social engagement, interpersonal functioning, competence for independent living, performance of independent living tasks, engagement in recreational hobbies, and prosocial behaviour (Birchwood, Smith, Cochrane, Wetton, & Copestake, 1990). Two additional subscales (see Appendix F, at end of thesis) were developed by Canty et al. (2015) to capture the quality of, and emotional availability within, close friendships (5 items) and relationships in the workplace (5 items). Results indicate satisfactory internal consistency for the two additional scales (Canty et al., 2015). An overall rating of perceived community functioning is obtained by summing scores across subscales.

The Social Skills Performance Assessment is a behavioural measure of social skills used to provide an index of functional capacity (Patterson, Goldman, McKibbin, Hughs, & Jeste, 2001). Participants initiate and maintain a conversation for 3 mins in two situations: (a) greeting a new neighbour, and (b) calling a landlord to request a repair for a leak that has gone unfixed despite a previous request. Performances are audio-recorded and scored by a blind rater according to fluency, clarity, focus, negotiation ability, persistence, social appropriateness, and overall conversational ability. An overall index of functional capacity is obtained by summing scores across situations.

Procedure

Participants were individually administered all measures during a 2 hour assessment session. Breaks were taken as required. Tasks were administered in the following order: the VAMA and Yoni Task (counterbalanced), neurocognitive assessment battery, Social Skills
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Performance Assessment, and the Social Functioning Scale. To ensure participants understood the requirements of the ToM tasks, participants were asked to recall their respective instructions prior to starting. Participants were reimbursed AUD$40 and, in the case of student participants, awarded course credit.

Data Analyses

Statistical analyses were carried out using SPSS for Windows (Version 22) and MedCalc (Version 15.8; MedCalc Software). Differences in demographic variables between early psychosis, chronic schizophrenia, and healthy control groups were assessed using chi-square tests and one-way ANOVAs. As estimated IQ and neurocognitive abilities were significantly different between groups and are dissociable from illness chronicity (unlike age and Chlorpromazine equivalent), a composite measure of neurocognition (including IQ; calculated by averaging standardised scores on the measures included in the neurocognitive assessment battery) was used as a statistical control in further analyses. The main and interactive effects between group (chronic schizophrenia, early psychosis, and healthy controls), order (first and second) and ToM type (cognitive and affective) as measured by the VAMA were tested using a $3 \times 2 \times 2$ ANCOVA. Further comparisons were performed using univariate ANCOVAs and the Bonferroni correction was applied ($\alpha = .05 / 8 = .006$). Classification accuracy of ToM tasks was assessed using Receiver Operating Characteristic (ROC) curves. The accuracy of the ROC curve is quantified by calculating the area under the curve (AUC). An AUC of .50 indicates that a test’s diagnostic performance is equal to chance, whereas an AUC of 1.0 indicates perfect diagnostic discrimination (Tabachnick & Fidell, 2007).

Partial correlations between the VAMA and Yoni Task, and the relationships of VAMA frequency/error scores with clinical symptoms and indices of social functioning were evaluated with Pearson’s $r$, with the neurocognition composite used as the statistical control.
Bivariate correlations were used to examine the relationship between VAMA frequency/error scores and neurocognitive abilities. As these correlational analyses are considered exploratory, caution was taken in interpreting the results of analyses significant at $\alpha = .01$ and the magnitude of effects are acknowledged (Cohen, 1992). Hierarchical multiple regression analyses were used to assess the relative contributions of neurocognition, clinical symptoms, and ToM performance, as measured by the VAMA, to functional capacity and community functioning in individuals with early psychosis and chronic schizophrenia.

**Results**

**Theory of Mind Task Performance**

There was no significant difference in accuracy on the VAMA’s control questions between groups ($F(2, 88) = 1.22, p = .30$), indicating that clinical and healthy participants were similar in their comprehension of task content. The ANCOVA results indicated that accuracy did not differ between cognitive and affective ToM, as reflected by the absence of a significant main effect of type ($F(1, 79) = 1.38, p = .24$). Accuracy was poorer for second-order items than for first-order items, as reflected in a significant main effect of order ($F(1, 79) = 93.75, p < .001, n_p^2 = .54$). Further, accuracy differed between groups as reflected in a main effect of group ($F(2, 79) = 76.65, p < .001, n_p^2 = .66$), Group × Type interaction ($F(2, 79) = 3.81, p < .05, n_p^2 = .09$), and Group × Order interaction ($F(2, 79) = 5.27, p < .01, n_p^2 = .12$). Additionally, accuracy on first- and second-order items differed with regards to whether cognitive (less difficult) or affective ToM (more difficult) was being assessed, as indicated by a significant Type × Order interaction ($F(1, 79) = 23.16, p < .001, n_p^2 = .23$). There was no significant Type × Order × Group interaction ($F(2, 79) = 0.59, p = .56$).

Further analyses were conducted to compare Groups across Type and Order by conducting univariate ANCOVAs, controlling for IQ and neurocognition. As seen in Figures 9.2 and 9.3, individuals with early psychosis performed similarly to healthy controls on first-
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order cognitive \((F(1, 52) = 3.02, p = .08)\), but significantly poorer on first-order affective
\((F(1, 52) = 22.57, p < .001, n^2_p = .30)\), second-order cognitive \((F(1, 52) = 57.47, p < .001, n^2_p = .53)\), and second-order affective ToM \((F(1, 52) = 64.68, p < .001, n^2_p = .55)\).

Individuals with chronic schizophrenia performed significantly poorer than individuals
with early psychosis (first-order cognitive, \(F(1, 50) = 10.14, p = .002, n^2_p = .17\); first-order
affective, \(F(1, 50) = 10.70, p = .002, n^2_p = .17\); second-order cognitive, \(F(1, 50) = 8.35, p =
.006, n^2_p = .14\); second-order affective, \(F(1, 50) = 15.71, p < .001, n^2_p = .24\) and healthy
controls across all VAMA subscales (first-order cognitive, \(F(1, 55) = 22.86, p < .001, n^2_p =
.29\); first-order affective, \(F(1, 55) = 53.84, p < .001, n^2_p = .50\); second-order cognitive, \(F(1,
52) = 76.94, p < .001, n^2_p = .58\); second-order affective, \(F(1, 52) = 103.93, p < .001, n^2_p =
.65\).

Significant differences were observed between groups in their frequency of selected error
types. Although individuals with early psychosis and chronic schizophrenia did not
significantly differ from one another, these groups selected significantly more
overmentalising (chronic schizophrenia, \(M = 6.09, SD = 2.73, t(61) = -3.62, p = .001, d =
0.92\); early psychosis, \(M = 7.50, SD = 3.17, t(54) = -5.13, p < .001, d = 1.36\), reduced
mentalising (chronic schizophrenia, \(M = 9.79, SD = 2.36, t(43.93) = -17.59, p < .001, d =
4.36\); early psychosis, \(M = 8.19, SD = 2.79, t(30.51) = -10.93, p < .001, d = 3.01\) and no ToM
(chronic schizophrenia, \(M = 7.42, SD = 2.54, t(32.25) = -15.54, p < .001, d = 3.95\); early
psychosis, \(M = 6.80, SD = 2.96, t(25.07) = -11.03, p < .001, d = 3.11\) errors than healthy
controls (overmentalising, \(M = 3.83, SD = 2.15\); reduced mentalising, \(M = 1.90, SD = 0.99\);
no ToM, \(M = 0.20, SD = 0.48\) ).
Figure 9.2. Performance of clinical and healthy participants on first-order and second-order cognitive ToM as measured by the Virtual Assessment of Mentalising Ability. Error bars represent ± 1 SE.
Participants performed close to ceiling on all subscales from the Yoni Task (see Table 9.2). On the inference condition, individuals with early psychosis performed significantly poorer than healthy controls (mean difference = 1.27, $p = .01$) but significantly higher than individuals with chronic schizophrenia (mean difference = 1.33, $p < .01$).

The sensitivity of the two ToM tasks to diagnostic group distinctions was determined via inspection of ROC curves (see Table 9.3). Pairwise comparisons of the AUCs identified the VAMA as significantly more accurate than the Yoni Task in discriminating individuals with early psychosis and chronic schizophrenia from healthy controls using the first-order affective and second-order cognitive and affective subscales (mean differences = 0.23 to 0.41, $p < .001$). The first-order cognitive subscale of the VAMA was not found to be
significantly more accurate than that of the Yoni Task in discriminating individuals with early psychosis from healthy controls.

**Theory of Mind and Clinical Symptoms**

Table 9.4 summarises the partial correlations between clinical symptoms and VAMA performance (with IQ and neurocognition controlled). Moderate significant correlations were observed between positive symptoms and first-order cognitive and affective and total ToM for both clinical groups. Moderate significant negative correlations were also observed between negative symptoms and second-order affective and total ToM for both clinical groups, and with first-order cognitive ToM for individuals with chronic schizophrenia. Disorganised symptoms also had moderate, significant negative correlations with first-order cognitive ToM for both individuals with early psychosis and chronic schizophrenia.

The frequency of overmentalising errors significantly correlated with positive symptoms for both clinical groups, and with disorganised symptoms (inversely) for individuals with chronic schizophrenia. Frequency of reduced mentalising errors also significantly correlated with disorganised symptoms for individuals with chronic schizophrenia. Frequency of no ToM errors significantly correlated with negative symptoms and positive symptoms (inversely) in both individuals with early psychosis and chronic schizophrenia.
Table 9.2

Mean Response Accuracy on the Yoni Task for Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th>ToM subscales</th>
<th>Early psychosis</th>
<th>Chronic schizophrenia</th>
<th>Healthy control</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-order cognitive</td>
<td>11.72 ± 0.61</td>
<td>11.91 ± 0.29</td>
<td>12.00 ± 0.00</td>
<td>3.96</td>
<td>.02</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>11.32 ± 0.80</td>
<td>11.09 ± 0.91</td>
<td>11.23 ± 1.10</td>
<td>0.43</td>
<td>.65</td>
</tr>
<tr>
<td>First-order affective</td>
<td>11.84 ± 0.37</td>
<td>11.73 ± 0.57</td>
<td>11.97 ± 0.18</td>
<td>2.54</td>
<td>.08</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>11.00 ± 0.91</td>
<td>11.06 ± 0.97</td>
<td>11.30 ± 0.95</td>
<td>0.81</td>
<td>.45</td>
</tr>
<tr>
<td>Inference</td>
<td>9.76 ± 2.59</td>
<td>11.09 ± 0.81</td>
<td>11.03 ± 1.27</td>
<td>5.67</td>
<td>.005</td>
</tr>
</tbody>
</table>

Note. $\alpha = .05 / 5 = .01$. 
### Table 9.3

**Areas under ROC Curves for the Virtual Assessment of Mentalising Ability and Yoni Task for Individuals with Early Psychosis and Chronic Schizophrenia**

<table>
<thead>
<tr>
<th></th>
<th>Chronic Schizophrenia</th>
<th>Early Psychosis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AUC</td>
<td>SE</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>VAMA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.83</td>
<td>.05</td>
<td>.72 - .92</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.96</td>
<td>.02</td>
<td>.88 - .99</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.95</td>
<td>.02</td>
<td>.86 - .99</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.98</td>
<td>.02</td>
<td>.91 - .99</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.99</td>
<td>.01</td>
<td>.93 - 1.0</td>
</tr>
<tr>
<td><strong>Yoni Task</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.55</td>
<td>.03</td>
<td>.42 - .67</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.56</td>
<td>.07</td>
<td>.43 - .69</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.59</td>
<td>.04</td>
<td>.46 - .71</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.57</td>
<td>.07</td>
<td>.44 - .70</td>
</tr>
<tr>
<td>Inference</td>
<td>.53</td>
<td>.07</td>
<td>.40 - .66</td>
</tr>
</tbody>
</table>

*Note.* VAMA = Virtual Assessment of Mentalising Ability. ToM = Theory of mind. AUC = Area under the curve. CI = confidence interval. \( \alpha = .05 / 10 = .005 \)
Table 9.4

Partial Correlations between Clinical Symptoms and Performance on the Virtual Assessment of Mentalising Ability for Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th>VAMA subscales</th>
<th>Positive symptoms</th>
<th>Negative symptoms</th>
<th>Disorganised symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early psychosis</td>
<td>Chronic</td>
<td>Early psychosis</td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.58**</td>
<td>.58**</td>
<td>-.33</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.58**</td>
<td>.55**</td>
<td>-.25</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.27</td>
<td>.26</td>
<td>-.40</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.44</td>
<td>.34</td>
<td>-.61**</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.64**</td>
<td>.55**</td>
<td>-.58**</td>
</tr>
<tr>
<td>Error Types</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overmentalising</td>
<td>.51**</td>
<td>.61**</td>
<td>-.38</td>
</tr>
<tr>
<td>Reduced mentalising</td>
<td>-.13</td>
<td>-.43</td>
<td>-.18</td>
</tr>
<tr>
<td>No mentalising</td>
<td>-.58**</td>
<td>-.52**</td>
<td>.63**</td>
</tr>
</tbody>
</table>

Note. Chronic = Chronic schizophrenia. VAMA = Virtual Assessment of Mentalising Ability. ToM = Theory of mind. Control variable = Neurocognition.

**p < .01.
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Theory of Mind and Neurocognitive Abilities

Table 9.5 summarises the mean performance of clinical participants and healthy controls on measures of neurocognitive ability. Healthy controls performed significantly better than individuals with early psychosis and chronic schizophrenia on indices of verbal fluency, mental flexibility, working memory, and verbal inhibition. Table 9.6 displays the results of the bivariate correlations between VAMA subscales and neurocognitive abilities for individuals with early psychosis and chronic schizophrenia, as well as healthy controls. Verbal fluency significantly correlated with first-order cognitive and affective ToM for individuals with chronic schizophrenia and with second-order cognitive ToM for individuals with early psychosis. Verbal fluency also correlated with total ToM scores for all three groups. Mental flexibility was found to significantly correlate with first- and second-order affective and total ToM for individuals with chronic schizophrenia and with first-order cognitive and total ToM for healthy controls. Working memory significantly correlated with total ToM for individuals with early psychosis.

Mental flexibility was also found to significantly correlate with the frequency of no ToM errors for individuals with chronic schizophrenia and frequency of overmentalising errors (inversely) for individuals with early psychosis. Verbal inhibition was found to significantly negatively correlate with frequency of overmentalising errors for all groups and with frequency of no ToM errors (inversely) for individuals with chronic schizophrenia.
## TABLE 9.5

**Between Group differences on Measures of Neurocognitive Ability**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Mean ± SD</th>
<th>t</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digit span</td>
<td>Healthy controls</td>
<td>Chronic schizophrenia</td>
<td>11.27 ± 2.13</td>
<td>10.79 ± 2.27</td>
<td>0.86</td>
<td>.39</td>
</tr>
<tr>
<td></td>
<td>Early psychosis</td>
<td>Chronic schizophrenia</td>
<td>10.58 ± 2.19</td>
<td>0.36</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>COWAT</td>
<td>Healthy controls</td>
<td>Chronic schizophrenia</td>
<td>45.70 ± 8.67</td>
<td>30.15 ± 7.93</td>
<td>7.44</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Early psychosis</td>
<td>Chronic schizophrenia</td>
<td>35.73 ± 7.07</td>
<td>4.67</td>
<td>&lt; .001</td>
<td>1.26</td>
</tr>
<tr>
<td>Trials B</td>
<td>Healthy</td>
<td>Chronic schizophrenia</td>
<td>52.80 ± 17.44</td>
<td>109.16 ± 36.49</td>
<td>-7.93</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Early psychosis</td>
<td>Chronic schizophrenia</td>
<td>85.27 ± 41.54</td>
<td>-3.71</td>
<td>.001</td>
<td>1.02</td>
</tr>
<tr>
<td>HSCT</td>
<td>Healthy</td>
<td>Chronic schizophrenia</td>
<td>5.90 ± 1.06</td>
<td>4.28 ± 1.61</td>
<td>4.70</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Early psychosis</td>
<td>Chronic schizophrenia</td>
<td>4.19 ± 1.70</td>
<td>4.43</td>
<td>&lt; .001</td>
<td>1.21</td>
</tr>
<tr>
<td>LNS</td>
<td>Healthy</td>
<td>Chronic schizophrenia</td>
<td>20.80 ± 2.36</td>
<td>16.86 ± 3.82</td>
<td>7.74</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Early psychosis</td>
<td>Chronic schizophrenia</td>
<td>17.68 ± 4.03</td>
<td>3.58</td>
<td>.001</td>
<td>0.94</td>
</tr>
</tbody>
</table>

*Note.* COWAT = Controlled Oral Word Association Task. HSCT = Hayling Sentence Completion Test. LNS = Letter Number Sequencing subtest from WMS-III.

α = .05 / 15 = .003
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Table 9.6

Bivariate Correlations between Neurocognitive Abilities and Performance on the Virtual Assessment of Mentalising Ability for Individuals with Early Psychosis and Chronic Schizophrenia and Healthy Controls

<table>
<thead>
<tr>
<th>VAMA subscales</th>
<th>Digit Span</th>
<th>COWAT</th>
<th>Trials B</th>
<th>HSCT</th>
<th>LNS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early</td>
<td>Chronic</td>
<td>Healthy</td>
<td>Early</td>
<td>Chronic</td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.34</td>
<td>.28</td>
<td>.07</td>
<td>.39</td>
<td>.65**</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.16</td>
<td>.25</td>
<td>.11</td>
<td>.39</td>
<td>.50**</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.19</td>
<td>.19</td>
<td>.21</td>
<td>.52**</td>
<td>.26</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.33</td>
<td>.20</td>
<td>.08</td>
<td>.08</td>
<td>.24</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.25</td>
<td>.37</td>
<td>.11</td>
<td>.55**</td>
<td>.61**</td>
</tr>
</tbody>
</table>

Error Types

<table>
<thead>
<tr>
<th></th>
<th>Overmentalis</th>
<th>Reduced mentalising</th>
<th>No mentalising</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.43</td>
<td>-.03</td>
<td>-.31</td>
</tr>
<tr>
<td></td>
<td>.31</td>
<td>-.09</td>
<td>-.41</td>
</tr>
<tr>
<td></td>
<td>.35</td>
<td>-.06</td>
<td>-.28</td>
</tr>
<tr>
<td></td>
<td>.38</td>
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<tr>
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<td>-.38</td>
<td>-.37</td>
</tr>
<tr>
<td></td>
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Note. Chronic = Chronic schizophrenia. COWAT = Controlled Oral Word Association Task. Early = Early psychosis. Healthy = Healthy control group. HSCT = Hayling Sentence Completion Test. LNS = Letter Number Sequencing subtest from WMS-III. ToM = Theory of mind. VAMA = Virtual Assessment of Mentalising Ability.

