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Autobiographical Self-Disturbances and Risk for Psychotic Disorders

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For Jenn.

"*I am, I exist,* is necessarily true each time that I pronounce it, or that I mentally conceive it…that is certain. But how often? Just when I think; for it might possibly be the case if I ceased entirely to think, that I should likewise cease altogether to exist."

- René Descartes, *Meditations on First Philosophy,* 1641

Abstract

Individuals with psychotic disorders experience profound challenges in maintaining a coherent sense of self and identity over time. Although disturbances in the basic, momentary sense of self are core features of psychotic experiences, less is known about psychosis's impact on the *autobiographical self*, the experience of being a coherent and unitary person across a lifetime. The autobiographical self, comprising the self-concept and narrative identity, is built in large part during adolescence and emerging adulthood, the same developmental period in which a clinical high risk for psychosis syndrome (CHR) can be identified. How is the autobiographical self affected in the CHR syndrome? Might common mechanisms explain dysfunction in various aspects of the autobiographical self? Are there any early indicators in this population of potentially more severe future autobiographical self-disturbances?

Three studies addressed these questions. Study 1 examined the self-concept's clinical and functional relevance in CHR sample (n = 73) and a matched healthy comparison (HC) sample (n = 73), finding that beliefs about the self tend to be more negative and less positive in CHR. Moreover, these dysfunctional beliefs—particularly a lack of normatively positive self-beliefs—were linked to negative attenuated psychotic symptoms, depression, and functional impairment.

Study 2 tested one possible mechanism for these effects: interactions between intrinsic-self (related to inner states) and extrinsic-self (related to interactions with the environment) networks in the brain. In a subgroup of the Study 1 sample (n = 56 CHR, 59 HC), resting-state functional connectivity MRI analyses examined interactions between the cortical midline structures (intrinsic-self) and sensorimotor (extrinsic-self) networks, finding that low positive self-beliefs were associated with hyperconnectivity between these networks.

Study 3 replicated and extended Studies 1 and 2 in a new sample (n = 50 CHR, 56 HC), with a larger set of self-concept variables, and added narrative identity variables coded from a life story interview. Principal components analysis in Study 3 found a broad core dysfunction in the self-concept, spanning negative self-beliefs, low self-esteem, excessive rumination, and poor self-concept clarity. This core dysfunction was associated with negativity and passivity in CHR participants' life stories, as well as negative attenuated psychotic symptoms and functional impairment. Two aspects of the autobiographical self—a heightened tendency toward self-reflection, and possibly subtle impairments in narrative structure—were altered in the CHR group but were unrelated to the core self-concept dysfunction. Resting-state fMRI analyses were inconclusive in Study 3 due to a small and unbalanced fMRI subsample.

Together, these studies built a nomological network of autobiographical self-disturbances in the CHR syndrome, showing that common mechanisms may account for a core dysfunction in the self-concept characterized by negativity and uncertainty about the self. Moreover, this core dysfunction reaches into narrative identity, in life stories marked by negativity and passivity. Finally, several key variables may be early indicators of more serious disturbances in the autobiographical self. The CHR syndrome captures a difficult period in which attenuated psychotic symptoms overlap undermine the normative development of self-concept and narrative identity. This dissertation's findings shed light on the unique challenges that individuals face as they attempt to maintain coherent selves and identities during this difficult period. By working to understand dimensions of variability in these processes, researchers may better understand etiological mechanisms of psychosis and identity development, and clinicians may better treat their patients as individuals.

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Glossary and Abbreviations

Adolescence: A developmental stage that begins at puberty and lasts until age 18.

Anterior cingulate cortex (ACC): Together with the medial prefrontal cortex (mPFC), forms the anterior node of the cortical midline structures (CMS).

Autobiographical self: A temporally extended consciousness of oneself as an individual with a past, present, and future.

Basic self: The consciousness of oneself as a subject of experience with agency and ownership in the present moment.