** p < .01
Theory of Mind and Social Functioning

Partial correlations were performed to explore the relationships between indices of social functioning and ToM subprocesses as measured by the VAMA (with IQ and neurocognition controlled) for individuals with early psychosis and chronic schizophrenia. Moderate significant correlations were observed between overall functional capacity (i.e., the Social Skills Performance Assessment) and first- and second-order cognitive and affective, and total ToM for both clinical groups \(r = .47\) to \(.68, p < .01\). Moderate significant correlations were observed between total perceived community functioning (i.e., the Social Functioning Scale) and first-order cognitive and affective, second-order cognitive, and total ToM for individuals with early psychosis and chronic schizophrenia \(r = .48\) to \(.56, p < .01\). The relationship between second-order affective ToM and total community functioning was not significant for either clinical group \(r = .18\) to \(.30\).

Contributions to Social Functioning in Schizophrenia

Hierarchical multiple regressions were used to assess the extent to which total performance on the VAMA (i.e., ToM) predicted functional capacity and community functioning in early psychosis and chronic schizophrenia, after controlling for neurocognition (including IQ) and clinical symptoms.

Community functioning. The composite measure of neurocognition was entered at Step 1, explaining 12.6\% of the variance in community functioning for individuals with early psychosis \(\Delta F(1, 21) = 3.02, p = .09\) and 28\% for individuals with chronic schizophrenia \(\Delta F(1, 22) = 8.57, p < .01\). After entry of positive, negative, and disorganised symptoms at Step 2, the total variance explained by the model was 41.6\% for individuals with early psychosis \(\Delta R^2 = .29, \Delta F(3, 18) = 2.98, p = .06\) and 43.7\% for individuals with chronic schizophrenia \(\Delta R^2 = .16, \Delta F(3, 19) = 1.77, p = .18\). At Step 3, ToM ability explained an additional 15.7\% of the variance in community functioning for individuals with early
psychosis \((\Delta F(1, 17) = 13.37, p = .002)\) after controlling for neurocognition and clinical symptoms and 19\% for individuals with chronic schizophrenia \((\Delta F(1, 18) = 19.27, p < .001)\). In the final model, only total ToM performance was statistically significant for both individuals with early psychosis \((\beta = .63, p < .001)\) and chronic schizophrenia \((\beta = .48, p < .05)\).

**Functional capacity.** The composite measure of neurocognition was entered at Step 1, explaining 28.3\% of the variance in functional capacity for individuals with early psychosis \((\Delta F(1, 21) = 8.29, p < .01)\) and 34.6\% for individuals with chronic schizophrenia \((\Delta F(1, 22) = 11.65, p = .002)\). After entry of positive, negative, and disorganised symptoms at Step 2, the total variance explained by the model was 53\% for individuals with early psychosis \((\Delta R^2 = .25, \Delta F(3, 18) = 3.15, p = .05)\) and 52.2\% for individuals with chronic schizophrenia \((\Delta R^2 = .18, \Delta F(3, 19) = 26.11, p = .11)\). At Step 3, ToM ability explained an additional 15\% of the variance in functional capacity for individuals with early psychosis \((\Delta F(1, 17) = 31.69, p < .001)\) after controlling for neurocognition and clinical symptoms and 18.3\% for individuals with chronic schizophrenia \((\Delta F(1, 18) = 26.11, p < .001)\). In the final model, only total ToM performance was statistically significant for both individuals with early psychosis \((\beta = .54, p < .001)\) and chronic schizophrenia \((\beta = .61, p < .001)\).

**Discussion**

This study examined the nature, breadth, and functional significance of ToM in early psychosis and chronic schizophrenia by using an ecologically valid virtual reality measure (viz., VAMA) that provides explicit indices of first- and second-order cognitive and affective ToM, as well as quantifies over- and undermentalising error types. Results suggest five main findings. Most significantly, individuals with early psychosis had intermediate performance between healthy controls and individuals with chronic schizophrenia on first-order affective, and second-order cognitive and affective ToM, after controlling for neurocognition. Second,
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The frequency of overmentalising responses was found to significantly correlate with positive symptoms, whereas frequency of undermentalising responses were associated with negative and disorganised symptoms. Third, whereas overmentalising errors were associated with high mental flexibility and low verbal inhibition, no ToM errors were associated with low mental flexibility and low verbal inhibition. Fourth, ToM accounted for unique variance in community functioning and functional capacity beyond that accounted for by neurocognition and clinical symptoms. Lastly, the VAMA, relative to another computerised measure of ToM (viz., Yoni Task), was found to be more sensitive to differences in ToM between healthy adults and individuals with early psychosis and chronic schizophrenia.

Theory of Mind in Schizophrenia

Contrary to expectation, individuals with early psychosis demonstrated a primary deficit in first-order affective ToM, whereas the integrity of first-order cognitive ToM was uncompromised. Impairments in first-order affective ToM are consistent with some previous research (Abu-Akel & Abushua’leh, 2004; Ho et al., 2015; Shamay-Tsoory et al., 2007) and may indicate that affective ToM is affected earlier in schizophrenia. Consistent with expectations, individuals with early psychosis were impaired on indices of second-order ToM relative to healthy controls. Moreover, individuals with chronic schizophrenia performed significantly poorer than individuals with early psychosis and healthy controls on first- and second-order cognitive and affective ToM. Such results corroborate existing evidence for ToM impairments in chronic schizophrenia (Fretland et al., 2015; Montag et al., 2011) and provide new preliminary evidence that ToM abilities selectively deteriorate over the course of illness. Evidence that ToM impairments are present early in the course of illness, as well as during a clinically stable remitted phase of illness, contributes to the argument that they may be a trait marker of schizophrenia.
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ToM and Clinical Symptoms

Consistent with predictions, frequency of overmentalising was associated with greater positive symptoms, frequency of reduced mentalising was associated with greater disorganised symptoms, and frequency of no ToM responses was associated with greater negative symptoms. The associations between positive symptoms and high frequency of overmentalising and low frequency of no ToM errors are complementary and provide support to etiological concepts of delusion formation and maintenance (Frith, 2004). Further, our results corroborate evidence indicating that individuals with high negative symptoms may lack a functional concept of ToM similar to that observed in autism (Fretland et al., 2015). Such findings lend evidence to a more complex ToM impairment in schizophrenia, whereby individuals with dominantly positive, negative, and disorganised symptoms may produce unique types of errors (Fretland et al., 2015; Montag et al., 2011). Nonetheless, it is likely that individuals make both over- and undermentalising errors and have substantial loads on two or more types of symptoms (e.g., positive and disorganised). Future research should examine whether specific symptom profiles (e.g., high positive/high negative vs. low positive/high negative) are associated with particular patterns of ToM errors. Inspecting profiles of error types has the potential to enhance treatments tailored to improving ToM in schizophrenia by informing whether mental state attributions need to be attenuated, refined, or enhanced.

Consistent with previous reports (viz., Corcoran et al., 2008; Montag et al., 2011), the severity of positive symptoms was most strongly associated with cognitive ToM and the severity of negative symptoms was most strongly associated with affective ToM. Furthermore, strong associations were observed between cognitive ToM and the severity of disorganised symptoms which is consistent with Sprong et al. (2007) and Abdel-Hamid et al. (2009). In contrast to research which has found that the association between cognitive ToM
and negative/disorganized symptoms was confounded by executive planning and intellectual deficits (e.g., Abdel-Hamid et al., 2009; Langdon, Coltheart, Ward, & Catts, 2002; Pousa et al., 2008), associations reported in the current study remained significant after controlling for neurocognition and IQ. Taken together, these findings indicate that the psychiatric symptoms of schizophrenia may be, in part, the consequence of impaired ability to mentalise (Fretland et al., 2015; Frith, 2004; Montag et al., 2011). Research that explores the longitudinal relationship between symptoms and mentalising in schizophrenia will contribute to the development of predictive social cognitive models of symptom formation and maintenance.

**Theory of Mind and Neurocognitive Abilities**

As expected, and consistent with Bozikas et al. (2011), group differences in ToM abilities persisted once neurocognition and IQ were controlled. These results suggest that individuals with early psychosis and chronic schizophrenia have a primary impairment in ToM that cannot be explained by low intellectual or neurocognitive deficits and that difficulties with ToM may represent a core characteristic of the illness (Frith, 2004).

It is important to note that aspects of ToM performance did correlate with verbal fluency, mental flexibility, and to a lesser extent with working memory and attention. This is not unexpected given the content and task parameters of the VAMA. Specifically, test takers are required to attend to dialogue and respond to multiple choice questions, which would place demands on verbal abilities and working memory. Furthermore, participants are required to switch between the ongoing and ToM task components, and attend to multiple channels of social information during interactions. Both of these aspects would require mental flexibility. These task features are representative of real-life social discourse. Thus, the VAMA is likely to provide an accurate measure of test takers’ ToM abilities as they manifest in daily life. Reducing these mild to moderate demands on cognitive processes may
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reduce the verisimilitude of the task. Notwithstanding, caution must be taken in interpreting results of the VAMA as a pure representation of test takers’ ToM abilities.

Interestingly, poor mental flexibility was related to the frequency with which individuals with chronic schizophrenia selected ‘no ToM’ responses. This finding indicates that mental flexibility may support mentalising processes. For example, failure to attend to, and integrate multiple channels of information in social situations may result in a reliance on self-referential knowledge or factual content when responding to situations that would benefit from an understanding of a broader context (e.g., faux pas and false belief). On the other hand, it is conceivable that concrete or literal interpretations of social stimuli in schizophrenia might not necessarily mark a complete lack of ToM. Selective inattention towards social cues and diminished social reward salience should also be considered (Montag et al., 2011).

In light of co-occurring difficulties with verbal fluency, no ToM response options may be more easily understood than sentences including mentalising content, and individuals with schizophrenia may fail to inhibit selection of a less cognitively demanding response. This is consonant with the result that strong verbal inhibition is associated with low frequency of no ToM errors, suggesting that individuals who can suppress readily available information to consider the broader context may have more accurate mental state reasoning.

Additionally, poor verbal inhibition was found to be strongly related to frequency of overmentalising errors indicating that difficulty suppressing responses is predictive of the tendency to over-generate hypotheses about other people’s mental states. This result supports research which has identified that accurate ToM inferences are, in part, dependent on the ability to inhibit mental processes associated with response generation (Canty et al., 2015; Carlson, Moses, & Breton, 2002). This is consistent with the finding that poor mental flexibility is also associated with low overmentalising, indicating further that generation of mental states may be supported by the ability to switch between thinking about competing
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cancepts, or consider multiple mental states simultaneously (Frith, 2004). Taken together, evidence that ToM abilities may be supported by cognitive processes is consistent with the results of neuroimaging research that suggests these abilities rely on a shared neural network (viz., Gallagher et al., 2000; Vogeley et al., 2001).

Contributions to Social Functioning

As predicted, ToM emerged as the strongest predictor of social functioning in early psychosis and chronic schizophrenia after accounting for neurocognitive abilities and clinical symptoms. Neurocognition and clinical symptoms made no unique contribution to the prediction of social functioning when ToM was included a predictor. Consistent with prior research, these findings suggest that ToM is a more important predictor than neurocognition and clinical symptoms in predicting both functional capacity and community functioning (Brekke, Kay, Lee, & Green, 2005; Fett et al., 2011; Mancuso et al., 2011; Pijenborg et al., 2009). It should be noted that neurocognition, clinical symptoms, and ToM still left a portion of variance in social functioning unexplained. Relations to the more distal outcome of real-world functioning can be more challenging to detect due to various personal (e.g., motivational and self-efficacy) and socio-environmental (e.g., cultural factors and social support) variables that impact how one performs in social contexts. This highlights the multifactorial causation of poor social functioning in schizophrenia and emphasises the need to explore the potential influence of these limiting factors, along with other potentially more important social cognitive contributors (e.g., empathy) in future research (Fretland et al., 2015).

Implications and Limitations

Utilising an ecological paradigm that assesses across multiple mentalising subprocesses has contributed to the theoretical understanding of how ToM abilities may selectively deteriorate over the course of illness in individuals with schizophrenia. This study is amongst
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the first to clearly demonstrate that individuals with early psychosis are impaired relative to healthy adults on most ToM subprocesses, but maintain higher ToM functioning relative to individuals in more chronic stages of illness. This result partly reconciles divergent theoretical approaches, suggesting that ToM impairments are likely a trait marker of schizophrenia, however the nature and extent of these impairments may vary according to predominant symptoms and stage of illness. Longitudinal research including prodromal samples would advance clinical understanding of the nature and course of ToM impairment in schizophrenia.

Results also demonstrate that the VAMA was significantly more sensitive than an existing measure of ToM (viz., the Yoni Task) to the variation in mentalising abilities observed in individuals with early psychosis and chronic schizophrenia. This result suggests that greater ecological validity may translate into heightened sensitivity to subtle individual variation in ToM performance. Although the VAMA did not clearly distinguish the first-order cognitive ToM abilities of individuals with early psychosis from healthy controls, this is consistent with previous research which has demonstrated that this clinical group does not demonstrate impairments on first-order cognitive ToM tasks (Ho et al., 2015). As first-order cognitive mentalising tasks do not require participants to understand dynamics between multiple characters, they are comparably less demanding on ToM processes than tasks assessing second-order ToM, which require test takers to mentalise about social interactions from a third-person’s perspective. These results extend previous research that explored the psychometric properties of the VAMA (Canty et al., 2015) by providing evidence of the measure’s clinical utility.

Some methodological issues are important when considering the current findings. The first important consideration is that there are a number of between-group differences that could have impacted the findings. Individuals in the early psychosis group were younger and
more likely to be female (1:1 vs. 2:1), had less severe clinical symptoms, and were receiving less antipsychotic treatment than individuals in the chronic schizophrenia group. Nonetheless, medication dosage (viz., Chlorpromazine equivalent) was not associated with ToM performance. Furthermore, a gender effect was not observed on VAMA performance in healthy controls or within the clinical groups sampled for the current study. For these reasons, these variables were not included as controls in the primary analytic models.

Second, as the study did not include a prodromal sample, conclusions concerning the nature and extent of ToM impairment prior to illness onset could not be explored. Further, the use of a cross-sectional design precludes conclusions concerning causality and trajectory of ToM impairments. To identify causality and more conclusive patterns of deterioration in ToM, longitudinal research that monitors the integrity of ToM subprocesses across the course of illness is needed. A parallel concern is the use of a single control group (which was somewhat more closely matched to the chronic schizophrenia group), rather than separate control groups matched to the early psychosis and chronic schizophrenia groups. The single control group design limits the ability to draw strong conclusions regarding the underlying cause of ToM deterioration over the course of schizophrenia, as it does not permit assessment of normal maturational/age-related changes in ToM. Accordingly, an alternative explanation for the between-group differences is that there were combined effects of diagnosis and age on ToM performance. This explanation would be consistent with meta-analytic studies of ToM in schizophrenia which do not report significant differences in effect sizes for ToM performance in recent-onset and chronic schizophrenia samples (e.g., Sprong et al., 2007). Although there is some evidence to suggest that age has no significant effect on ToM performance (Couture et al., 2008; Green et al., 2011), further research is needed to tease out whether progressive changes in ToM abilities are associated with illness chronicity or normative cognitive changes associated with aging.
Third, several studies have demonstrated that individuals with schizophrenia are impaired in recognising emotions (e.g., facial expressions), and that this ability supports mental state inferences (viz., affective ToM; Brüne, 2005; Ofir-Eyal, Hasson-Ohayon, & Kravetz, 2014). Caution should be taken in interpreting group-differences in ToM performance as measured by the VAMA, as these may be explainable by abnormalities in emotion perception/recognition (e.g., visual encoding of facial features). Nevertheless, VAMA items were designed to rely on the interpretation of body language, gestures, and verbal content, with only a small portion of items directly relying on the ability to decode facial expressions. Such variability is representative of real-life discourse and in turn enhances the verisimilitude of the task. Comparatively, the majority of items in the Yoni Task place minimal demands on basic emotion recognition abilities (viz., simplistic happy and sad cartoon faces) which may account for the ceiling effects observed in healthy and clinical participants (Shamay-Tsoory & Aharon-Peretz, 2007). Future research should explore the extent to which performance on the VAMA relies on emotion recognition and perceptual abilities.

Conclusion

In summary, the present findings implicate a primary deficit in ToM abilities in schizophrenia, the nature and extent of which varies with respect to stage of illness. Specifically, individuals with early psychosis were found to have intermediate performance between healthy controls and individuals with chronic schizophrenia after controlling for neurocognition and IQ. Positive and negative/disorganised symptoms were found to have significant correlations with overmentalising and undermentalising respectively. Furthermore, ToM was found to be a more important predictor of community functioning and functional capacity than clinical symptoms and neurocognitive abilities in early and late stages of illness. Evidence of variation in mentalising ability between individuals with early
psychosis and chronic schizophrenia, as well as the functional significance of these abilities, highlight the value of using sensitive, ecologically valid measures when investigating ToM in schizophrenia to comprehensively ascertain an individual’s strengths and challenges.
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Chapter 10: Foreword

Study 2 (Chapter 9) provided convincing evidence that ToM is a stronger predictor of community functioning and functional capacity than neurocognition and severity of clinical symptoms in early psychosis and chronic schizophrenia. Notwithstanding, there was variance within the predictive models left unexplained. Evidence of common associations between empathy, ToM, and social functioning in schizophrenia has been translated into sophisticated theoretical models (viz., the integrative mediation model). One possibility is that reductions in social functioning are the product of a process by which impairments in affective ToM result in deficits in cognitive empathy (Lieberman, 2007; Ofir-Eyal, Hasson-Ohayon, & Kravetz, 2014).

The current study (Study 3) was the first to examine the functional value of cognitive empathy relative to that of ToM, neurocognition, and severity of clinical symptoms in early psychosis and chronic schizophrenia. Additionally, this research expands on an earlier attempt to examine the mediating influence of empathy on the relationship between ToM and social functioning (viz., Sparks, McDonald, Lino, O'Donnell, & Green, 2010) by using an ecological measure of ToM (viz., the VAMA), a theoretical, psychometrically sound self-report measure of cognitive empathy (viz., the EQ), and measures of both community functioning and functional capacity. Findings of this study have implications for the remediation of social cognitive deficits in schizophrenia.
The theorist puzzled and puzzled until his puzzler was sore, and then the theorist thought of something she hadn’t before. What if mentalising she thought, doesn’t work alone to predict the social functioning score? What if mentalising she thought, is carried by the empathy score?
Chapter 10: Study 3

Investigating the Functional Significance of the Relationship between Cognitive Empathy and Affective Theory of Mind

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Abstract

Although prior research has demonstrated the functional value of individual social cognitive processes (viz., emotion recognition and ToM), no research to date has explored the relative contributions of empathy and ToM to social functioning in early and late stages of schizophrenia. The aim of this study was to explore the functional value of cognitive empathy relative to that of ToM, neurocognition, and clinical symptoms in early psychosis and chronic schizophrenia. Furthermore, this study expanded earlier attempts to demonstrate the mediating influence of cognitive empathy on the relationship between affective ToM and social functioning (Sparks, McDonald, Lino, O’Donnell, & Green, 2010). The participants with early psychosis and chronic schizophrenia described in Chapter 9 also participated in the current study. Participants were administered the VAMA and EQ, as part of a larger neuropsychological and social functioning assessment battery. Results indicated that individuals with early psychosis reported their cognitive empathy significantly higher than individuals with chronic schizophrenia. Despite this, ToM emerged as the strongest predictor of social functioning for both clinical groups. There was also preliminary evidence to suggest that cognitive empathy mediates the association between affective ToM and social functioning. These findings highlight the intricate and compounding nature of the social cognition construct, and its’ influences on social functioning in schizophrenia. Thus, the implication of these findings for the remediation of social cognitive deficits in schizophrenia is discussed.
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Introduction

Individuals with schizophrenia often experience severe deficiencies in their everyday functioning that manifest within the domains of independent living, the initiation and maintenance of interpersonal relationships, and vocational functioning (Bellack et al., 2007; Couture, Penn, & Roberts, 2006; Green et al., 2008). Finding treatable determinants of deficits in these functional domains is one of the principal goals in schizophrenia research (Fett et al., 2011). While there has been recent interest in the functional impact and targeted remediation of basic social cognitive impairments in schizophrenia (e.g., facial emotion perception; Horan, Kern, Green, & Penn, 2008), the functional consequences of deficits in more complex social cognitive skills, including ToM and empathy, have been less well studied (Sparks et al., 2010).

As defined in Chapter 6, empathy is a set of distinct processes by which one person attends to the subjective experiences of another person (Bora, Gökcen, & Veznedaroglu, 2008; Zaki, Ochsner, & Ochsner, 2012). This definition alludes to a major dichotomy that, over the last decade, has become a strong catalyst for theoretical and empirical research on empathy. This dichotomy distinguishes between affective empathy with its emphasis on phylogenetically emotional contagion systems, and cognitive empathy with its emphasis on phylogenetically advanced perspective taking which, is arguably subserved by ToM processes (Shamay-Tsoory, 2011; Singer, 2006; Zaki et al., 2012). More specifically, affective empathy refers to vicariously sharing the emotional experiences of others (Decety, 2011; Michaels et al., 2014). Cognitive empathy, on the other hand, refers to a set of reflective processes that include understanding the emotional state of others, distinguishing another’s feelings from one’s own, and being able to integrate this information with social knowledge to adaptively guide interpersonal behaviour (Bernhardt & Singer, 2012; Decety,
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2011; Shamay-Tsoory, 2011). The capacity to accurately empathise is likely to require a coordinated interaction between these subprocesses (Zaki et al., 2012).

Findings concerning the integrity of cognitive and affective empathy in schizophrenia have been mixed. A recent meta-analysis (Achim, Ouellet, Roy, & Jackson, 2011) and empirical research published thereafter (Corbera, Wexler, Ikezawa, & Bell, 2013; Haker, Schimansky, Jann, & Rössler, 2012; Lee, Zaki, Harvey, Ochsner, & Green, 2011; Michaels et al., 2014; Smith et al., 2012; Sparks et al., 2010) consistently indicates that individuals with chronic schizophrenia report diminished cognitive empathy relative to healthy adults. Although most self-report studies indicate that individuals with schizophrenia are similar to healthy adults on measures of affective empathy (Achim et al., 2011; Haker et al., 2012; Michaels et al., 2014; Singh, Pineda, & Cadenhead, 2011), others have found that this clinical group reports diminished empathic concern and/or heightened personal distress (Lee et al., 2011; Shamay-Tsoory, Aharon-Peretz, & Levkovitz, 2007; Shamay-Tsoory, Shur, et al., 2007; Sparks et al., 2010).

Montag, Heinz, Kunz, and Gallinat (2007) assessed the relationship between duration of illness and ratings of cognitive empathy in schizophrenia. Results indicated a significant decrease in empathic perspective taking ratings with increased duration of illness. However, duration of illness has not been found to have a significant relationship with ratings of the self-orientated and other-oriented affective components of empathy (Montag et al., 2007) or global empathy (Bora, Yucel, & Pantelis, 2009). The more consistent findings for cognitive versus affective empathy in schizophrenia are largely echoed in studies using other assessment methods, including behavioural performance (Derntl et al., 2009; Dernt et al., 2012; Smith et al., 2014), fMRI (Lee et al., 2010; Smith et al., 2014; Horan, Pineda, et al., 2014), and electrophysiological tasks (McCormick et al., 2012; Corbera et al., 2013; Horan, Wynn, et al., 2014).
Contrary to results reported for individuals with more chronic schizophrenia, Achim et al. (2011) found that ratings of cognitive and affective empathy did not significantly differ between individuals with FEP and healthy controls. These results were compared to previous studies of empathy in individuals with chronic schizophrenia via a meta-analysis. For the index of cognitive empathy, results revealed a significantly lower effect size for differences between individuals with FEP and healthy controls relative to those reported in studies comparing healthy controls with individuals with chronic schizophrenia. These results suggest that the cognitive component of empathy is less affected early in the course of illness, and that this ability may deteriorate with illness chronicity.

**Relationship between Empathy and Theory of Mind**

Kalbe et al. (2007) and Singer, Critchley, and Preuschoff (2009) proposed that affective ToM (i.e., the ability to infer others’ feelings) is a prerequisite of cognitive empathy. Intuitively, to appreciate and understand another’s subjective emotional experience, an individual needs to first correctly infer the mental state and emotions of the person with whom they are interacting. An emerging body of empirical research has provided preliminary confirmation of this association. Mathersul, McDonald, and Rushby (2013) reported that cognitive empathy was positively associated with affective ToM performance in high-functioning adults with ASD. Further, cognitive empathy has been shown to be related to affective ToM in individuals with vmPFC damage (Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003) and schizophrenia (Shamay-Tsoory, Shur et al., 2007). Similarly, Shamay-Tsoory et al. (2005) found affective ToM to be significantly correlated with total empathy scores in individuals with damage to the vmPFC, but when affective and cognitive empathy were separated, only cognitive empathy was correlated with affective ToM performance.
The aforementioned results are consonant with those reported within neuroimaging research, which indicate, albeit not conclusively, that affective ToM and cognitive empathy are subserved by a shared neural network (Shamay-Tsoory, Aharon-Peretz, et al., 2007). Dvash and Shamay-Tsoory (2014) and Smith et al. (2014) independently reported activation in areas previously found to be associated with cognitive (i.e., mPFC, superior temporal sulcus, and temporal poles) and affective (i.e., vmPFC) ToM, during cognitive empathy trials. Interestingly, Lough et al. (2006) found that individuals with frontotemporal dementia (which can include damage to the vmPFC) demonstrated impaired emotion recognition, cognitive ToM, and cognitive and affective empathy, but unimpaired affective ToM. Although Lough et al.’s (2006) results support the dissociation between cognitive empathy and affective ToM, confirmation of the dynamic link between affective ToM and cognitive empathy was not apparent. This inconsistency may reflect heterogeneity within the sample (e.g., varying levels of atrophy within the vmPFC) and the limited sensitivity of the measures used to assess affective ToM. Notwithstanding, these findings provide preliminary support for the theoretical association between cognitive empathy and affective ToM.

Neurocognitive and Clinical Correlates of Empathy in Schizophrenia

Although researchers generally agree that schizophrenia is associated with impairments in social cognition (e.g., ToM and empathy), the underlying mechanisms of these impairments are debated (Shamay-Tsorry et al., 2007). Multidimensional theories of empathy in schizophrenia suggest that alterations in the empathic response may reflect impairment in a number of cognitive processes. Specifically, Decety and Jackson (2004) emphasized the relationship between empathy and cognitive flexibility, by suggesting that mental flexibility to adopt someone else’s point of view is an effortful and controlled process that permits the diversion of attentional resources away from the default mode of reasoning about others, which is biased toward self-perspective and egocentricity. Additionally,
individuals are required to be able to shift a course of thought or action according to the demands of a social situation. Such flexibility may be essential for the empathic response as it allows an individual to adopt another person’s point of view. This theoretical reasoning has been supported by evidence that impaired empathy was significantly correlated with measures of cognitive flexibility, as opposed to other neuropsychological measures, such as visuospatial perception and verbal abstract reasoning (Grattan & Eslinger, 1989; Shamay-Tsoory et al., 2003). These results provide an early but promising indication that deficits in specific aspects of empathy (viz., cognitive empathy) may reflect a breakdown in neurocognitive processes.

Research examining the relationships between empathy and clinical symptoms in schizophrenia has returned mixed results. Correlations have been observed between global ratings of empathy and negative symptoms in individuals with chronic schizophrenia (Shamay-Tsoory, Aharon-Peretz, et al., 2007; Shamay-Tsoory, Shur, et al., 2007). When empathy subcomponents were examined separately, however, no significant correlations were observed between cognitive and affective empathy ratings and positive, negative, or general psychopathology scales on the PANSS for individuals with FEP (Achim et al., 2011) or chronic schizophrenia (Derntl et al., 2009). Using a newly developed measure of cognitive and affective empathy (viz., the QCAE), Michaels et al. (2014) found a significant relationship between cognitive empathy and disorganized symptoms in individuals with chronic schizophrenia ($r = -.36, p < .01$). As indicated above, little research has directly examined the neurocognitive and clinical correlates of empathy in early psychosis and chronic schizophrenia. As such, these relationships serve as a fruitful area for future research that is interested in the mechanisms that contribute to reduced empathic performance in schizophrenia.
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Relationship between Empathy and Social Functioning

There is preliminary evidence to suggest that empathy impairments, like other components of social cognition, account for a considerable portion of variance in the poor functional outcomes reported by individuals with schizophrenia. Smith et al. (2012) examined the relative contributions of self-reported empathy, neurocognitive deficits, and clinical symptoms to social functioning in schizophrenia. Results indicated that lower cognitive empathy, deficits in working and episodic memory, and greater disorganized symptoms were associated with lower scores on indices of functional capacity and community functioning. Self-reported cognitive empathy explained significant incremental variance in both functional capacity ($\Delta R^2 = .09, p < .05$) and community functioning ($\Delta R^2 = .15, p < .01$) after accounting for relevant neurocognitive and psychopathological variables. The consistency of these findings across interview- and performance-based measures of functioning suggests that cognitive empathy likely influences the extent and quality of social functioning observed in populations with schizophrenia.

In a similar study, Michaels et al. (2014) found that both cognitive and affective empathy showed significant positive relationships with social functioning in individuals with schizophrenia, but only cognitive empathy accounted for significant variance in social attainment beyond that accounted for by neurocognition and severity of clinical symptoms ($\Delta R^2 = .11, p < .01$). Further, there was a pattern, although not-significant, indicating that affective empathy accounted for incremental variance in social attainment ($\Delta R^2 = .06, p = .07$). Taken together, these findings support the presence and functional significance of impaired cognitive empathy in schizophrenia.

Theory of Mind and Social Functioning

A detailed review of the relationship between ToM and social functioning in schizophrenia was provided in Chapters 5 and 8. Results consistently indicated that ToM
impairments are associated with poor social functioning (Fett et al., 2011; Canty, Neumann, & Shum, in prep). Most relevant to the current study is the relationship between affective ToM and social functioning. Significant moderate correlations have been reported between affective ToM, as measured by the Faux Pas Recognition Test, and self-reported community functioning ($r = .55, p < .001$), and was found to be a stronger predictor of community functioning than both severity of clinical symptoms and neurocognitive abilities (Pijnenborg et al., 2009). Similar results were reported by Zhu et al. (2007) who found that affective ToM was significantly associated with self-reported ratings of independent living ($r = .35 \text{ to } .38, p < .05$) and engagement in employment ($r = .37 \text{ to } .38, p < .05$) within a Chinese sample of individuals with schizophrenia. Furthermore, Canty et al. (in prep) observed associations between first- and second-order affective ToM as measured by the VAMA and measures of functional capacity and community functioning ($r = .18 \text{ to } .52$) in individuals with early psychosis and chronic schizophrenia. Contrary to these results, Shamay-Tsoory, Shur, et al. (2007) did not find a significant relationship between affective ToM, as measured by the Yoni Task, and a measure of community ability.

Mixed findings regarding the relationship between affective ToM and social functioning may be related to the ecological validity of the methods used to assess ToM. For example, the VAMA was rated as having stronger verisimilitude than the Yoni Task, and in turn was found to have a much stronger and consistent pattern of relationships with indices of social functioning in a sample of healthy adults (Canty, Neumann, Flemming, & Shum, 2015). As such, future research should use measures that include immersive naturalistic stimuli, as this will more likely provide sensitive indices of mentalising ability that are predictive of functional outcomes (Canty et al., in prep).

**Theory of Mind, Empathy, and Social Functioning**

The integrative mediation model described by Ofir-Eyal, Hasson-Ohayon, and Kravetz
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(2014) can be adapted to explain the decline in social functioning commonly observed in individuals with schizophrenia (see Figure 10.1). According to the adapted version of this model, reductions in social functioning may be the product of a process by which impairments of cognitive empathy are contingent on impairments of affective ToM. That is, cognitive empathy and the resulting attainment and maintenance of adaptive social functioning are based upon the ability to infer the emotional experiences of others and integrate these with contextual cues, by means of affective mental state decoding. Therefore, impaired affective mental state decoding is considered a precursor of impaired cognitive empathy. This impairment, in turn, is expected to affect social functioning. For example, the interpersonal problems of persons with schizophrenia may emerge because their interpretation of the goals, intentions, and emotions of others do not lead to accurate empathic understanding and emotional displays congruent with the other persons’ emotional experience. In turn, inaccurate empathising can reduce the fluidity, intimacy, and quality of social interactions (Harvey, Zaki, Lee, Ochsner, & Green, 2013; Lee et al., 2011).

Figure 10.1. The integrative mediation model. The red lines represent the adapted portion of the model to account for the mediating influence of cognitive empathy on the relationship

The new relationships described in the adapted integrative mediation model are supported by preliminary results within the schizophrenia literature that demonstrate moderate associations between measures of affective ToM and cognitive empathy (Mathersul et al., 2013) and between these social cognitive processes and social functioning (Fett et al., 2011; Mancuso, Horan, Kern, & Green, 2011; Michaels et al., 2014). Only one study to date has attempted to explicitly test whether empathy mediates the relationship between social cognition (viz., emotion recognition and ToM) and social functioning. Utilising a sample of 30 individuals with schizophrenia or schizoaffective disorder, Sparks et al. (2010) found that impairment in the comprehension of sarcasm (i.e., cognitive ToM) was associated with higher empathic personal distress (i.e., affective empathy), and lower recreational functioning. However, empathy could not be explored as a mediator of the association between social cognition and functional outcome due to a lack of common associations with functional outcome measures. The poor construct validity of the measures used to assess empathy (viz., the IRI) may have contributed to this outcome. Further, the TASIT utilises verbal social communication, predominantly sarcasm, to indicate ToM capabilities. As this measure does not explicitly distinguish between cognitive and affective ToM, the relationship between cognitive empathy and affective ToM could not be explored. Future research should utilise sensitive, multidimensional measures of ToM and empathy that permit further exploration of the potential mediating role of empathy on the mentalising-social functioning relationship.

Aims and Hypotheses

The primary aim of this study was to examine the added value of cognitive empathy
above that of ToM, neurocognition, and severity of clinical symptoms in predicting social functioning in early psychosis and chronic schizophrenia. Although research has identified links between these social cognitive processes and social functioning separately, this research represents the first attempt to explore the relative contributions of both empathy and ToM to social functioning across early and late stages of psychotic illness. Based on the findings of Michaels et al. (2014) and Smith et al., (2012) it was anticipated that individuals with early psychosis will report their cognitive empathy significantly higher than that of individuals with chronic schizophrenia. It was also expected that cognitive empathy would account for a unique portion of variance in social functioning for both clinical groups, after controlling for first- and second-order cognitive and affective ToM, neurocognition and clinical symptoms.

This research also sought to evaluate the adapted portion of the integrative mediation model (Ofir-Eyal et al., 2014) in early psychosis and chronic schizophrenia. That is, the mediating influence of cognitive empathy on the relationship between affective ToM and social functioning was explored utilising a sensitive and ecological measure of ToM (viz., the VAMA), a theoretical, psychometrically sound self-report measure of cognitive empathy (viz., the EQ), and measures of both community functioning and functional capacity. It was anticipated that: (a) cognitive empathy would significantly correlate with affective ToM and indices of social functioning, (b) affective ToM would significantly correlate with social functioning, and (c) cognitive empathy would mediate the association between affective ToM and social functioning (viz., community functioning and functional capacity) for both individuals with early psychosis and chronic schizophrenia (see Figure 10.2; Ofir-Eyal et al., 2014; Sparks et al., 2010).
Method

The current study was conducted as a part of the research described in Chapter 9. As there is considerable overlap in the participants, materials and methods, only additions to the content in Chapter 8 are described in detail.

Participants

The participants with early psychosis and chronic schizophrenia described in Chapter 9 also participated in the current study.

Measures and Procedure

The measures of clinical symptoms, ToM (viz., the VAMA), neurocognitive abilities (viz., attention, verbal fluency, mental flexibility, verbal response inhibition, and working memory), estimated IQ, functional capacity, and community functioning, which were described in Chapters 8 and 9, were also used in the current study.

The Empathy Quotient (EQ; Baron-Cohen, 2003; Baron-Cohen & Wheelwright, 2004) was identified as the best measure of cognitive empathy available at the time of commencing the current study. As discussed in Chapter 6, the EQ is psychometrically sound, reflective of modern conceptualisations of cognitive empathy, and has been shown to be sensitive to variations in empathy abilities in the schizophrenia population (Allison, Baron-
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Cohen, Wheelwright, Stone, & Muncer, 2011; Bora et al., 2008; Didehbani et al., 2012). The three-factor, 15 item scale confirmed by Muncer and Ling (2006) was used to provide indices of cognitive empathy (items 25, 26, 44, 52, 54), emotional reactivity (items 4, 8, 12, 14, 35) and social skills (items 6, 27, 32, 50, 59). The remaining items were excluded. Muncer and Ling (2006) reported moderate to strong internal consistency for two of the three subscales (viz., $\alpha = .84$ for cognitive empathy and $\alpha = .76$ for emotional reactivity). The internal consistency for the social skills subscale, however, was below benchmark standards ($\alpha = .57$, Nunnally & Bernstein, 1994). These subscales have also been shown to have good test-retest reliability ($r = .84, p < .001$; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004).