Beck Anxiety Inventory (BAI): A 21-item self-report scale of current anxiety severity.

Beck Depression Inventory-II (BDI): A 21-item self-report scale of depression severity in the past two weeks.

Brief Core Schema Scales (BCSS): A 24-item self-report measure of core beliefs, made up of 6-item subscales assessing positive-self, negative-self, positive-other, and negative-other beliefs.

Clinical high risk for psychosis syndrome (CHR): A syndrome of individuals aged roughly 14 – 24 who are not currently diagnosed with a DSM-5 psychotic disorder, and who exhibit attenuated psychotic symptoms, brief intermittent psychotic symptoms, or genetic risk and functional decline (T. J. Miller et al., 1999). The incidence of psychotic disorders is 10 – 40% over 24 months in CHR samples (Fusar-Poli et al., 2012, 2013, 2016).

Cortical midline structures (CMS): A network of brain structures in the midline of the cortex whose coordinated function supports self-referential processing. Key regions include the medial prefrontal cortex (mPFC), anterior cingulate cortex (ACC), and posterior cingulate cortex (PCC).

Egoistic and moralistic self-enhancement scale (EMS): An 8-item questionnaire assessing tendencies toward self-enhancement, made up of 4-item subscales for egoistic (individualistic) and moralistic (communal) self-enhancement.

Emerging adulthood: A transitional developmental stage between adolescence and adulthood (typically defined as ages 18 to 25) (Arnett, 2007).

Extrinsic self-processing: Processes which produce agency and ownership in interactions with the environment, associated with the sensorimotor network.

Intrinsic self-processing: Cognitive and affective processing of self-relevant stimuli producing agency and ownership over internal experience, associated with the cortical midline structures.

Global Functioning Scale (GFS): A clinician-rated scale of current functioning, with two subscales for role functioning (GFS-R) and social functioning (GFS-S).

Healthy comparison (HC): Normatively-developing youth, matched to the clinical high risk group on age, sex, income, and education.

Medial prefrontal cortex (mPFC): Together with the anterior cingulate cortex (ACC), forms the anterior node of the cortical midline structures (CMS)

Narrative identity: An individual's ''internalized and evolving life story, integrating the reconstructed past and imagined future to provide life with some degree of unity and purpose" (McAdams & McLean, 2013, p. 233). Narrative identity is typically studied through narrative interviews such as the Life Story Interview (McAdams, 2008), with trained raters assigning numerical values to interview transcripts (e.g., 0 = "absent" to 3 = "strongly present") to capture narrative features such as agency, coherence, or meaning-making.

Posterior cingulate cortex (PCC): The key region in the posterior node of the cortical midline structures (CMS).

Resting-state functional connectivity MRI (fcMRI): Functional connectivity MRI records correlations between the time series of coactivation in different brain regions. Positive connectivity indicates that regions are active at the same time, while negative connectivity indicates that regions are active at opposite times. Resting-state functional connectivity refers to functional connectivity observed when the brain at rest, i.e., not engaged in a task.

Rosenberg Self-Esteem Scale (RSES): A commonly used unidimensional 10-item scale of self-esteem.

Rumination: Repetitive thinking about threats, losses, injustices, or personal failings motivated by distress and associated with trait neuroticism.

Rumination and reflection questionnaire (RRQ): A 24-item measure of self-reflective tendencies, made up of 12-item subscales assessing rumination and self-reflection.

Schizophrenia spectrum disorders (SSD): A category of diagnosable clinical disorders characterized by positive symptoms such as hallucinations and delusions, negative symptoms such as apathy and diminished emotional expression, and/or disorganized symptoms such as disorganized speech and thought. The most common schizophrenia-spectrum are schizophrenia, schizophreniform disorder (symptoms of schizophrenia with a duration less than 6 months) and schizoaffective disorder (symptoms of schizophrenia plus pronounced mood symptoms), which have a combined worldwide lifetime prevalence of around 0.8%.