Responses were given on a forced choice scale ranging from strongly agree to strongly disagree. As shown as an example item in Figure 10.3, responses were scored in the suggested manner, with participants receiving a mark of 0 if one of the two ‘non-empathic’ responses were selected, 1 for an attenuated empathic response and 2 for a strong empathic response. Higher scores reflect higher perceived empathic abilities.

| I can tune into how someone else feels rapidly and intuitively |
|----------------------------------|---------------|-----------|----------------|
| Strongly agree | Slightly agree | Slightly disagree | Strongly disagree |
| 2 | 1 | 0 | 0 |

Figure 10.3. Example item and corresponding scoring from the cognitive empathy subscale of the Empathy Quotient.

All participants provided informed written consent to a protocol approved by the institutional research ethics committee (see Appendix B at end of thesis). Participants were individually administered all measures during a 2-hour assessment session. Breaks were
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taken as required. The EQ was administered after the ToM tasks and prior to the neurocognitive assessment battery. Participants were reimbursed AUD$40.

Data Analyses

All raw data were screened according to the procedures outlined by Tabachnick and Fidell (2007). Given that IQ and neurocognitive abilities were significantly different between individuals with early psychosis and chronic schizophrenia and are dissociable from illness chronicity (unlike age and Chlorpromazine equivalent), a composite measure of neurocognition (including IQ) was used as a statistical control in all analyses. Group differences in empathic abilities, as assessed by the EQ, were explored using univariate ANCOVAs with the composite measure of neurocognition used as the covariate. The assumption of equality of variances was met.

Partial correlational analyses (Pearson’s r) were performed to explore the relationships between EQ subscales and duration of illness, medication dosage (i.e., chlorpromazine equivalent), positive, negative, and disorganised symptoms of schizophrenia, first- and second-order cognitive and affective ToM, and indices of social functioning (with neurocognition controlled). Bivariate correlations were used to explore the relationships between EQ subscales and neurocognitive abilities. All correlational analyses were performed separately for individuals with early psychosis and chronic schizophrenia. As these correlational analyses are considered exploratory, corrections for Type I errors resulting from multiple comparisons were not performed. Rather, caution will be taken by interpreting results using a more conservative alpha (i.e., at α = .01) and acknowledging the size of effects (Cohen, 1992).

Separate hierarchical multiple regressions were conducted for individuals with early psychosis and chronic schizophrenia to investigate the extent to which ToM and cognitive empathy account for incremental variance in functional capacity and community functioning,
after controlling for neurocognitive abilities and severity of clinical symptoms. The composite measure of neurocognitive abilities was entered as Step 1. Positive, negative and disorganised symptoms were entered at Step 2. Total ToM performance on the VAMA (i.e., first- and second-order cognitive and affective ToM) and cognitive empathy on the EQ were entered at Steps 3 and 4, respectively. The mediated effect of affective ToM (i.e., composite of first- and second-order indices) on community functioning and functional capacity, via cognitive empathy, was tested using the Baron and Kenny’s (1986) four-step approach, with neurocognition and clinical symptoms entered as covariates. In the absence of a sufficient sample size, tests of indirect effects (e.g., using the 95% bias-corrected bootstrap procedure; Preacher & Hayes, 2004) were considered inappropriate.

Results

Demographic and Clinical Variables

The clinical and demographic characteristics of the individuals with early psychosis and chronic schizophrenia, as well as their mean performance on the VAMA and measures of neurocognitive abilities, are reported in Chapter 9.

Cognitive empathy and emotional reactivity, but not social skills, were significantly and negatively associated with duration of illness (see Table 10.1). No relationship was identified between empathy and medication dosage. High cognitive empathy was moderately associated with low disorganised symptoms in individuals with early psychosis and high positive symptoms in individuals with chronic schizophrenia. However these relationships were not significant at a more conservative alpha (i.e., $\alpha = .01$).
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Table 10.1

Partial Correlations between Empathy and Clinical Characteristics of Schizophrenia

<table>
<thead>
<tr>
<th></th>
<th>Cognitive empathy</th>
<th>Emotional reactivity</th>
<th>Social skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Psychosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of illness</td>
<td>-.58**</td>
<td>-.46**</td>
<td>-.17</td>
</tr>
<tr>
<td>Chlorpromazine equivalent</td>
<td>-.16</td>
<td>-.34</td>
<td>-.28</td>
</tr>
<tr>
<td>Positive symptoms factor</td>
<td>.37</td>
<td>-.07</td>
<td>.21</td>
</tr>
<tr>
<td>Negative symptoms factor</td>
<td>-.27</td>
<td>.18</td>
<td>.21</td>
</tr>
<tr>
<td>Disorganised symptoms factor</td>
<td>-.51*</td>
<td>.06</td>
<td>-.13</td>
</tr>
<tr>
<td><strong>Chronic Schizophrenia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of illness</td>
<td>-.62**</td>
<td>-.47*</td>
<td>-.24</td>
</tr>
<tr>
<td>Chlorpromazine equivalent</td>
<td>-.02</td>
<td>-.20</td>
<td>.10</td>
</tr>
<tr>
<td>Positive symptoms factor</td>
<td>.46*</td>
<td>-.34</td>
<td>.04</td>
</tr>
<tr>
<td>Negative symptoms factor</td>
<td>.37</td>
<td>-.03</td>
<td>.04</td>
</tr>
<tr>
<td>Disorganised symptoms factor</td>
<td>-.31</td>
<td>.20</td>
<td>.11</td>
</tr>
</tbody>
</table>

Note. Control variable = Neurocognition.
* $p < .05$.
** $p < .01$.

Self-Reported Empathy in Schizophrenia

Participants’ mean ratings of cognitive empathy, emotional reactivity, and social skills, as measured by the EQ, are summarised in Figure 10.4. The ANCOVA results indicated that individuals with early psychosis rated their cognitive empathy ($F(1, 50) = 10.83, p = .002, \eta^2_p = .18$) and their emotional reactivity ($F(1, 50) = 5.59, p < .05, \eta^2_p = .10$) significantly higher than did individuals with chronic schizophrenia. Significant differences were not observed between groups on self-reported ratings of social skills ($F(1, 50) = .29, p = .59$).
Factors Associated with Empathy in Early Psychosis and Chronic Schizophrenia

**Empathy and neurocognitive variables.** As shown in Table 10.2 significant moderate correlations were observed between cognitive empathy and an index of working memory in individuals with early psychosis, and with indices of attention, verbal fluency, and mental flexibility in individuals with chronic schizophrenia. A significant moderate correlation was also observed between estimated IQ and emotional reactivity for individuals with early psychosis.
Table 10.2

Bivariate Correlations between Empathy and Neurocognitive Abilities for Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th>Cognitive Abilities</th>
<th>Empathy</th>
<th>Emotional Reactivity</th>
<th>Social Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early psychosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit span</td>
<td>.28</td>
<td>.09</td>
<td>.08</td>
</tr>
<tr>
<td>COWAT</td>
<td>.46*</td>
<td>.11</td>
<td>.16</td>
</tr>
<tr>
<td>Trials B</td>
<td>-.40*</td>
<td>-.11</td>
<td>-.02</td>
</tr>
<tr>
<td>LNS</td>
<td>.61***</td>
<td>.31</td>
<td>.02</td>
</tr>
<tr>
<td>HSCT</td>
<td>.04</td>
<td>-.11</td>
<td>-.37</td>
</tr>
<tr>
<td>Estimated IQ</td>
<td>.31</td>
<td>.52**</td>
<td>.36</td>
</tr>
<tr>
<td><strong>Chronic schizophrenia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit span</td>
<td>.43**</td>
<td>.17</td>
<td>.11</td>
</tr>
<tr>
<td>COWAT</td>
<td>.60***</td>
<td>.03</td>
<td>-.05</td>
</tr>
<tr>
<td>Trials B</td>
<td>-.49**</td>
<td>-.09</td>
<td>.02</td>
</tr>
<tr>
<td>LNS</td>
<td>.24</td>
<td>-.09</td>
<td>.10</td>
</tr>
<tr>
<td>HSCT</td>
<td>-.19</td>
<td>.22</td>
<td>.21</td>
</tr>
<tr>
<td>Estimated IQ</td>
<td>.29</td>
<td>-.25</td>
<td>-.16</td>
</tr>
</tbody>
</table>

Note. COWAT = Controlled Oral Word Association Test. HSCT = Hayling Sentence Completion Task. LNS = Letter Number Sequencing Subtests of the Wechsler Memory Scale-III.

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Empathy and theory of mind. As shown in Table 10.3 significant moderate correlations were observed between cognitive empathy and second-order cognitive and total ToM for individuals with early psychosis, and with first-order cognitive and total ToM for
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individuals with chronic schizophrenia. Significant moderate correlations were also observed between social skills and second-order affective ToM for individuals with early psychosis. Although other small to moderate correlations were observed between the EQ and VAMA subscales, particularly between cognitive empathy and affective ToM, these were not significant at $\alpha = .01$.

Table 10.3

Partial Correlations between the Virtual Assessment of Mentalising Ability and Empathy Quotient Subscales for Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th></th>
<th>Cognitive empathy</th>
<th>Emotional reactivity</th>
<th>Social skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early psychosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive ToM</td>
<td>.39</td>
<td>-.01</td>
<td>.46*</td>
</tr>
<tr>
<td>First-order affective ToM</td>
<td>.46*</td>
<td>-.04</td>
<td>.14</td>
</tr>
<tr>
<td>Second-order cognitive ToM</td>
<td>.52**</td>
<td>-.01</td>
<td>-.10</td>
</tr>
<tr>
<td>Second-order affective ToM</td>
<td>.30</td>
<td>-.21</td>
<td>-.53**</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.65***</td>
<td>-.01</td>
<td>.08</td>
</tr>
<tr>
<td><strong>Chronic schizophrenia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive ToM</td>
<td>.65***</td>
<td>.09</td>
<td>.11</td>
</tr>
<tr>
<td>First-order affective ToM</td>
<td>.45*</td>
<td>.05</td>
<td>-.12</td>
</tr>
<tr>
<td>Second-order cognitive ToM</td>
<td>.44*</td>
<td>.46*</td>
<td>.04</td>
</tr>
<tr>
<td>Second-order affective ToM</td>
<td>.48*</td>
<td>.25</td>
<td>.18</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.65***</td>
<td>.15</td>
<td>.16</td>
</tr>
</tbody>
</table>

*Note.* ToM = Theory of mind. Control variable = Neurocognition.

* $p < .05$.

** $p < .01$.

*** $p < .001$. 
Social cognitive correlates of social functioning. As seen in Table 10.4 cognitive empathy scores were significantly and moderately associated with indices of functional capacity and community functioning in individuals with early psychosis and chronic schizophrenia. No significant relationships were identified between indices of social functioning and the EQ emotional reactivity and social skills subscales.

Moderate significant correlations were observed between first- and second-order cognitive and affective ToM and functional capacity for both individuals with early psychosis and chronic schizophrenia (see Table 10.5). First-order cognitive and affective ToM also had significant medium associations with self-reported community functioning for both groups. Further, second-order cognitive and total ToM performance significantly and moderately correlated with ratings of community functioning for both individuals with early psychosis and chronic schizophrenia.

Table 10.4

Partial Correlations between Empathy Quotient Subscales and Indices of Social Functioning for Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th></th>
<th>SFS</th>
<th>SSPA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early psychosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive empathy</td>
<td>.66***</td>
<td>.61***</td>
</tr>
<tr>
<td>Emotional reactivity</td>
<td>.09</td>
<td>.02</td>
</tr>
<tr>
<td>Social skills</td>
<td>.19</td>
<td>.01</td>
</tr>
<tr>
<td><strong>Chronic schizophrenia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive empathy</td>
<td>.67***</td>
<td>.68***</td>
</tr>
<tr>
<td>Emotional reactivity</td>
<td>.27</td>
<td>.21</td>
</tr>
<tr>
<td>Social skills</td>
<td>.36</td>
<td>.36</td>
</tr>
</tbody>
</table>
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Note. Control variable = Neurocognition. SFS = Social Functioning Scale. SSPA = Social Skills Performance Assessment.

** p < .01.
*** p < .001.

Table 10.5

Partial Correlations between Theory of Mind Subscales and Indices of Social Functioning for Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th></th>
<th>SFS</th>
<th>SSPA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Psychosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.55**</td>
<td>.56**</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.48**</td>
<td>.52**</td>
</tr>
<tr>
<td>Second-order cognitive</td>
<td>.47**</td>
<td>.57**</td>
</tr>
<tr>
<td>Second-order affective</td>
<td>.30</td>
<td>.50**</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.52**</td>
<td>.66***</td>
</tr>
<tr>
<td><strong>Chronic Schizophrenia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-order cognitive</td>
<td>.48**</td>
<td>.62***</td>
</tr>
<tr>
<td>First-order affective</td>
<td>.42*</td>
<td>.52**</td>
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<tr>
<td>Second-order cognitive</td>
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<td>.47**</td>
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<tr>
<td>Second-order affective</td>
<td>.18</td>
<td>.48**</td>
</tr>
<tr>
<td>Total ToM</td>
<td>.56***</td>
<td>.68***</td>
</tr>
</tbody>
</table>

Note. Control variable = Neurocognition. SFS = Social Functioning Scale. SSPA = Social Skills Performance Assessment. ToM = Theory of mind.

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

Regression Analyses

Tables 10.6 and 10.7 summarise the hierarchical regressions examining the contributions of ToM and cognitive empathy to community functioning and functional
capacity, beyond that of neurocognition and severity of clinical symptoms for individuals with early psychosis and chronic schizophrenia. The first three steps of these regressions (viz., entry of neurocognition, clinical symptoms, and ToM) are the same as those reported in Chapter 9 (Study 2). To prevent repetition, only the findings associated with empathy (viz., Step 4 in the models) and the total models are described.

**Community functioning.** When added to the model, cognitive empathy accounted for 9% incremental variance in community functioning for individuals with early psychosis ($\Delta F(1, 16) = 78.73, p < .001$), and 10% for individuals with chronic schizophrenia ($\Delta F(1, 17) = 98.16, p < .05$). In the final models, both total ToM performance ($\beta = .39, p < .001$) and cognitive empathy ($\beta = .31, p < .001$) explained significant variance in community functioning for individuals with early psychosis and chronic schizophrenia ($\text{ToM } \beta = .43, p < .001$; cognitive empathy $\beta = .33, p < .001$).

**Functional capacity.** When added to the model, cognitive empathy accounted for 5.9% incremental variance in functional capacity for individuals with early psychosis ($\Delta F(1, 16) = 15.96, p = .001$) and 7.9% for individuals with chronic schizophrenia ($\Delta F(1, 17) = 18.62, p < .001$). In the final model, both total ToM performance ($\beta = .52, p = .005$) and cognitive empathy ($\beta = .48, p = .001$) explained significant variance in functional capacity for individuals with early psychosis and chronic schizophrenia ($\text{ToM } \beta = .49, p < .001$; cognitive empathy $\beta = .21, p < .01$).
### Table 10.6

Hierarchical Regression Analyses for Incremental Prediction of Community Functioning in Individuals with Early Psychosis and Chronic Schizophrenia

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step 1</th>
<th></th>
<th></th>
<th>Step 2</th>
<th></th>
<th></th>
<th>Step 3</th>
<th></th>
<th></th>
<th>Step 4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
<td>SE B</td>
</tr>
<tr>
<td><strong>Early Psychosis</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurocognition</td>
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### THEORY OF MIND IN SCHIZOPHRENIA

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*Note.* First- and second-order cognitive and affective ToM as measured by the Virtual Assessment of Mentalising Ability.

* $p < .05$

** $p < .01$.

*** $p < .001$. 
**THEORY OF MIND IN SCHIZOPHRENIA**

**Table 10.7**

*Hierarchical Regression Analyses for Incremental Prediction of Functional Capacity in Individuals with Early Psychosis and Chronic Schizophrenia*

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| **Chronic Schizophrenia**    |        |        |        |        |        |        |        |        |        |
| Neurocognition               | 1.58   | .46    | .47**  | 1.28   | .45    | .48    | .37    | .34    | .14    |
| Positive symptoms            | .48    | .43    | .28    | .03    | .29    | .02    | .02    | .10    | .02    |
| Negative symptoms            | .35    | .35    | .19    | .11    | .24    | .06    | .13    | .07    | .07    |
| Disorganised symptoms        | .15    | .63    | .05    | .27    | .42    | .09    | .01    | .13    | .00    |
### THEORY OF MIND IN SCHIZOPHRENIA

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**Note.** $^a$First- and second-order cognitive and affective ToM as measured by the Virtual Assessment of Mentalising Ability.

* $p < .05$

** $p < .01$

*** $p < .001$. 
THEORY OF MIND IN SCHIZOPHRENIA

Mediation Models

According to the statistical procedures described by Baron and Kenny (1986), mediation is present when the following conditions are met, (a) the independent variable (affective ToM) significantly predicts the proposed mediator (cognitive empathy), as described in Path A, (b) the proposed mediator (cognitive empathy) significantly predicts the dependant variable (social functioning), as described in Path B, and (c) the independent variable (affective ToM) significantly predicts the dependent variable (social functioning), as described in Path C, but this relationship is substantially minimised, or is no longer significant, when the proposed mediator (cognitive empathy) is added as an independent variable in the multiple regression model. The mediational model described in Figure 10.1 was tested according to these requirements.

Community Functioning

Early psychosis. As seen in Figure 10.5, results for Path A indicated that affective ToM was positively and significantly associated with cognitive empathy for individuals with early psychosis ($\beta = .65, p < .001; R^2 = .74$). In the second model, which assessed Path B, a significant relationship was observed between cognitive empathy and community functioning ($\beta = .63, p < .001; R^2 = .64$). Results for Path C (without the mediator) indicated a significant positive association between affective ToM and social functioning ($\beta = .82, p < .001; R^2 = .67$). In the final model, the third analysis was repeated with the inclusion of the proposed mediator (cognitive empathy) in the model (see Table 10.8) and was found to be a significant predictor of community functioning. The standardised beta-weight for affective ToM decreased from .82 ($p < .001$) to .16 ($p = .23$) in the fourth model, indicating that cognitive empathy mediated the relationship between affective ToM and community functioning for individuals with early psychosis.
**Chronic schizophrenia.** The aforementioned steps were repeated for individuals with chronic schizophrenia (see Figure 10.6). Results for Path A indicated that affective ToM was positively and significantly associated with cognitive empathy ($\beta = .78, p = .002; R^2 = .70$). Results for Path B indicated a highly significant relationship between cognitive empathy and community functioning ($\beta = .58, p < .001; R^2 = .47$). Results for Path C (without the mediator) indicated a significant positive association between affective ToM and community functioning ($\beta = .73, p < .01; R^2 = .63$). As seen in Table 10.8, cognitive empathy remained a significant predictor in the final model, but affective ToM no longer contributed significantly to the variance in community functioning. The standardised beta-weight for affective ToM decreased from .73 ($p < .01$) to .11 ($p = .23$) in the fourth model, indicating that cognitive empathy mediated the relationship between affective ToM and community functioning for individuals with chronic schizophrenia.

Table 10.8

*Mediating Effect of Cognitive Empathy on the Relationship between Affective Theory of Mind and Community Functioning for Individuals with Early Psychosis and Chronic Schizophrenia*

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<td>.78</td>
<td>14.36</td>
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*Note.* Affective ToM = Composite of first- and second-order VAMA subscales. Dependent variable = Total scores on the Social Functioning Scale. Control variables = neurocognition and clinical symptoms.
**Figure 10.5.** Path model depicting influence of cognitive empathy on the relationship between affective theory of mind and community functioning for individuals with early psychosis. Path coefficients represent standardised beta-weights. The coefficient below the path from affective ToM to social functioning represents the direct effect without the mediator in the model, and the coefficient above the path represents the direct effect when the mediator is included in the model.

** Figure 10.6.** Path model depicting influence of cognitive empathy on the relationship between affective theory of mind and community functioning for individuals with chronic schizophrenia. Path coefficients represent standardised beta-weights. The coefficient below the path from affective ToM to social functioning represents the direct effect without the mediator in the model, and the coefficient above the path represents the direct effect when the mediator is included in the model.

**Functional Capacity**

**Early psychosis.** As seen in Figure 10.7, results for Path A indicated that affective ToM was positively and significantly associated with cognitive empathy for individuals with...
early psychosis ($\beta = .65, p < .001; R^2 = .74$). In the second model, which assessed Path B, a significant relationship was observed between cognitive empathy and functional capacity ($\beta = .74, p < .001; R^2 = .76$). Results for Path C (without the mediator) indicated a significant positive association between affective ToM and functional capacity ($\beta = .78, p < .001; R^2 = .79$). In the final model, the third analysis was repeated with the inclusion of the proposed mediator (cognitive empathy) in the model (see Table 10.9) and was found to be a significant predictor of functional capacity. The standardised beta-weight for affective ToM decreased from .78 ($p < .001$) to .64 ($p = .001$) but remained statistically significant in the fourth model. Although these results indicate that cognitive empathy may partially mediate the relationship between affective ToM and functional capacity, the inclusion of the mediator in the model did not have a large influence on the predictive value of affective ToM. Thus, the influence of cognitive empathy should be interpreted with caution.

**Chronic schizophrenia.** The aforementioned steps were repeated for individuals with chronic schizophrenia (see Figure 10.8). Results for Path A indicated that affective ToM was positively and significantly associated with cognitive empathy ($\beta = .78, p = .002; R^2 = .70$). Results for Path B indicated a highly significant relationship between cognitive empathy and functional capacity ($\beta = .55, p < .001; R^2 = .68$). Results for Path C (without the mediator) indicated a significant positive association between affective ToM and functional capacity ($\beta = .75, p = .002; R^2 = .71$). Cognitive empathy remained a significant predictor in the final model, but affective ToM no longer contributed significantly to the variance in functional capacity. The standardised beta-weight for affective ToM decreased from .75 ($p = .002$) to .01 ($p = .94$) in the fourth model, indicating that cognitive empathy mediated the relationship between affective ToM and functional capacity for individuals with chronic schizophrenia.
Table 10.9

Mediating Effect of Cognitive Empathy on the Relationship between Affective Theory of Mind and Functional Capacity for Individuals with Early Psychosis and Chronic Schizophrenia

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Note. Affective ToM = Composite of first- and second-order VAMA subscales. Dependent variable = Total scores on the Social Skills Performance Assessment. Control variables = neurocognition and clinical symptoms.

Figure 10.7. Path model depicting influence of cognitive empathy on the relationship between affective theory of mind and functional capacity for individuals with early psychosis. Path coefficients represent standardised beta-weights. The coefficient below the path from affective ToM to social functioning represents the direct effect without the mediator in the model, and the coefficient above the path represents the direct effect when the mediator is included in the model.

** p < .01.

*** p < .001.
Figure 10.8. Path model depicting influence of cognitive empathy on the relationship between affective theory of mind and functional capacity for individuals with chronic schizophrenia. Path coefficients represent standardised beta-weights. The coefficient below the path from affective ToM to social functioning represents the direct effect without the mediator in the model, and the coefficient above the path represents the direct effect when the mediator is included in the model.

**p < .01.
***p < .001.

Discussion

This study successfully examined the functional impact of cognitive empathy relative to that of ToM, neurocognition, and severity of clinical symptoms, in early psychosis and chronic schizophrenia. Results indicated three key findings which supported earlier predictions. First, individuals with early psychosis reported significantly higher cognitive empathy than individuals with chronic schizophrenia. Second, ToM emerged as a stronger predictor of social functioning than cognitive empathy, neurocognition, and clinical symptoms. Third, there was preliminary evidence to suggest that affective ToM is a prerequisite of cognitive empathy, and that cognitive empathy mediates the association between affective ToM and social functioning.

Self-Reported Empathy Abilities in Schizophrenia

The finding that individuals with early psychosis report their cognitive empathy and emotional reactivity significantly higher than do individuals with chronic schizophrenia are consistent with the results reported by Achim et al. (2011) and Montag et al., (2007) and may
THEORY OF MIND IN SCHIZOPHRENIA

indicate that cognitive empathy is less impacted in the early stage of illness. These findings are also consistent with reports that individuals with chronic schizophrenia have difficulty with the amplification (but not suppression) of emotionally expressive behaviour and that subjective experiences of emotions decline with illness progression (Henry et al., 2007; Shamay-Tsoory, Shur, et al., 2007). Furthermore, these findings are consonant with evidence that individuals with chronic schizophrenia show diminished performance on behavioural and physiological measures of emotional reactivity, such as spontaneous mimicry of others’ observable emotional expressions or behaviours (Sestito et al., 2015; Varcin, Bailey, & Henry, 2010). Research that tracks the integrity of cognitive (and ideally affective) empathy across prodromal and remitted phases of illness, as well as comparing the abilities of individuals with early psychosis and chronic schizophrenia to those of appropriately matched healthy control participants, will contribute to a more sophisticated understanding of the nature and evolution of empathy impairment in schizophrenia.

Correlates of Empathy in Schizophrenia

The current study examined whether empathy was related to clinical symptoms, neurocognitive abilities, and ToM in early psychosis and chronic schizophrenia. No significant correlations emerged between any aspect of empathy and the positive, negative, and disorganized symptom factors on the PANSS. This finding converges with prior studies to suggest that disturbances in empathy are not related to psychotic state-related changes (Achim et al., 2011; Montag et al., 2007), but rather reflect a trait-like disturbance in schizophrenia. Although not significant at a more conservative alpha level, there was preliminary evidence to suggest that high cognitive empathy is moderately associated with low levels of disorganized symptoms in early psychosis and high levels of positive symptoms in chronic schizophrenia ($p < .05$). This is consistent with previous reports of inverse associations between cognitive empathy and disorganised symptoms (Michaels et al., 2014;
THEORY OF MIND IN SCHIZOPHRENIA

Sparks et al., 2010). Such results may indicate that the capacity to articulate one’s emotional understanding is associated with psychological coherence. Conversely, other studies have reported no association between cognitive empathy and disorganization or reality distortion (Achim et al., 2011; Haker & Rössler, 2009). Given the limited research on these relationships, additional examination is needed.

Consistent with Smith et al. (2012), emotional reactivity was positively correlated with estimated IQ in individuals with early psychosis. This result suggests that individuals with more general cognitive limitations may be less likely to accurately process the emotional significance of negative events and are less equipped to demonstrate emotional reactions congruent with the experiences of others facing adversity. Consistent with previous studies that have found that executive functioning correlates with cognitive empathy (Shamay-Tsoory et al., 2003), higher cognitive empathy was associated with better performance on indices of attention, verbal fluency, and mental flexibility in chronic schizophrenia. These associations were also observed for individuals with early psychosis, although most of the observed relationships did not remain significant when using a more conservative alpha criterion ($\alpha = .01$). Interestingly, cognitive empathy was associated with performance on a measure of working memory for individuals with early psychosis, but not individuals with chronic schizophrenia. This discrepancy may reflect the limited variability in performance on the measure of working memory (i.e., floor effects) observed for individuals with chronic schizophrenia. Nevertheless, these results indicate that an individual’s ability to engage in, and demonstrate understanding of, another person’s emotional point of view may be supported by the capacity to identify and use emotionally informed dialogue (i.e., verbal fluency) and, attend to and incorporate incoming contextual cues (i.e., attention, working memory), whilst maintaining a clear self-other distinction (i.e., mental flexibility).
Small to moderate associations between cognitive and affective components of ToM and cognitive empathy were observed in this study, indicating that mentalising processes likely contribute to the empathy abilities reported by individuals with schizophrenia. This result supports a key premise of the adapted integrative mediation model (Ofir-Eyal et al., 2014). That is, mental state decoding and affective perspective taking (i.e., affective ToM) are important for understanding and adapting to the subjective emotional experience of others (i.e., cognitive empathy).

**Empathy and Social Functioning**

Previous studies in schizophrenia suggest that some aspects of social cognition, particularly ToM, distinctly contribute to poor social functioning above and beyond the contributions of cognitive dysfunction and clinical symptoms (e.g., Roncone et al., 2002; Pinkham & Penn, 2006; Brüne, Schaub, Juckel, & Langdon, 2011). The current study extended this research by indicating that cognitive empathy, a key social cognitive process that has received relatively limited attention in schizophrenia, is a valuable consideration when explaining social functioning in early psychosis and chronic schizophrenia. Consonant with previous research (Michaels et al., 2014; Smith et al., 2012; Smith et al., 2014), cognitive empathy was found to account for incremental variance in social functioning (viz., community functioning and functional capacity) in early psychosis and chronic schizophrenia after controlling for neurocognition and clinical symptoms.

Although cognitive empathy was found to significantly contribute to social functioning in schizophrenia, ToM emerged as the strongest predictor of social functioning in the final models for both clinical groups. This result may reflect an advantage for ToM versus cognitive empathy in predicting social functioning. However, this result may also reflect the breadth of the variables used. The ToM predictor was a composite of first- and second-order cognitive and affective performance on the VAMA, whereas the cognitive empathy predictor
reflected scores on an individual subscale from the EQ. As such, the predictive value of empathy may have been equal or greater to that of ToM if the total EQ score had been used. As the current research was interested in the functional value of empathy, and emotional reactivity and social skills are arguably not key components of empathy (Decety & Jackson, 2004), they were not included in the analyses.

The finding that ToM was a stronger predictor of social functioning than cognitive empathy may also reflect the measures used to assess these constructs. The VAMA is a more cognitively demanding task, assesses ‘online’ mentalising processes, and provides objective, performance-based scores. In contrast, cognitive empathy was measured using an offline, self-report questionnaire, which is a simpler, less cognitively demanding task and scores reflect subjective interpretations of abilities. As such, the relative contributions of empathy and ToM to social functioning should be clarified using more comparable measures.

Mediation Model

As noted previously, the only study to date to attempt to assess the mediating influence of cognitive empathy on the relationship between social cognition and social functioning in schizophrenia found no evidence of common associations between these variables, and thus could not proceed with the mediation analysis (Sparks et al., 2010). Sparks et al. (2010) proposed that this result was likely a function of the low sensitivity of their self-report measure of social functioning. To overcome this problem, participants’ functioning (viz., community functioning and functional capacity) was assessed using observation- and interview-based measures. According to Baron and Kenny’s (1986) criteria, the present results indicated that cognitive empathy qualified as a mediator of the relationship between affective ToM and community functioning in early psychosis and chronic schizophrenia, and between affective ToM and social functioning for individuals with chronic schizophrenia. These results provide preliminary support for the adapted portion of the
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The integrative mediation model (Ofir-Eyal et al., 2014) and indicate that affective ToM is a prerequisite of cognitive empathy. That is, the capacity to understand and adapt one’s affective behaviour to the subjective experience of those with whom we interact is secondary to being able to predict their thoughts, beliefs, and intentions. Although accurate mental state reasoning may promote appreciation and understanding of another’s subjective experience, it is the latter social cognitive process that translates into positive functional outcomes.

Interestingly, cognitive empathy was observed to only partially mediate, at best, the relationship between affective ToM and functional capacity in individuals with early psychosis. Although the significance of affective ToM in predicting functional capacity decreased when cognitive empathy was added to the model, this reduction was minimal. As such, the mediating influence of cognitive empathy on this relationship is unclear. One possible explanation for this finding is that the associations between affective ToM, cognitive empathy, and functional capacity are, in part, supported by emotion recognition abilities. This explanation is consistent with the integrative mediation model, which suggests that affective ToM, and the resulting ability to demonstrate understanding of others’ emotional experiences, may be based upon the ability to identify emotional experiences by means of the affective content in physical and vocal expressions (Ofir-Eyal et al., 2014). This explanation is also consistent with results of previous research that demonstrate that emotion recognition is less impaired in early psychosis compared to chronic schizophrenia (Kucharska-Pietura, David, Masiak, & Phillips, 2005). Nonetheless, this explanation is speculative and further research is needed to examine other factors (viz., emotion recognition) which may be contributing to the relationships between affective ToM, cognitive empathy, and social functioning in early psychosis and chronic schizophrenia.

Although the magnitudes of the observed associations within the models are promising, they were based on small heterogeneous samples. Accordingly, the mediating
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influence of cognitive empathy on the relationship between affective ToM and social functioning must be accepted with caution. Furthermore, the generalisability of this finding across inpatient and outpatients, as well as how the observed relationships differ with respect to predominant symptom profiles (e.g., predominantly positive or negative symptoms) is unknown. Further research with larger sample sizes is needed to confirm the influence of cognitive empathy and explore other potentially more important social cognitive mechanisms underpinning the observed association between affective ToM and social functioning (e.g., emotion recognition). Specifically, study designs that allow for structural equation modelling will contribute to a more comprehensive understanding of the intricate ways in which impaired emotion recognition and clinical symptoms contribute to impaired ToM, and in turn impact social functioning.

Implications and Limitations

Research that explores the relationships between social cognitive domains can develop clinical and theoretical understanding of the nature and functional impact of these abilities in psychotic illnesses. The present results indicate that cognitive empathy and ToM may have equivalent value as treatment targets to neurocognition, and possibly clinical symptoms, for functional recovery-oriented interventions. The consistency of findings across measures of community functioning (i.e., what a person actually does) and functional capacity (i.e., what a person can do) indicates that cognitive empathy may be a strong predictor of the extent to which an individual with schizophrenia can function adaptively and independently (Smith et al., 2012). Emerging evidence indicates that social cognitive deficits are amenable to psychosocial intervention in schizophrenia (Kurtz & Richardson, 2012). There is also growing interest in psychopharmacological approaches to enhancing social cognition (Carter et al., 2009; Goldman, Gomes, Carter, & Lee, 2011; Rosenfeld, Lieberman, & Jarskog, 2011). The inclusion of cognitive empathy and ToM in these treatment development
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efforts may achieve greater improvements in social cognition and overall functioning in early psychosis and chronic schizophrenia.

Although our findings provide insight into the relationship between social cognitive domains and social functioning, they must be interpreted in the context of some limitations. First, the absence of a healthy control group within the design of the present study precludes discussion of whether the self-reported empathy of individuals with early psychosis and chronic schizophrenia is abnormal. Furthermore, the cross-sectional design of this study prevents conclusions about whether empathy dysfunction has a causal relation to poor social functioning. The inclusion of healthy control and prodromal comparison groups, or using large cohorts within a longitudinal design, could elucidate whether empathy impairment, as reported in prior research (Bora et al., 2009; Fett et al., 2011), is stable or evolves with illness progression, shows treatment resistance, and changes with clinical symptomatology.

Second, it is important to note that the current findings are based on self-reported levels of empathy. Specifically, the EQ measures individuals' beliefs about their own empathic skills, and the ratings of people with deficits in awareness or knowledge of their cognitive abilities (meta-cognition) could be unreliable. Montag et al. (2007) noted that the applicability of self-ratings of empathic abilities in schizophrenia remain unclear, particularly given issues related to insight in this population (Konstantakopoulos et al., 2014; Ng, Fish, & Granholm, 2015). Nevertheless, the EQ was identified as the most theoretical and psychometrically sound measure of cognitive empathy available at the time that this study was conceived and executed. Furthermore, studies using alternative methods, such as behavioural and functional neuroimaging tasks, suggest that individuals with schizophrenia show impairments in multiple processes that underlie empathy, including emotional contagion, emotion attribution, and empathic accuracy (Benedetti et al., 2009; Brüne et al., 2011; Derntl et al., 2009; Lee et al., 2011). It remains to be determined how the cognitive
empathy subscale and other subscales of the EQ relate to these processes in schizophrenia. Future research employing comprehensive measures that tap into these, and other distinct cognitive and affective empathy processes, may help clarify the scope of empathic disturbances in schizophrenia, their relations to other aspects of social cognition, and the psychological and neural mechanisms through which empathy predicts functional outcome.

Third, although significant associations were observed between cognitive empathy and indices of social functioning, the modest sample sizes may have limited the ability to detect meaningful relations between these indices and other processes assessed by the EQ. A priori power analyses, based on effect sizes previously reported in the literature (r = .26 to .47; Fett et al., 2011; Sparks et al., 2010), indicated that larger sample sizes (n = 52) would have provided greater power for regression analyses. Notwithstanding, previous researchers have acknowledged the difficulties inherent in recruiting large samples of clinical participants, and proceeded to perform mediational analyses with less than optimal sample sizes (n = 41, Chung, Matthews, & Barch, 2011; n = 27, Ownsworth, Henderson, Chambers, & Shum, 2009).