Self-beliefs: Core beliefs about the self as being, e.g., a talented, well-liked, vulnerable, or helpless person. Self-beliefs typically originate in early experiences in childhood and adolescence, although they change over the life course. Notably, self-beliefs tend to become more negative over time for people who develop psychotic disorders.

Self-concept: The set of semantic information which a person believes to be representative of him- or herself. It is typically measures through self-report scales of constructs such as self-esteem or self-concept clarity.

Self-concept clarity: The extent to which self-beliefs are clearly and confidently defined, internally consistent, and stable.

Self-concept clarity scale (SCC): A 14-item unidimensional measure of self-concept clarity.

Self-enhancement: The process of shoring up one's self-esteem against threatening feedback by seeking positive feedback and avoiding negative feedback. Self-enhancement can be individualistic, promoting infallible competence, or cooperative, promoting politeness, morality, and humility.

Self-esteem: Global evaluations of one's own worth, likeability, and competence.

Self-reflection: Intellectual self-exploration motivated by epistemic curiosity and associated with trait openness.

Self-referential processing: Self-referential processing is the basic neurocognitive process of relating information to the self. It can be studied by experimental tasks such as assigning traits to the self vs. another person (Damme et al., 2019), viewing one's own face vs. another person's face (Platek et al., 2008), or personally relating a scene to oneself vs. passively viewing the scene (Nejad et al., 2013)..

Sensorimotor network (SMN): A network of brain regions, including the primary sensory and motor cortices and the supplemental motor region, involved in imagined and actual sensations and movements.

Structured Interview for Psychosis-Risk Syndromes (SIPS): Diagnostic interview commonly used to assess the attenuated psychotic symptoms that are typically used to identify a clinical high risk for psychosis syndrome. Contains four clinician-rated scales assessing positive, negative, disorganized, and general symptoms.

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CHAPTER I

Introduction

Robert Bayley first experienced psychotic symptoms "cowering in the corner of a deserted school playground, overwhelmed by voices attacking me" (Bayley, 2018). A primary school classmate had encouraged him to swear for the first time, and he believed God was now punishing him for failing to resist. Increasingly alienated from others "as my reality became increasingly fractured and confused" (Bayley, 2018), he was hospitalized, diagnosed with schizophrenia, and prescribed antipsychotics at age 16. Robert Bayley has been in treatment ever since. "For me," he writes, "daily life is almost constant torment. The voices and visions intrude and disturb me greatly…leaving me shattered and distressed" (Bayley, 2018). His experiences in treatment have been mixed, and he feels that "one of the most frustrating aspects of having schizophrenia is losing control of the treatment that you receive" (Bayley, 1996, p. 728). Some newer generation antipsychotics and psychotherapy have helped somewhat, but he still experiences schizophrenia as "a terrible illness, one that ravages the mind and soul" (Bayley, 1996, p. 728).

Nevertheless, Mr. Bayley has found "some kind of balance" through art, music, and writing (2018). He has published a semi-autobiographical novel and released an album of his original compositions. A loving wife, friends, and family "keep me as positive as I can be" (Bayley, 2018). Ultimately, he writes, "I have been transformed from a vulnerable 16-year-old…to an individual, now 51, who has created works of literature and music, and studied the

visual arts.… I've managed to create a rich amount of work that I'm incredibly proud of" (Bayley, 2018).

Robert Bayley's story eventually turned toward redemption. But along the way he has often struggled against a health care system that strips him of his individuality. "Frequently", he writes, "there is no attempt made to explore beyond the illness.… It is critical to be aware that the path schizophrenia pursues is particular to each person afflicted…. It is often forgotten that there is a person behind the condition, with a fundamental need to be understood…. We must be seen as individuals and not regarded as just a collection of symptoms" (1996, pp. 728–729). This challenge—to see people with schizophrenia as individuals—is an ongoing concern among many psychosis researchers and clinicians (e.g., Lysaker et al., 2012; Parnas & Handest, 2003). What can we do to understand people on the psychosis spectrum as individuals? One answer is to ask them how they see themselves. How does Robert Bayley understand himself as a person? How does this self-understanding impact his symptoms, and vice versa? And how did the onset of psychotic symptoms in his teenage years impact his self-understanding?