Conclusion

In conclusion, these findings provide further support for the functional significance of cognitive empathy in early psychosis and chronic schizophrenia. These findings also contribute to emerging evidence that cognitive empathy is less affected in the early stage of schizophrenia. Preliminary evidence was found to suggest that affective ToM is a prerequisite of cognitive empathy, and that cognitive empathy mediates the relationship between affective ToM and social functioning. Efforts to target these processes in social cognitive training programs for schizophrenia may be a useful way to enhance the generalisability of these interventions to real-life settings (Kurtz & Richardson, 2012; Michaels et al., 2014). Further clarification of how cognitive and affective empathy are impacted, and continued efforts to
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develop theoretical, multidimensional measures of empathy, will contribute to a more sophisticated understanding of empathy processes in schizophrenia.
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After discussing his VAMA results with the clinician and the theorist, the Grinch no longer puzzled and puzzled until his puzzler was sore. Rather, he did something he hadn’t done before. He practiced his mentalising and went and played with the Whos in Whoville, which he enjoyed much more.
Chapter 11: General Discussion

Schizophrenia is a chronic psychotic disorder characterized by impoverished thought processes and deficits in social interaction, communication, and emotional responsiveness (SANE, 2011). Schizophrenia has an estimated prevalence of 7 per 1000 of the adult population in Australia (SANE, 2011) and affects approximately 24 million individuals worldwide (World Health Organisation, 2012). The psychosocial outcomes and quality of life of individuals with schizophrenia are often poor (Fretland et al., 2015). Finding treatable determinants of functional outcomes is a priority in schizophrenia research. Social cognitive impairments have been found to be present before the onset of illness, relatively stable over time, independent of cognitive dysfunction, and more strongly associated with social functioning than neurocognition, with the strongest association found with ToM (Fett et al., 2011). This qualifies ToM as an important target for assessments and interventions that can improve daily functioning for individuals with schizophrenia (Green, Wynn, & Mathis, 2011; Pinkham et al, 2014). Despite a growing test database dedicated to the assessment of mentalising abilities, there is a paucity of ecological measures suitable for use with the schizophrenia population.

The current thesis had five primary foci. The first aim was to develop and validate a virtual reality measure capable of providing comprehensive and ecologically valid profiles of mentalising processes (viz., first- and second-order cognitive and affective) and error types (viz., no ToM, reduced mentalising, and overmentalising) in healthy adults, and individuals with early psychosis and chronic schizophrenia. Results from this thesis indicated that the VAMA has sound internal consistency, test-retest reliability, and construct validity in a sample of healthy adults. Furthermore, the VAMA was found to be more sensitive to diagnostic group distinctions and have higher verisimilitude and veridicality than another computerised measure of ToM (viz., the Yoni Task).
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The second aim of this thesis was to use the VAMA to compare the integrity of ToM processes in early psychosis and chronic schizophrenia. Results indicated that individuals with early psychosis have intermediate performance between individuals with chronic schizophrenia and healthy adults on first-order affective and second-order cognitive and affective ToM. Group differences in ToM abilities persisted once neurocognition and IQ were controlled, indicating that ToM impairment are independent of cognitive dysfunction in early psychosis and chronic schizophrenia. Thus, findings of this research contributed to the theoretical debate about whether ToM impairments reflect a state or trait marker of schizophrenia.

Third, this thesis aimed to clarify the clinical and neurocognitive correlates of ToM abilities and error types in individuals with early psychosis and chronic schizophrenia. Results indicated that performance on the VAMA was associated with neurocognitive abilities (viz., verbal fluency, mental flexibility, and working memory) and the frequency with which clinical participants performed certain types of ToM errors was associated with their clinical symptoms and neurocognitive strengths and weaknesses. These findings also contribute to the state versus trait debate, and were used to discuss whether ToM impairment is primary or secondary to general cognitive deficits.

The fourth and final aims of this thesis were to examine the functional significance of ToM and empathy, respectively. Results indicated that ToM is an important predictor of social functioning in both early psychosis and chronic schizophrenia. Interestingly, ToM was found to have added value in predicting both community functioning and functional capacity that was beyond that accounted for by cognitive empathy, clinical symptoms, and neurocognition. Additionally, this thesis sought to test an adapted social cognitive model of social functioning in schizophrenia (Ofir-Eyal, Hasson-Ohayon, & Kravetz, 2014), and results indicated that the capacity to demonstrate empathic understanding on another’s
situation (i.e., cognitive empathy) mediates the relationship between affective ToM and social functioning. These findings encourage the inclusion of individualised social cognitive training programs in rehabilitative efforts for individuals with schizophrenia.

Theory of Mind Assessment

Compared to existing measures of ToM which have limited evidence of psychometric stability and sensitivity (Brüne, 2005; Montag, Heinz, Kunz, & Gallinat, 2007), the current thesis provides evidence of the reliability, validity, and clinical utility of the VAMA, which in turn positions it as an attractive measure within the assessment literature. Findings indicated that the VAMA has sound internal consistency, test-retest reliability, construct validity, and ecological validity. Specifically, performance on the VAMA was significantly associated with indices of functional capacity and community functioning in both healthy and clinical adult samples, indicating the measure has good veridicality. Participants rated the VAMA as having significantly higher verisimilitude (i.e., reflective of real-life social interactions) than an existing computer-based platform (viz., Yoni Task). Importantly, the VAMA was also found to have greater sensitivity to diagnostic group distinctions than the Yoni Task.

In addition to these preliminary indicators of sound psychometric properties, the VAMA overcomes several limitations of existing assessment platforms. First, whereas other measures typically assess ‘offline’ ToM processes via third-person observations of cartoon or static social stimuli, the VAMA simulates embodied, contextualised interactions, thereby assesses ‘online’ ToM processes (Brüne, 2005; Dziobek, 2012; Montag et al., 2011). The value of the VAMA manifests in this direct engagement of the first-person perspective and the dynamic immersive nature of the environment which situates the participants’ reasoning within an interactive context. As such, performance on the VAMA is more likely than ‘offline’ measures to represent real-world ToM abilities.
Second, with the exception of the MASC, existing measures are narrow in scope, assessing isolated aspects of ToM (e.g., hints or faux pas). Although such measures provide valuable insight into these specific skills, they do not reflect the demands of everyday discourse. Real-life social interactions place multidimensional demands on ToM processes simultaneously, thus verisimilitude is an important characteristic for ToM measures. Furthermore, current theoretical conceptualisations of ToM refer to multiple components, thus measures which examine isolated aspects of ToM are theoretically limited in scope. Although the MASC assesses first-and second-order processes, it does not provide explicit indices of performance in these domains. As such, the VAMA was designed to provide measures of first- and second-order cognitive and affective ToM using a range of mentalising concepts (e.g., hints, sarcasm, false-belief, metaphor, and faux pas).

Third, quantifying error types has increasingly been recognized within the literature as an important aspect of ToM assessment (Dziobek et al., 2006; Montag et al., 2011). Fretland et al. (2015) stated that “one way to bring the field forward is through the use of more sophisticated methods to assess ToM…tasks tend to only be scored in correct/incorrect ToM, which may camouflage the different kinds of ToM errors that explain reduced performance” (p. 43). As such, models which emphasise a detailed analysis of ToM abilities (viz., Abu-Akel & Bailey, 2000; Frith, 2004; Montag et al., 2011) directly informed the scoring methodology of the VAMA. Specifically, the VAMA quantifies two types of undermentalising errors. The first type reflects an inability to represent mental states (i.e., no ToM). Responses in this error category are literal or over-simplistic interpretations of mental state cues. The second type of undermentalising reflects difficulties in applying mental state knowledge (i.e., reduced mentalising). Responses in this error category reflect difficulties in integrating relevant contextual information to facilitate the accurate application of mental state knowledge. The VAMA also quantifies the tendency to excessively ascribe significance...
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to what others perceive as incidental or random events or social inferential reasoning that
goes beyond the bounds of the context (i.e., overmentalising). Responses in this category
often have malevolent, judgmental, jealous, and bitter themes. The value of assessing ToM
along a continuum is evident in the novel associations observed between error types and
clinical symptoms (Montag et al., 2011; Fretland et al., 2015), as well as neurocognitive
abilities. Specifically, findings from the current thesis indicate that overmentalising was
associated with severity of positive symptoms, poor verbal inhibition and high mental
flexibility, whereas a lack of mental state concept was associated with negative symptoms,
poor verbal inhibition and low mental flexibility. These associations provide new insights
into potential causes of the clinical presentation of schizophrenia and may explain the
heterogeneity of ToM impairment that can manifest in this population. Elucidating specific
ToM subprocesses and error types that are most closely related to failures in social
interactions may not only enhance clinical formulations of patients’ difficulties in social
situations, but also guide the design of social cognitive training programs.

Fourth, newly developed measures of ToM are seldom demonstrated to be more
sensitive than existing measures (Dziobek et al., 2006; Klin, 2000). The present research
showed that clinical and healthy adults performed close to ceiling on the Yoni Task, whereas
the VAMA was sensitive to the spread of mentalising ability in these populations.
Furthermore, the VAMA was found to be sensitive to changes in ToM subprocesses between
early psychosis and chronic schizophrenia that was not captured by the Yoni Task. As such,
the VAMA overcomes some of the problems inherent in simple paradigms that are low in
ecological validity and use dichotomous measurement (e.g., ceiling and floor effects).

Overall, the results of this thesis suggest that the VAMA has the potential to contribute
to the literature on the nature, breadth, and functional significance of mentalising abilities in
healthy and clinical populations. Importantly, the VAMA was designed to complement rather
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	han replace existing measures of ToM. Whereas the VAMA would be suitable to provide a holistic and ecologically valid assessment of mentalising subprocesses and styles, measures which assess individual mental state concepts (e.g., the Hinting Task and False Belief Story Task) would be suitable for isolating specific impairments. Confirmation of the existence of these different mentalising problems among individuals with schizophrenia, as well as their functional consequences, emphasises the value of extending clinical assessments beyond traditional neuropsychological measures to include ecological tools that evaluate ToM abilities (Green et al., 2011).

Nature of Social Cognitive Impairment in Schizophrenia

Much of the current knowledge about ToM impairment in early psychosis and chronic schizophrenia, and the stability of these impairments across the course of illness, comes from piecing together fragmented results of individual studies that have focused on specific components of ToM. As these studies vary in methodology, illness duration, and selection criteria (e.g., inclusion of drug-induced psychosis and schizoaffective disorder), conclusions which are based on the comparison of their findings may be misleading. The current thesis makes an important contribution to understanding the nature and course of ToM impairment in schizophrenia by directly comparing the first- and second-order cognitive and affective ToM abilities, as well as error types, of individuals in early and chronic stages of illness.

Of particular interest are differences across ToM subprocesses between patients with early psychosis and chronic schizophrenia. To the best of this candidate’s knowledge, this is the first study to directly compare the first- and second-order ToM abilities of clinically stabilised individuals in early and chronic phases of illness. Whereas individuals with early psychosis demonstrated impaired performance on first-order affective and second-order cognitive and affective ToM, performance on first-order cognitive ToM was comparable to that of healthy adults. Comparatively, individuals with chronic schizophrenia performed
significantly poorer than individuals with early psychosis and healthy adults on both first- and second-order processes. These results indicate that first-order cognitive ToM may be less affected earlier in the course of illness and that increased illness chronicity corresponds with selective declines in ToM. This pattern of findings supports Brüne’s (2003) speculation that declines in ToM may follow the reverse order of ontogenetic acquisition. That is, that patients’ ability to understand faux pas (i.e., first-order affective ToM) may be affected first, whereas comprehension of first-order cognitive ToM problems such as false belief and metaphor may be relatively preserved early in the course of illness (Brüne, 2003).

One possible explanation for the selective deterioration in ToM abilities observed in this research is that individuals who are earlier in their course of illness are less socially isolated, and thus are more frequently engaging with others. Frequent social and occupational contact may encourage practice and maintenance of ToM abilities, or the use of other cognitive skills to compensate for mild ToM impairments. A complementary explanation for the differences in ToM observed between early and chronic stages of schizophrenia is that neural degeneration in the regions thought to subserve cognitive mentalising may occur as a result of illness chronicity, age, and the long-term use of psychotropic medication (Crespo-Facorro, Kim, Andreasen, O’Leary, & Magnotta, 2000; Herold et al., 2008; see Nesvåg et al., 2008 for inconsistent results). As atrophy increases in the regions thought to subserve cognitive ToM, the integrity of these and other ToM abilities may decline.

Evidence of a selective deficit in first-order cognitive ToM supports the theoretical argument that cognitive and affective ToM are dissociable processes. Furthermore, evidence that group differences in ToM abilities persisted after neurocognition and IQ were controlled is consistent with the theoretical argument that the organization of ToM is modular (Fodor, 1983). That is, the processes associated with cognitive and affective mentalising are likely subserved by neural regions which are dissociable from those subserving neurocognitive
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abilities. Contrary to Fodor’s (1983) model, however, evidence of small to moderate associations between ToM subprocesses and measures of neurocognitive abilities indicates that ToM and neurocognition are subserved by a shared neural network which is more consistent with Hardy-Baylé, Sarfati, and Passerieux (2003) perspective. Future research utilising comparable, ecologically valid measures of ToM and neurocognition (e.g., virtual reality measures of executive functioning; Renison, Ponsford, Testa, Richardson, & Brownfield, 2012) in conjunction with new imaging techniques such as hyperscan fMRI (i.e., scans a test-taker whilst they are engaging in interactive paradigms) will help disentangle the neural networks associated with these processes (Dziobek, 2012). Such research will in turn help clarify the validity of the models proposed by Fodor (1983; viz., the ToMM) and Hardy-Baylé et al. (2003).

As previously mentioned, utilising error types to explain the nature of mentalising dysfunction within clinical populations has attracted considerable attention in recent years. The findings of the current research provide convincing support for Abu-Akel and Bailey’s (2000) continuum of ToM impairments in schizophrenia. As predicted by this model, the type of ToM impairment varied amongst clinical participants. Some participants demonstrated a conceptual impairment in ToM with the inability to metacognitively reason about one’s own and others’ mental states as evidenced by a high frequency of no mentalising errors. Other participants demonstrated some ToM ability but had difficulty applying this knowledge, as evidenced by a high frequency of reduced mentalising errors. Lastly, some participants overmentalised, as evidenced by frequently misreading the significance of social cues and selecting erroneous responses. Importantly, most participants selected more than one type of error over the course of the task. Furthermore, it remains unclear whether individuals with schizophrenia can be clustered according to predominant mentalising styles (e.g.,
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‘overmentalisers’), and future research is needed to explore patterns in the types of error responses individuals with schizophrenia select.

The associations observed between clinical symptoms and ToM error types support Frith’s (1992, 2004) conceptualization of schizophrenia symptomatology. Frith (2004) proposed that ToM abilities, by definition, must be available for symptoms of delusion and paranoia to transpire. ToM is inherently linked to the risk of making false conjectures about other people's intentions, for instance, by inferring “too much” or simply by overrating one's personal affectedness in a given social interaction. These theoretical links are consonant with the finding that higher positive symptoms are associated with more frequent overmentalising in early psychosis and chronic schizophrenia. This observed association indicates that individuals with schizophrenia who experience predominantly positive symptoms are capable of applying ToM, but do so in an exaggerated fashion.

The findings of the current thesis, like those of Fretland et al., (2015) suggest that individuals with early psychosis and chronic schizophrenia who experience more severe negative symptoms produce more reduced mentalising errors and those with more severe disorganised symptoms produce more no ToM errors. The associations observed between undermentalising and negative/disorganized symptoms, support Frith’s (1992, 2004) hypothesis that these symptoms (viz., disorganized behaviour, poverty of action, social withdrawal, and blunted affect) are the consequence of a breakdown in the ability to mentalise. These results indicate that the type of ToM impairment, whether it is a fundamental lack of mental state concept, accuracy problems, or overmentalising, is associated with distinct symptom dimensions. This encourages the use of ToM measures which discriminate between aspects of over- and undermentalising to more thoroughly understand the relationship between major symptom dimensions in schizophrenia and mentalising styles. Further research is needed to identify causal relationships, specifically
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whether ToM impairments are at the origin of clinical symptomology (Frith, 2004) or whether symptomology leads to greater ToM impairments.

In addition to expanding clinical and theoretical understanding of ToM impairment in schizophrenia, this thesis provided preliminary evidence that cognitive empathy, another key aspect of social cognition, may also be more impaired in individuals with chronic schizophrenia than in individuals with early psychosis. This finding converges with the between-group differences identified by Achim, Ouellet, Roy, and Jackson (2011), whereby individuals with chronic schizophrenia scored significantly lower than individuals with FEP on indices of cognitive empathy. This suggests that the ability to understand the emotional perspectives of others may decline with illness chronicity. Furthermore, findings of this thesis indicated a much broader emotional deficit characterized by lower affective responsiveness reported by individuals with chronic schizophrenia compared to individuals with early psychosis. This is a novel finding as prior to this thesis there was “no robust evidence for a deficit in shared affectivity and subjective emotional reactivity in schizophrenia” (Bora, Gökçen, Kayahan, & Veznedaroglu, 2008, p. 27). While a deficit in the expression of emotions is a frequent finding, subjective experience of emotions has been reported to be rather normal in previous studies (Mattes, Schneider, Heimann, & Birbaumer, 1995; Gur et al., 2006). The possible reduction in emotional reactivity between early psychosis and chronic schizophrenia should be further examined using more ecological valid measures of emotional reactivity (e.g., immersion in emotionally arousing 4D contexts) together with objective measures of psychophysiological reactions (e.g., heart rate and skin conductance).

Consistent with the results of a prior study (Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003) but not others (Michaels et al., 2014; Smith et al., 2012), cognitive empathy was found to be associated with aspects of neurocognitive functioning (viz., mental flexibility and working memory). The discrepancy with some studies may reflect differences in the
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Executive functioning measures used across studies (Smith et al., 2012) or the use of an aggregate neurocognitive score (Michaels et al., 2014). Notwithstanding, although deficient empathy in schizophrenia is suggested to be independent of generalized cognitive deficits or intellectual functioning (Lee, Farrow, Spence, & Woodruff, 2004), alterations in the empathic response may reflect impairment in a number of cognitive processes (Shamay-Tsoory et al., 2003). One such process is the ability to shift a course of thought or action according to the demands of the social situation. Such flexibility may be essential for the empathic response, which requires an individual to adopt another person’s point of view. Decety and Jackson (2004) have also emphasized the relationship between empathy and cognitive flexibility, by suggesting that having the mental flexibility to adopt someone else’s view is an effortful and controlled process, especially because an individual’s default mode of reasoning about others is biased toward self-perspective and egocentricity. Additionally, the relationship observed between cognitive empathy and working memory is consistent with theoretical models proposing that memory processes help guide one’s ability to emotionally relate to others and produce germane empathic responses (Decety & Jackson, 2004; Lieberman, 2007).

Regarding relations to clinical symptoms, no significant correlations were observed between any component of empathy on the EQ and the positive, negative, or disorganised symptom factors of the PANSS. These findings converge with prior studies to suggest that disturbances in empathy, like ToM impairment, are not simply psychotic state related changes (Achim et al., 2011; Montag et al., 2007; Smith et al., 2012), but may instead reflect more trait like disturbances associated with schizophrenia.

Results of the current thesis, as well as previous studies in schizophrenia, suggest that impairments in empathy and ToM predict poor social functioning (Brüne, Schaub, Juckel, & Langdon et al., 2011; Pinkham & Penn, 2006). The current thesis extended this research by indicating that cognitive empathy, a key social cognitive process that has received relatively
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limited attention in schizophrenia, also demonstrates added value in explaining for poor social functioning beyond that accounted for by ToM, neurocognition, and clinical symptoms. Associations between cognitive empathy and social functioning were found across measures of both what an individual does (i.e., community functioning) and what an individual is capable of doing (i.e., functional capacity). Notwithstanding, ToM emerged as the strongest predictor of both aspects of social functioning in early psychosis and chronic schizophrenia. Consistent with previous research that has demonstrated that ToM impairments significantly contribute to empathy dysfunction in schizophrenia (Bora et al., 2008), ToM subprocesses were modestly associated with cognitive empathy. This result supports the idea that affective perspective taking and mental state decoding may be a prerequisite of cognitive empathy.

Understanding the neurocognitive and clinical correlates, and trajectory of social cognitive impairments in schizophrenia have implications for interventions targeting improvements in social functioning for this group. There is already some evidence that training programs targeting emotion recognition and ToM deficits may be effective in improving functional outcomes for individuals with schizophrenia (Combs et al., 2007; Van der Gaag, Kern, van den Bosch, & Liberman, 2002; Wölwer et al., 2005). Although some researchers argue that more automatic and basic contagion-like forms of empathy (e.g., emotional reactivity) cannot be taught, interventions for recognising cognitive and affective mental states and developing coping strategies (e.g., communicating empathic understanding) may be helpful to reduce the severity of social difficulties in schizophrenia (Bora, Gökçen, Kayahan, & Veznedaroglu, 2008).

Theory of Mind Impairment: State or Trait Marker of Schizophrenia

The results of the current thesis can be used to reconcile the theoretical debate of whether ToM impairment in schizophrenia represents a state or trait marker of the disorder.
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Evidence that ToM impairment is present early in the course of illness, as well as in clinically stable chronically ill patients, indicates that ToM deficits in schizophrenia represent a trait marker of the disorder that are not explained by the acuity or chronicity of illness alone. Notwithstanding, moderate associations between clinical symptoms, ToM subprocesses, and error types indicate that the type of ToM impairment an individual experiences may vary according to their predominant symptomology. Taken together, these findings suggest that ToM impairment, although a likely trait marker of the illness has an interwoven state-like component, whereby symptomology may influence the way in which impairment manifests. Thus, the type of ToM impairment may be transient or ‘state’ dependent. For example, individuals with schizophrenia may demonstrate pervasive ToM impairment as evidenced by poor performance on first- and second order cognitive and affective tasks prior to illness onset, during acute phases and symptom remission, as well as during chronic phases of illness. However, the extent to which they demonstrate under- or overmentalising may depend on the severity of positive, negative, and disorganised symptoms at the time of assessment.

Given there is now strong evidence that ToM is impaired in individuals with schizophrenia, this domain of research could be advanced by examining the stability of impairment type. Awareness of the different types of mentalising impairments, and the extent to which they are stable over time or change with current symptomology, would have clinical and theoretical implications. Specifically, further evidence that the type of ToM impairment is altered by the presence and severity of particular symptoms may encourage changes to the type and dose of medication that is prescribed, and encourage the content of social cognitive interventions to be tailored to individuals’ specific needs (e.g., applying, refining, or attenuating mental state attribution). Furthermore, such research could advance the state versus trait debate, by confirming a hybrid stance (viz., state and trait components) as
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suggested by the results of the current thesis.

Contrary to the support found for other components of Frith’s (1992) model, evidence of ToM impairment in clinically stable patients is not consistent with his suggestion that patients with remitted symptoms will perform normally on ToM tasks. Although clinical stability is not synonymous with remission, all clinical participants were considered to have returned to their personal baseline which is considered, by some researchers, to reflect ‘remission’ (Green et al., 2011; Pousa et al., 2008). A major challenge to Frith’s (1992) model is the categorical approach to subgrouping, as it does not account for the considerable overlap between diagnostic categories. For example, a number of clinical participants in the current research had equivalent ratings of positive and negative symptoms. This overlap in symptom presentation makes it difficult to relate specific types of ToM impairment to clinical subgroups (Harrington, Siegert, & McClure, 2005).

Inconsistencies in previous research in relating symptom dimensions to mentalising subprocesses may reflect the varied scope, sensitivity, psychometric strength, and theoretical basis (e.g., social cognitive vs. social perceptual) of the diverse range of ToM measures used in the individual studies. Alternatively, these mixed findings may reflect the competing methods used to group symptoms (i.e., categorical or dimensional). Using a hybrid system of symptom classification, whereby symptoms within categories are rated dimensionally (i.e., according to severity), as done in the current study, may inform more generalizable and clinically applicable inferences about the relationship between ToM and symptomatology in schizophrenia.

Social Cognition in Schizophrenia: Primary or Secondary Impairment

This thesis contributed to the debate concerning whether reduced performance on measures of social cognition (viz., ToM and empathy) in schizophrenia represent a primary impairment or is secondary to a generalised deficit in neurocognition. Robust group
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differences in mentalising and empathy performance were observed when estimated IQ and neurocognition were controlled. This finding is consistent with those reported in previous studies (Bliksted, Fagerlund, Weed, Frith, & Videbech, 2014; Pentaraki et al., 2008) and reviews (Green et al., 2011) and may be interpreted as reflecting the independence of ToM, which only to a limited extent can be predicted by neurocognition.

The relationships between cognitive functions and ToM in early psychosis and chronic schizophrenia, as reported in the current thesis, are relevant to the debate regarding the existence of a separate ToM module. The modular model of ToM (viz., ToMM) postulates the existence of a specific brain organization specialized for social inference. Frith’s (1992) theory also suggests a modular, domain-specific abnormality in ToM in schizophrenia. However, domain general, non-modular accounts of mentalising ability suggest that brain regions supporting social cognition are also important for other cognitive abilities such as executive functions (Hardy-Baylé et al., 2003). Evidence from this thesis suggests that low IQ and executive function abnormalities contribute to ToM impairments in early psychosis and chronic schizophrenia. Consistent with this view, there is some evidence for shared neural networks activated in response to both ToM and executive function tasks (Hirao et al., 2008; Russell et al., 2000). According to these findings, ToM impairment may be a reflection of a domain general frontal lobe related abnormality rather than being a domain-specific dysfunction. Notwithstanding, the robust group differences in ToM abilities after controlling for IQ and neurocognitive abilities alludes to the dissociation of ToM impairment from neurocognitive dysfunction in schizophrenia (Brüne, 2003; Langdon, Connors, Still, Ward, & Catts, 2014; Mazza, De Risio, Surian, Roncone, & Casacchia, 2001). Future research that integrates ecologically valid measures of ToM (such as the VAMA) within imaging paradigms will help map the neural regions associated with cognitive and affective ToM, as well as clarify the necessary inputs from regions typically thought to support neurocognitive
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processes.

The present results indicated that deficient cognitive mechanisms may underpin specific types of mentalising errors. Prior research has indicated that the capacity to extract relevant meaning and important contextual information from speech facilitates ToM (Sarfati, Passerieux, & Hardy-Baylé, 2000). Furthermore, to effectively use and interpret language, an individual must go beyond the literal meaning of words and utterances on the basis of contextual information (Green et al., 2012; Horan et al., 2012). As such, functional or structural disruptions of the neural mechanisms underlying verbal processes and mental flexibility may contribute to errors in mental state inferences. Results of the current thesis indicate that overmentalising is associated with poor verbal inhibition and high mental flexibility, whereas undermentalising is associated with poor verbal inhibition and low mental flexibility. Such findings support the argument that dysfunctional cognitive processes may, in part, explain the type of ToM impairment, which in turn may underlie the heterogeneity of performance on ToM tasks.

The associations between ToM performance and neurocognitive abilities bolsters support for Hardy-Baylé et al.’s (2003) model of ToM in schizophrenia, whereby ToM is related to executive functioning deficits. In particular, individuals with highly disorganized thought, language, and communication skills are predicted to perform most poorly on ToM tasks because they are unable to integrate and personalise contextual information, which in turn compromises their capacity to adequately assign mental states to others. Consistent with this model, the present results showed that individuals with schizophrenia with more severe disorganized symptoms performed a high frequency of ‘no ToM’ errors, alluding to a conceptual deficit in ToM.

Furthermore, estimated IQ and neurocognitive abilities were found to correlate moderately and significantly with ToM performance in healthy controls and individuals with
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schizophrenia. The study by Blinksted et al. (2014), which indicated that complex, cognitively demanding aspects of social cognition are correlated to functional and premorbid IQ, whereas simpler forms of social cognition are not, fits well with the current findings. ToM is an advanced social cognitive domain, and the VAMA is a complex and demanding ToM task. Correlations between aspects of neurocognition and ToM would therefore be expected (Montag et al., 2011; Ventura, Wood, Jimenez, & Hellemann, 2013). Indeed, Fernandez-Gonzalo et al. (2013) argued that different ToM paradigms vary in the demand they place on specific neurocognitive functions. For instance, the Faux Pas Recognition Test requires not only mentalising abilities but also language comprehension and semantic memory, and the cartoon-based Yoni Task placed demands on cognitive flexibility and attentional resources. As a result, the heterogeneous findings in previous studies regarding the relationship between ToM and other neurocognitive functions may be a result of the different ToM paradigms used in individual studies (Bora et al., 2008).

Overall, the results of this thesis indicated that reduced performance on indices of first- and second-order ToM is likely to be representative of a primary deficit in ToM, but the manner in which these impairments manifest (i.e., over- or undermentalising) may be secondary to specific cognitive strengths and limitations. These findings encourage further exploration of the stability of neurocognitive impairments across different phases of illness and in turn, whether deterioration in neurocognitive functioning corresponds with changes in the type of mentalising impairment an individual presents with. Research such as this may encourage theorists to propose hybrid models that converge arguments from the state versus trait and primary versus secondary debates, to explain the nature and trajectory of ToM impairment in schizophrenia. For example, an individual with schizophrenia may have enduring ToM impairment which is independent of their neurocognitive functioning, but the type of this impairment may vary according to their clinical and neurocognitive profile at the
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time of assessment.

**Functional Significance of Theory of Mind Impairment**

This thesis has contributed to theoretical accounts of social functioning in schizophrenia in which a deficit of social cognition is at the origin of social disturbance (Ofir-Eyal et al., 2014). Findings from this thesis indicated that social cognition (viz., ToM and empathy) is a stronger predictor of functional capacity and community functioning than clinical symptoms and neurocognition. Furthermore, these results support the dissociation between ToM and empathy, and the unique contributions of these processes to social functioning in schizophrenia.

Expanding previous research which has focused on isolated domains of social cognition to explain social functioning in schizophrenia (Cassetta & Goghari, 2014; Maat, Fett, & Derks, 2012; Romeo, Chiandetti, Siracusano, & Troisi, 2014), the current thesis examined a broader model of social functioning which accounts for the interaction between multiple processes (viz., affective ToM and cognitive empathy). Consistent with the theoretical reasoning underpinning the DP framework (Brüne, 2005) and integrative mediation model (Ofir-Eyal et al., 2014), results of the current thesis indicate that normative and efficient social cognition relies on the interaction between multiple control systems. It is probable that inaccurate empathic understanding (e.g., cognitive empathy) remains uncorrected due to the failure to fully engage other controlled processing networks (i.e., affective ToM), which in turn translate into social reactions (e.g., hostility) that are not congruent with the social context. Furthermore, the moderate associations between mentalising styles and poor verbal inhibition are also consistent with the DP framework, in that ToM impairment may be the result of dysfunctional connections within the controlled processing network (viz., with the ventral LPFC which is implicated in inhibitory control). Taken together, abnormal functioning of controlled neural networks may play a causal role in
the social dysfunction characteristic of schizophrenia. Although the research design precludes discussion about whether individuals with schizophrenia show over-activation of automatic neuro-circuitry (i.e., affective empathy), the results are consistent with the under activation of controlled processing neuro-circuitry (viz., cognitive empathy and affective ToM; e.g., mPFC; Pinkham, Hopfinger, Pelphrey, Piven, & Penn, 2008). Future research should explore whether impaired social cognition in schizophrenia is the result of aberrant automatic inputs (viz., emotion recognition) combined with unusually weak controlled processing resources.

As one of the first studies to connect ToM and empathy to social functioning, this thesis sets a foundation for further exploration of these processes in other clinical populations. Major depression, autism, social phobia, multiple sclerosis, and Alzheimer’s disease are all disorders associated with impairments in social functioning (Henry, von Hippel, Molenberghs, Lee & Sachdev, 2015). The variables examined in the current research may also influence social functioning in these clinical populations and have important implications for treatments that could improve quality of life. For example, results indicate that despite cognitive deficits, the prosocial traits of ToM and empathy uniquely contribute to social functioning. Based on these findings, it is reasonable to suggest that treatments focused on improving social cognition (viz., ToM and empathy) may help improve functional outcomes (Horan, Kern, Green, & Penn, 2008).

Limitations and Future Directions

Theory of mind assessment. The VAMA was designed to overcome limitations of existing measures and has a number of features that position it as a valuable tool for advancing the understanding of ToM in general and in clinical populations more specifically. Notwithstanding, the VAMA has three key limitations that warrant acknowledgment. First, the VAMA has a strong verbal component. Although this feature upholds the verisimilitude of the task, language processing deficits may account for reduced performance on the task.
Similarly, although colloquial language and Australian phrasing and humour are not included in the script of the VAMA, language (viz., English), sarcasm, and relationship dynamics include Western themes. As such, it is possible that performance on the VAMA is culturally-biased. Given that both the clinical and healthy adult samples included predominantly Caucasian Australians, further research is needed to examine the effects of culture on VAMA performance. For example, research that samples Eastern cultures would be useful to examine the cross-cultural utility of the VAMA. Furthermore, as the characters in the simulated social interactions are adults and portray mature themes (e.g., romantic interest and financial concerns) it is likely that the VAMA is most suitable for use with adult populations. However, future research should explore the suitability of the VAMA for use with adolescent and older adult populations.

The VAMA also places demands on other executive functions, as evidenced by relationships between ToM scores and indices of attention and mental flexibility. As such, the utility of the VAMA may be restricted to populations with sufficient cognitive resources to support task completion. Nonetheless, robust group differences in ToM performance were observed after controlling for neurocognition and IQ. This pattern of results indicates that performance on the VAMA is independent of neurocognition. These results encourage future researchers to use ToM measures within a broad assessment battery including measures of executive functioning, language ability, and attention span (Green et al., 2004). It is anticipated that the inclusion of these measures will provide the data necessary to better interpret test scores, such as whether impairments are specific to ToM and not a result of general cognitive dysfunction. The results of this thesis also caution researchers to consider the cognitive deficits commonly identified within the population from which they are sampling, and use this information to guide the selection of an appropriate measure of ToM.
Such consideration will likely ensure that mentalising abilities are accurately reflected in test scores.

Second, the use of multiple-choice response options specifically cues ToM reasoning. It is plausible therefore, that patients in the early stages of psychosis retain explicit ToM causal knowledge that they acquired before the onset of their illness and can access and apply this knowledge at least when cued to do so. Contingent upon their language abilities, patients may be able to use this ToM knowledge to compensate for impairments in ToM processing. As indirect test instructions do not draw attention to what is being measured, they may be better suited to assessing the spontaneous engagement of ToM abilities as required in most real-world social encounters. A fruitful area of future research may be to explore the utility and reliability of a free-response format of the VAMA, whereby test takers responses are scored according to standardised criteria.

Third, a key assumption of simulation-based assessments (viz., the VAMA) is that the social content matches 'real' stimuli and situations and that interacting with artificial agents is equivalent to interacting with other people in real-life. Although the findings reported in this thesis suggest that the simulated interactions included in the VAMA are high in verisimilitude and closely approximate everyday interactions, a critical examination of the differences between real and simulated interactions is essential. Furthermore, the greater ecological validity of the VAMA over the measures used to assess neurocognition and empathy in the current research may have biased the results in favour of the predictive validity of ToM in explaining social functioning. Future research is needed to explore the contributions of neurocognition to ToM performance, as well as the utility of the VAMA in other populations with and without cognitive impairments.

A final consideration is that little is known about how individual differences in responses to artificial social dynamics impacts performance on the VAMA. Individual
differences in ToM task performance have been found with regard to participant sex (Russell, Tchanturia, Rahman, & Schmidt, 2007), cultural background (Adams et al., 2010) and personality (Walters, Syrdal, Dautenhahn, Te Boekhorst, & Koay, 2008). Future research examining ToM processes with the VAMA should consider demographic and attitudinal factors to establish a better understanding of their effects.

A fruitful area of future research in the domain of ToM assessment is the use of cognitive simulation technology (Byom & Mutlu, 2013). Cognitive simulation refers to developing artificial representations of neurocognitive mechanisms (e.g., imitation and perception of self), simulating them in artificial agents such as humanlike robots, and assessing their capacity to enable ToM inferences in human-agent interactions (Breazeal & Scassellati, 2002). Building on simulation theory (Gallese & Goldman, 1998), cognitive simulation involves the robot establishing and maintaining representations of the mental states of the test taker by tracking and matching their mental states with resonant mental states of its own. These representations enable the robot to take the perspective of the test taker, make inferences about the test taker’s goals, and learn from their actions (Byom & Mutlu, 2013).

Utilising cognitive simulation for assessment purposes promises two key methodological advances in the study of ToM. First, this approach may help in assessing existing neurocognitive models of ToM mechanisms by computationally simulating them and observing resulting behaviour in interactive situations. Second, cognitive simulation may enable empirical studies to build new understanding of ToM processes in truly interactive protocols in which all agents, human and artificial, involved in the interaction employ ToM mechanisms. This approach would extend the methodological advantages of simulated social interactions by enabling not only online measurement of responses to social stimuli but also flexible, precise control over simulated cognitive mechanisms and social behaviours, thus
affording greater experimental control (Byom & Muthu, 2013).

**Emotion Recognition and Insight.** Individuals with schizophrenia have been shown to experience difficulties with judging the accuracy of their perceptions and behaviour, as well as naming and describing their own psychological states (Lysaker, Hasson-Ohayon, Kravetz, Kent, & Roe, 2013). It is possible that deficits in these metacognitive processes in schizophrenia resulted in over-reporting on self-report measures of empathy in the current research. Furthermore, the extent to which metacognitive abilities influence performance on the VAMA is unclear. As such, the results of the current thesis should be accepted with caution. It is recommended that further research into empathy and ToM in schizophrenia include insight and metacognition as statistical controls, and use a multimodal approach to assess empathy (e.g., behavioural observations, other-report questionnaires, and experimental tasks).