Mr. Bayley clearly faces significant challenges in his efforts to maintain a coherent sense of self and personal identity over time. Throughout the psychosis spectrum, people similarly report disturbances in the *autobiographical self,* the reflective sense of being a unitary person across time and in different contexts. Mr. Bayley describes several ways in which his illness interacts with his autobiographical self. He notes that schizophrenia "insidiously [feeds] on and [accentuates] the sufferers' inherent personality" (1996, p. 728). In other words, each individual's personality is reflected in his or her symptoms. Importantly, this includes the *self-concept,* or the semantic information a person believes to be true about him- or herself. The beliefs people hold about themselves are key individual differences that impact symptom expression, functional

outcomes, and subjective experience. Moreover, Mr. Bayley understands schizophrenia as a neurological disease, noting alterations in language- and vision-related neural processing (Bayley, 2018). The neurological effects of schizophrenia also extend to brain networks that support a cohesive sense of self. Multiple *self-referential neural networks* are affected in schizophrenia. By probing these networks, functional neural data may suggest mechanisms or even causes of perplexing self-experiences. Ultimately, Mr. Bayley argues that he is best understood through his *narrative identity*, his internalized understanding of becoming the person he is today through a long and varied life story—a life story with intense pain and struggle, but also one with a redemptive arc toward personal growth, meaningful relationships, and artistic expression. As an autobiographical author, he actively situates semantic knowledge about himself within its episodic context, lending his autobiographical self some degree of purpose, unity, and forward momentum.

Each of these three perspectives may help to understand Mr. Bayley's unique experiences, and the unique experiences of tens of millions of others who live with schizophrenia-spectrum disorders (SSD) worldwide. The complementary perspectives of the self-concept, self-referential neural networks, and narrative identity can illuminate the personal path each individual takes through a life impacted by psychotic phenomena. A wealth of research data show that all three are altered in psychotic disorders. Moreover, disturbances in the basic, momentary sense of self are theorized to underlie cognitive, affective, and motivational deficits in psychotic disorders. But how do basic self-disturbances spill over into the autobiographical self? Are these disturbances part of the serious impairment that typically accompanies diagnosable psychotic disorders? Or do they appear in milder forms or psychosis, or before the onset of psychosis? Might they even play a role in the development of psychotic disorders?

Preliminary evidence suggests that the autobiographical self is already affected in individuals at imminent risk for psychosis, i.e., those exhibiting subclinical psychotic symptoms or genetic risk for psychosis and functional decline. As we saw in Robert Bayley's case, psychotic experiences tend to begin in adolescence and emerging adulthood (roughly ages 14-25). Adolescence and emerging adulthood are crucial developmental stages for the autobiographical self in normative individuals. Together, these stages make up a time when the self-concept, self-referential neural patterns, and narrative identity grow and solidify into their adult forms. Any disturbances in the development of a coherent autobiographical self at this age could have long-lasting effects throughout the life course. It is therefore crucial to understand how the symptoms of an incipient psychotic disorder may interact with autobiographical self-development in imminent risk populations.

Broadly, the goal of this dissertation was to establish a nomological network of autobiographical self-disturbances in individuals at imminent risk for psychosis. This nomological network includes relationships between the self-concept, self-referential neural processing, narrative identity, symptoms, and functional impairment. A multimodal, integrative examination of autobiographical self-disturbances is a novel approach in psychosis, with the potential to greatly enhance our understanding of incipient self-difficulties that precede the dramatic self-dysfunction observed in individuals with psychotic disorders. This approach can: (a) define which aspects of the autobiographical self are altered in individuals at imminent risk for psychosis; (b) investigate common mechanisms which may account for these alterations; and (c) determine key variables that may be viable early indicators of more serious autobiographical self-disturbances.

Chapter 2 provides a high-level overview of the self-concept, narrative identity, and self-referential neural processing in the psychosis spectrum. It will briefly highlight two gaps in the literature. First, little is known about how various aspects of the autobiographical self relate to one another in the psychosis spectrum. Second, little is known about these constructs in individuals at imminent risk for psychosis, who represent a crucial phenomenological and developmental midpoint between healthy populations and individuals with diagnosable psychotic disorders. The current project will address developmental and pathogenetic questions about the origins of self-disturbances. Moreover, it will pose theoretical and mechanistic questions about how various levels of the autobiographical self interact and influence clinical symptoms and functional outcomes.

Chapters 3 through 5 describe a series of studies to address these questions. Study 1 (Chapter 3) examined the clinical and functional relevance of the self-concept in a clinical high risk for psychosis (CHR) sample and a matched healthy comparison sample. Study 2 (Chapter 4) examined self-referential neural processing and tested links between the self-concept and neural self-referential processing. Study 3 (Chapter 5) replicated and extended Studies 1 and 2 in a new sample, with a larger set of self-concept variables, and narrative identity variables coded from a life story interview. Study 3 also examined links between these various elements of the autobiographical self and tested their unique and shared power in predicting clinical symptoms and functional outcomes.

Finally, Chapter 6 synthesizes the three studies' contribution to the literature on self-disturbances in psychosis. What aspects of the autobiographical self were found to be altered in the CHR syndrome, and how did these alterations relate to one another? Might common mechanisms account for any of the findings? And which variables may be early indicators of

more serious autobiographical self-disturbances? Each of these questions will be discussed, with suggestions for future research to explore them further.

Together, this research program presents an integrative step toward unifying various perspectives on the autobiographical self in the psychosis spectrum. A unified understanding will allow future research on each aspect to be interpreted in relation to the others, suggest mechanisms driving dysfunction across multiple aspects, and identify early indicators of severe autobiographical self-disturbances. This thorough study of autobiographical self-disturbances and psychosis risk takes one small step closer to treating individuals on the psychosis spectrum "with empathy and insight, with our personal characteristics recognized as unique and distinctive in their own right" (Bayley, 1996, p. 728).

CHAPTER II

Overview and Research Plan

> "What scared me the most was a sense that I had lost myself, a constant feeling that my self no longer belonged to me.…the real 'me' is not here anymore.…my thoughts, my emotions, and my actions, none of them belong to me anymore.…in my opinion, schizophrenia is ultimately a disorder of the self" (Kean, 2009, p. 1034).

Since the earliest descriptions by Bleuler and Kraepelin, a disturbed sense of self has been considered a hallmark of the subjective experience of schizophrenia (Bleuler, 1911; Kraepelin, 1919; Lysaker & Lysaker, 2010). This self-disturbance is profound, reaching from basic senses of agency and ownership over experience (de Vries et al., 2013; Henriksen & Parnas, 2012; B. Nelson, Parnas, et al., 2014; Sass & Parnas, 2003) to lifelong struggles to build personal identity and find meaning amid lost roles, relationships, and internalized stigma (Andresen et al., 2003; Ben-David & Kealy, 2019; Conneely et al., 2020; Roe & Davidson, 2005). "My illness eradicated my sense of self," one individual with schizophrenia described, "and now I am engaged in the lifelong process of obtaining, maintaining, and slowly modifying my sense of who I am" (Anonymous, 1994).