A parallel criticism is that a measure of emotion recognition was not included in the current research. Several studies have demonstrated that patients with schizophrenia have impaired affect recognition and processing (Addington, Addington, Penn, Woods, & Perkins, 2008; Amminger et al., 2012; Kohler, Barrett, Gur, Turetsky, & Moberg, 2014). Several of the models reviewed in this thesis (viz., Decety & Jackson’s model, 2004; DP framework, Brüne, 2005; integrative mediation model, Ofir-Eyal et al., 2014) identify emotion recognition as a precursor to mentalising. The extent to which emotion recognition abilities contributed to ToM performance on the VAMA, particularly first- and second-order affective ToM, is uncertain and requires clarification. Research examining the contribution of emotion recognition abilities to accurate mental state attribution, and how this relationship translates into functional outcomes, will advance theoretical understanding of the functional impact of social cognition.
Sample Characteristics. The conclusions drawn from the current research are also open to criticism as a result of the small sample size, the cross-sectional design, and the potential influence of psychotropic medication. Although the sample sizes, as well as sample characteristics (i.e., illness duration, age, and gender distribution) described in this thesis are comparable to those described in other studies exploring social cognitive phenomena in schizophrenia (Shamay-Tsoory, Shur, et al., 2007; Sparks et al., 2010), replication of the findings reported in this thesis with larger sample sizes would improve confidence that the reported effects are representative of those observed in the early psychosis and chronic schizophrenia populations. Evidence of strong, reliable relationships between social cognitive, clinical, neurocognitive, and functional variables will contribute necessary information to further develop empirically-grounded interventions targeting the improvement of social cognition in schizophrenia.

The cross-sectional design of the research described in this thesis does not permit confirmation of causal factors related to social cognitive impairment. Nonetheless, the results of this thesis provide justification for future longitudinal research examining the onset, origin, and trajectory of social cognitive impairment in schizophrenia. Longitudinal research that assesses ToM subprocesses prior to illness onset, during acute psychosis, and after symptom remission will likely provide convincing evidence that ToM impairment is an enduring feature of schizophrenia. Future work should carefully consider the influence of residual symptoms and, importantly, the effect of other cognitive impairments in individuals with schizophrenia. Studies that recruit first degree relatives of individuals with schizophrenia and employ longitudinal designs with people at high risk for developing this illness will also be important in understanding the trajectory of ToM impairment. Based on early research with these groups (Bora & Pantelis, 2013; Chung, Kang, Shin, Yoo, & Kwon, 2008), it is anticipated that individuals at high risk of developing schizophrenia will perform
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significantly poorer than healthy controls on measures of ToM. Although these findings will likely provide further evidence that ToM impairment is a trait marker of schizophrenia, further work is necessary to examine the specificity of these findings to schizophrenia and disentangle the relationship between ToM and other cognitive deficits in people at risk for developing psychotic disorders (Bora & Pantelis, 2013).

Lastly, Savina and Beninger (2007) found that ToM performance is influenced by the type of anti-psychotic medication an individual is taking. Specifically, individuals with schizophrenia treated with clozapine or olanzapine performed better on ToM tasks than those treated with risperidone or typical antipsychotic medications. Although antipsychotic dosage was not correlated with ToM abilities in individuals with early psychosis or chronic schizophrenia in the current research, future studies should compare the ToM performance of medicated and medication-naïve patients with schizophrenia to better understand the impact of medication on ToM abilities. This has implications for research exploring psychopharmacological treatments of social cognitive impairments in schizophrenia, in that hybrid drug and behavioural treatments may be most effective in reducing the social impairments characteristic of this population (Kucharska-Pietura & Mortimer, 2013).

Conclusion

From a theoretical perspective, the attenuated ToM impairments found in early psychosis and greater impairments in individuals with chronic schizophrenia suggest a gradient effect in terms of a gradual reduction in ToM abilities will illness chronicity. The results presented in this thesis offer new insights into the nature of ToM impairment in schizophrenia and reconcile significant theoretical debates within the social cognition and schizophrenia literature. Specifically, although reduced ToM ability is likely to be a trait marker of the illness, the specific types of ToM impairment may be state dependent. Similarly, performance on ToM tasks is likely supported by neurocognitive processes and an
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individual’s mentalising style may reflect their cognitive strengths and weaknesses.

From a clinical perspective, the results of this thesis confirm that impairments in social cognitive processes (viz., empathy and ToM) impact how individuals with schizophrenia interact and communicate with others in their everyday social life. Results allude to a complex social cognitive deficit in schizophrenia, whereby social functioning is best explained by the interplay of social cognitive domains (viz., ToM and empathy), rather than any isolated component alone. Furthermore, the findings from the current research, combined with recent evidence of social cognitive impairments in individuals at high risk for developing schizophrenia (Bora & Pantelis, 2013), indicate that early targeted social cognitive interventions may prevent deterioration in social abilities or significantly reduce the severity of social impairment that parallels illness chronicity. Reducing the social impact of schizophrenia would reduce the economic burden and average years lost to disease in this population. Taken together, enhancing the assessment of ToM through the use of simulation technology has the potential to improve the quality of life of individuals with schizophrenia by providing comprehensive, ecologically valid test scores that directly translate into intervention targets.
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Appendix A: Example Items from Existing Theory of Mind Measures

Task: False Belief Story Task


Example item – Deception Story 1

It is Mary’s birthday and her auntie pops in to give her a box of chocolates. She puts her chocolates in her top drawer for safe-keeping.

Memory question: Where does Mary put her chocolates?

A few minutes later, her greedy brother comes in and asks Mary “where have you put your chocolates, in your top drawer or your bottom drawer?” Mary does not want Bill to find her chocolates.

First-order deception question: In which drawer does Mary say her chocolates are and why?

Reality question: Where are the chocolates really?

Inference question: Does Mary live close to her?

Mary discovers that give of her chocolates have disappeared. She suspects that Bill was not fooled when she said her chocolates were in the bottom drawer and has pinched them. Later on, Mary’s best friend gives her a tin of sweets. She hides these carefully in her bottom drawer.

Mary does not want Bill to pinch any of these.

Memory question: Where does Mary put the tin of sweets?

When Bill next sees Mary he asks her: “Where have you put your sweets, in your top drawer or your bottom drawer?” Bill expects Mary to lie, but Mary is very clever and realises this and does not want Bill to find her sweets.

First-order deception question: In which drawer will Mary say her sweets are in and why?

Reality question: Where are the sweets really?

Inference question: Does Bill have a sweet tooth
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Task: Happè’s Strange Stories


Example item – ToM item

Helen waited all year for Christmas because she knew at Christmas she could ask her parents for a rabbit. Helen wanted a rabbit more than anything in the world. At last Christmas Day arrived, and Helen ran to unwrap the big box her parents had given her. She felt sure it would contain a little rabbit in a cage. But when she opened it, with all the family standing round, she found her present was just a boring old set of encyclopaedias, which Helen did not want at all! Still, when Helen’s parents asked her how she liked her Christmas present, she said, “it’s lovely, thank you. It’s just what I wanted”.

Is it true, what Helen said?
Why did she say that to her parents?

Task: Picture Sequencing Story Telling Task


Example item – ToM item
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Task: Picture Stories Inference Intention Task


Example item – ToM item

[Image showing a sequence of story pictures]

Answer cards A and B

Pictures 1, 2, and 3
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Task: Cartoon Comprehension Task


Example items: (a) ToM joke and (b) physical/behavioural joke

![Cartoon example a](image1)

![Cartoon example b](image2)

Task: Sarcasm Comprehension Task


Example item – Sincere, direct sarcastic and indirect sarcastic items

Example of a sincere item: One week, Carla’s husband came home late every night. Carla started to worry. At the end of the week, she went to the bank. She found that there was no
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money in their account. Her husband confessed that he had been gambling and lost a lot of money.

Carla said: “That was very stupid of you!”

Question: What did Carla mean when she said that?

Example of a direct sarcastic item: Vicky had bought tickets for a new play at the theatre. One was for herself and the other for her friend Jean. Vicky told Jean the play would be good because her favourite actor was in it. The play turned out to be terrible. They were both disappointed.

Jean said: “That was a fantastic play you took me to see!”

Question: What did Jean mean when she said that?

Example of an indirect sarcastic item: Liz and her friend often played tennis. Her friend always wanted to be best at everything. One day they were playing tennis in the local park. Liz knew that her friend expected to win the game. However, that day her friend did not win.

Liz said:

“I suppose you’ll say there’s a hole in your racket!”

Question: What did Liz mean when she said that?

Task: Attitudinal Subtest of the Aprosodia Battery


Example item

‘This looks like a safe boat’

‘That was a smart thing to say’

Recorded twice by a female speaker, once with a sincere tone and once with a sarcastic tone

Task: Hinting Task


Example item – ToM item
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Paul has to go to an interview and he’s running late. While he’s cleaning his shoes he says to his wife, Jane: ‘I want to wear that blue shirt, but it’s very creased’.

**Question:** What does Paul really mean when he says this?

**Extra information:** Paul goes on to say: ‘It’s in the ironing basked.’

**Question:** What does Paul want Jane to do?

---

**Task: Faux Pas Recognition Test**


**Example item – ToM item**

Helen’s husband was throwing a surprise party for her birthday. He invited Sarah, a friend of Helen’s, and said, 'Don't tell anyone, especially Helen.' The day before the party, Helen was over at Sarah’s and Sarah spilled some coffee on a new dress that was hanging over her chair.

"Oh!" said Sarah, "I was going to wear this to your party!"

"What party?" said Helen.

"Come on," said Sarah, "Let's go see if we can get the stain out."

1. Did anyone say something they shouldn't have said or something awkward?

   If yes, ask:

   2. Who said something they shouldn't have said or something awkward?

   3. Why shouldn't he/she have said it or why was it awkward?

   4. Why do you think he/she said it?

   5. Did Sarah remember that the party was a surprise party?

   6. How do you think Helen felt?

**Control questions:**

7. In the story, who was the surprise party for?

8. What got spilled on the dress?
Task: Reading of the Mind in the Eyes Test


Example item

(a) CONCERNED vs. Unconcerned.

(b) SERIOUS MESSAGE vs. Playful Message.
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Task: Yoni Task


Example items – First and second-order cognitive and affective ToM and control condition

<table>
<thead>
<tr>
<th>1st order</th>
<th>2nd order</th>
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<tbody>
<tr>
<td>cognitive</td>
<td>affective</td>
</tr>
<tr>
<td>cog1</td>
<td>cog2</td>
</tr>
<tr>
<td>Yoni is thinking of ___</td>
<td>Yoni is thinking of the fruit that ___ wants</td>
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Task: Social Attribution Test – Multiple Choice (SAT-MC)

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Example item – (a) SAT-MC and (b) SAT-MC II

SAT-MC: What are the two triangles doing?
   a) Playing
   b) Dancing
   c) Bumping into each other
   d) Fighting

SAT-MC-II: Why did the rectangle move off screen?
   a) Because it’s angry
   b) Because it’s looking for something
   c) Because it’s happy
   d) So that there are only two objects in the box

Task: The Awareness of Social Inference Task


Example item – Paradoxical sarcasm

Gary: Have you got your ticket?
Keith: Nope. I tore it up and threw it away.
Gary: Good. And your passport’s safe?
Keith: Sure, I threw that in the bin along with my ticket.
Gary: So, you’ve got everything.

Probe questions

Do: Is Keith seriously trying to make Gary think he’s lost his ticket?
Say: Does Keith mean he has got his ticket and passport?
Think: By the end of the scene, does Gary think Keith has his ticket?
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Feel: Is Keith grateful that Gary checked about his ticket?

Task: Movie Assessment of Social Cognition


Example item – First-order cognitive ToM

*Picture 1 (below):* Cliff is the first one to arrive at Sandra’s house for the dinner party. He and Sandra seem to enjoy themselves when Cliff is telling about his vacation in Sweden.

*Picture 2 (below):* When Michael arrives, he dominates the conversation directing his speech to Sandra alone.

*Picture 3 (below):* Slightly annoyed by Michael’s bragging story, Sandra shortly looks in Cliff’s direction and then asks Michael: “Tell me, have you ever been to Sweden?”
Examples for correct answers: To change to the topic that Cliff talked about before so that he gets involved again; to redirect the conversation to Cliff; to integrate Cliff; to reconnect with Cliff.

Examples for incorrect answers: To hear if Michael also has something interesting to say about Sweden; to see which of the two guys has a cooler story to tell; to see if Michael can corroborate Cliff’s story; she liked the Sweden topic better than the current one; to compare the two; to loosen Michael up, the Sweden topic also worked for Cliff.

Task: Th.o.m.a.s.


Example item – Scale C

Do you notice when others feel bad?

When do you notice that? Can you give an example?
Appendix B: Ethical Clearance

Ethics clearance was granted for this research and it was conducted in accordance with the approved protocol (Griffith University Human Research Ethics Committee Reference ID: PSY/D5/12/HREC; Gold Coast University Hospital Human Research Ethics Committee Reference ID: HREC/13/QGC/26).
Appendix C: Example VAMA Interaction

Scenario One: Test taker meets Isabel at the coffee shop. They greet each other and Isabel explains that she has received text messages from Aaron and Tiffany saying they have arrived and are trying to find a car park. Isabel reminds test taker to congratulate Aaron for his recent promotion. Isabel asks to hear about the test taker’s recent vacation. Whilst the test taker is describing their trip, Aaron and Tiffany enter the scene. Aaron asks what was being discussed. Test taker explains that they were talking about the recent vacation. Aaron says “oh yeah [shrugs shoulders]. [Directs speech to Isabel] You won’t believe how much I’ve had on the last week. It is like everyone wants my time. I’ve had to go the gym each night, I’ve been helping a mate out with an ad campaign, I’ve…”. Isabel [glances at test taker] interrupts Aaron and says “Tell me, have you ever been to Europe?”. Throughout Tiffany offers apologetic looks at the test taker who has been excluded from the conversation.

Question: Why is Isabel asking Aaron if he has been to Europe?

a) To engage you in the conversation (accurate mentalising)

b) To learn more about Europe (reduced mentalising)

c) To find out if Aaron has been to Europe (no mentalising)

d) To be able to compare you and Aaron (overmentalising)
### Appendix D: Description of VAMA Scenarios

<table>
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<th>Scenario</th>
<th>Description</th>
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<tbody>
<tr>
<td>2</td>
<td>Test taker, Isabel and Aaron meet at the cinemas. They are waiting for John and Tiffany to arrive. Aaron is exclusively discussing his new job as a lawyer with Isabel. Test taker attempts to enter conversation by asking Aaron questions. John enters the cinema looking irritated and makes a negative comment about the legal profession. Tiffany interrupts and physically directs John to go purchase movie tickets.</td>
</tr>
<tr>
<td>3</td>
<td>Test taker, John and Tiffany are in a department store. Tiffany discusses the frustrations with trying to lose weight. Aaron enters and boasts about how easy he finds it to stay fit. Tiffany and John are offended and Isabel attempts to redirect Aaron’s attention.</td>
</tr>
<tr>
<td>4</td>
<td>Test taker and Isabel meet Tiffany at the hair dresser, where she has just had her hair cut. Isabel positively jokes about Tiffany’s hair. John and Aaron arrive and John provides a sarcastic remark.</td>
</tr>
<tr>
<td>5</td>
<td>Aaron is talking with Isabel and test taker about a medical concern within his family. John enters and tells an inappropriate joke about terminal illness.</td>
</tr>
<tr>
<td>6</td>
<td>Tiffany and Isabel are arranging to meet up in a fortnight. Tiffany asks John if he can look after their children. John asks Aaron if we would like to keep him company on this night.</td>
</tr>
<tr>
<td>7</td>
<td>Tiffany is telling Isabel and test taker that John is going to receive a promotion at work and she is arranging a surprise party to which they are invited. John overhears that there is a party and asks for details. Isabel deflects his questions.</td>
</tr>
<tr>
<td>8</td>
<td>Test taker and Isabel are discussing her free social schedule. Aaron approaches and asks Isabel to go to the beach with him. Isabel says she does not have time.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>407</td>
<td><strong>THEORY OF MIND IN SCHIZOPHRENIA</strong></td>
</tr>
<tr>
<td></td>
<td>Aaron attempts to convince Isabel. Isabel suggests to the test taker that the three of them attend the beach as a group.</td>
</tr>
<tr>
<td>9</td>
<td>Tiffany is telling test taker about a book that Isabel got her as a birthday gift. Tiffany says that she gave the book away. Isabel comes over and asks Tiffany to borrow the book. Tiffany lies about the books whereabouts.</td>
</tr>
<tr>
<td>10</td>
<td>John is telling Aaron how he and Tiffany are experiencing financial strain. Aaron offers to provide legal advice. Tiffany enters and asks to be filled in on what they are discussing. John lies.</td>
</tr>
</tbody>
</table>
Appendix E: User Friendliness Questionnaire

Thankyou for your participation in this study. We are interested in your feedback on the two computer tasks that you have just completed. Please respond by circling the number on the scale that best describes how strongly you agree with the following statements.

Virtual Reality Shopping Task

1. I felt as if I were physically present in the social interactions.

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

2. This task included activities that were similar to inferring the thoughts and feelings of other people in everyday life.

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

3. I found the task interesting

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

4. The task was easy to learn.

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

5. I found the shopping part of the task difficult.

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

6. I found answering questions about the social scenarios difficult.

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

7. The instructions accompanying the task were clear and easy to understand.

   Strongly Agree                        Strongly Disagree
   1                               2        3        4        5

8. I would recommend this task to other people.
Yoni Task

1. I felt as if I were physically present in the task

2. This task included activities that were similar to inferring the thoughts and feelings of other people in everyday life.

3. I found the task interesting

4. The task was easy to learn.

5. I found answering questions about who/what Yoni was referring to difficult.

6. The instructions accompanying the task were clear and easy to understand.

7. I would recommend this task to other people.
Appendix F: Social Functioning Scale: Additional Question

The following questions are about your friends and what you have been doing in your spare time – Over the last 2 weeks have you:

Responses to questions are provided on the following scale. Questions with an asterisk (*) next to them are reverse scored.

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Occasionally</th>
<th>About half the time</th>
<th>Most of the time</th>
<th>All of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Questions for close interpersonal relationships

1. Talked about your feelings openly with your friends?
2. Felt comfortable about sharing your feelings with your friends?
3. Got angry with or argued with your friends?*
4. Been offended or had your feelings hurt by your friends?*
5. Felt ill at ease, tense or shy when with your friends?*

Questions for occupational interpersonal functioning:

1. Felt comfortable socially interacting with work colleagues?
2. Share your thoughts and feelings with work colleagues?
3. Felt ashamed of your social interactions at work?*
4. Got angry with or argued with people at work?*
5. Felt upset, worried or uncomfortable in social interactions at work?*