This brief overview chapter will introduce several key concepts. It will identify two forms of self-experience (the basic self and autobiographical self) and one potential mechanism

linking them together (intrinsic/extrinsic self-processing). It will also define the psychosis spectrum, a dimension extending from normative experience all the way into clinical psychotic disorders. Finally, it will briefly discuss self-disturbances observed thus far in the psychosis spectrum. Building on these topics, I will introduce the dissertation's research plan. In brief, this project will build a nomological network of autobiographical self-disturbances in the CHR syndrome to understand relationships between various kinds of self-disturbances; investigate whether common mechanisms may explain multiple kinds of self-disturbances; and determine key variables that may be early markers of increasing dysfunction in the autobiographical self.

The Basic Self and Autobiographical Self

What is "the self"? Several theorists have distinguished the *basic self* from the *autobiographical self* (Damasio, 1999; Gallagher, 2000; Kircher et al., 2003; B. Nelson, Parnas, et al., 2014; Singer et al., 2013; Zahavi, 2008). The basic self (aka. core or minimal self) is the consciousness of oneself as a locus of experience in the present moment. It is pre-reflective (occurring outside awareness) and, recalling William James's classic description of the "I" self (1890), primarily a subject—an "acting" or "experiencing" self. The basic self operates in the moment, monitoring unconscious representations of bodily states and the external environment and producing subjective experience with a sense of agency and a sense of ownership (Damasio, 1999; Gallagher, 2000; Northoff & Panksepp, 2008; Sass & Parnas, 2003).

Over time, an autobiographical self (aka. extended or narrative self) emerges as the basic self triggers encoding and recall of self-relevant memories. This process produces a continuous sense of self that links present experiences to the remembered past self and the imagined future self (Damasio, 1999; Gallagher, 2000; B. Nelson, Parnas, et al., 2014). The autobiographical self

is thus a temporally extended consciousness of oneself as an individual with a past, present, and future. The autobiographical self is reflective (within conscious awareness) and, recalling James's "me" self (1890), it is not only a subject of awareness but also an object with characteristics such as personality traits, valued goals, and life stories. Clara Kean's account, quoted at the start of this chapter, illustrates basic self experience. Robert Bayley's account, discussed in Chapter 1, illustrates autobiographical self experience. Figure 2.1 shows a conceptual illustration of the relationship between the basic and autobiographical self.

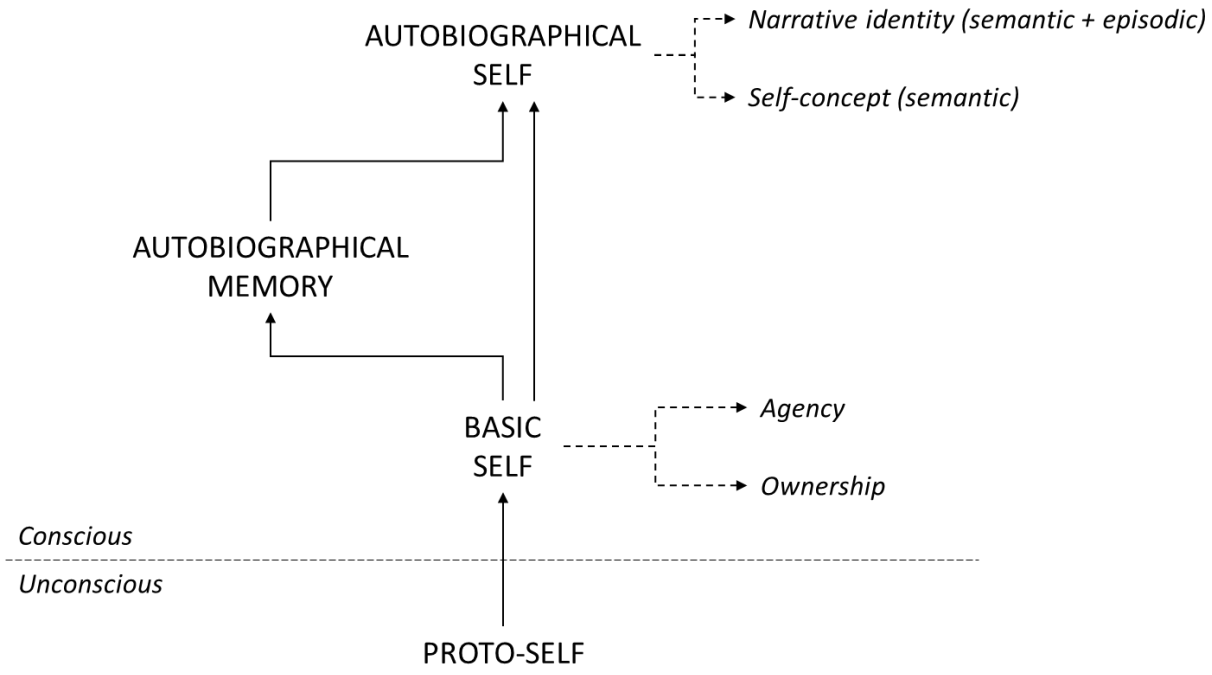

Figure 2.1. A conceptual map of kinds of self. The proto-self contains unconscious representations of bodily states and the environment. The basic self monitors these unconscious representations and produces core consciousness, with phenomenological senses of ownership and agency over experience in the present moment. Repeated "pulses" of core consciousness, in tandem with relevant cued episodic and semantic autobiographical memory, produce the experience of the autobiographical self, including the self-concept and narrative identity. Adapted from Damasio, A. (1999). *The Feeling of What Happens: Body and Emotion in the Making of Consciousness*. Harcourt.

The basic sense of self serves the main functions of producing agency and ownership over subjective experience. But what is included in the autobiographical self? Primarily, it includes trait-based and story-based modes of self-understanding (McAdams, 2019). Since the mimetic culture of *Homo Erectus* 1.5 million years ago, humans have had the self-reflective capacity to assign traits to ourselves and others (Donald, 1991; Dor, 2015; McAdams, 2019; McAdams & Cowan, 2020). Traits encode semantic information about the characteristic ways we are likely to think, feel, and act across many different contexts. More recently, within the past few hundred thousand years, *Homo Sapiens* have developed a further ability to combine semantic and episodic self-knowledge into personal stories (Donald, 1991; McAdams, 2019; McAdams & Cowan, 2020; Mead, 1934; K. Nelson & Fivush, 2020). In contrast to trait-based understanding, story-based understanding attempts to explain how a person might act, feel, or think in a specific context. By applying episodic context to semantic information, a story-based understanding explains not only what someone might do in a certain situation, but why they might do it, and how this might change over time. Personal storytelling is a key adaptation in modern humans, for both social cohesion and self-understanding (Donald, 1991; Dor, 2015; Mead, 1934).

Thus, modern humans experience two parallel forms of self-understanding. The self-concept is the set of semantic information we believe about ourselves. It is an understanding of oneself through knowledge of one's own traits, values, motivations, competencies, likes, and dislikes (Marsh et al., 1992; McAdams, 2013; McAdams & Cowan, 2020; Sebastian et al., 2008). It describes the self as social actor and motivated agent (McAdams, 2013). Narrative identity, by contrast, is an understanding of oneself as an autobiographical author crafting an

"internalized and evolving life story, integrating the reconstructed past and imagined future to provide life with some degree of unity and purpose" (McAdams & McLean, 2013, p. 233).

Self-concept and narrative identity may seem superficially different from one another. Although both are embedded in the continuous, reflective experience of self across extended periods of time, the self-concept is a simpler form of self-knowledge than narrative identity. It relies primarily on semantic information, it is observable earlier in development (in childhood) (McAdams, 2013), and it likely preceded narrative identity in our evolutionary history by over 1 million years (Donald, 1991; Leary & Buttermore, 2003; McAdams & Cowan, 2020). On the other hand, the self-concept is clearly distinct from and considerably more complex than the basic self. The self-concept is reflective, meaning that the individual is aware of having a self-concept, and it relies on stimuli derived outside the present moment. This information is retrieved from personal semantic memory (i.e., "information about ourselves, our personality, and who we are"; Kircher et al., 2003, p. 453), a characteristic which places the self-concept squarely within the autobiographical self (Damasio, 1999; Gallagher, 2000; Kircher et al., 2003). Although there are clear differences between the self-concept and narrative identity, they share a common core mechanism: they both emerge from repeated instantiations of the basic self which trigger recall of relevant autobiographical memory. Thus, they are best modeled as two aspects of the autobiographical self.

This model has another important implication. Because self-concept and narrative identity are both built on the foundation of basic self-experience, any alterations or dysfunctions in the basic self are likely to produce significant consequences in the self-concept and narrative identity. Mechanistically, the basic self may be linked to the autobiographical self in part through

activity in self-referential functional neural networks. Two key functional brain networks support the basic sense of self. The *cortical midline structures* (CMS) form an intrinsic self-network that cognitively and affectively processes self-relevant stimuli. For instance, this network is active when participants consider whether personality traits apply to themselves (Damme et al., 2019). The *sensorimotor network* (SMN), meanwhile, forms an extrinsic self-network that provides agency and ownership over interactions with the environment (Ebisch & Aleman, 2016). Abnormal interactions between these two networks may underlie basic self-disturbances in psychosis (Ebisch & Aleman, 2016). If intrinsic and extrinsic self-processing also support the autobiographical self, then their dysfunction in the psychosis spectrum could be a key mechanism linking basic and autobiographical self-disturbances.

The Psychosis Spectrum and the Clinical High Risk Syndrome

What is "psychosis"? Substantial research evidence supports the idea that psychotic experiences form a continuum in the population, ranging from mild and transient psychotic-like experiences to debilitating symptoms of chronic psychotic disorders. The prototypical and most common *DSM-5* schizophrenia-spectrum disorder is schizophrenia, which combines positive symptoms such as hallucinations and delusions, negative symptoms such as apathy and diminished emotional expression, and/or disorganized symptoms such as disorganized speech and thought (American Psychiatric Association, 2013; Kotov et al., 2020; Reininghaus et al., 2019). Schizophrenia is one of the leading causes of disability worldwide (Vos et al., 2015) and costs the global economy billions of dollars per year (Chong et al., 2016). Yet schizophrenia is relatively rare. Its lifetime prevalence is around 0.5% (Moreno-Küstner et al., 2018; Saha et al., 2005; Simeone et al., 2015), which rises to roughly 0.8% when including related diagnoses of

schizophreniform disorder (symptoms of schizophrenia with a duration less than 6 months) and schizoaffective disorder (symptoms of schizophrenia plus pronounced mood symptoms) (Moreno-Küstner et al., 2018; Simeone et al., 2015).

By contrast, nonclinical psychotic-like experiences are surprisingly common in the general population: 10-25% of adults have experienced hallucinations (Johns & van Os, 2001), and one meta-analysis estimated that 17.5% of adults fall within a broad psychosis phenotype placing them at some kind of elevated risk for psychotic experiences (van Os et al., 2000). In fact, 75 to 90% of all reported psychotic-like experiences are transitory and do not require clinical attention (van Os et al., 2009). Convergent genetic, neuropsychological, social, and environmental findings support a "fully dimensional" model of psychosis in which nonclinical psychotic-like experiences and diagnosable psychotic disorders form opposite ends of a continuous distribution (Claridge & Beech, 1995; DeRosse & Karlsgodt, 2015; M. T. Nelson et al., 2013). This distribution is both phenomenological, with individuals at different points along the continuum experiencing different severities of psychotic-like experiences, and temporal, with psychotic-like experiences becoming more severe over time in those who eventually develop formal psychotic disorders (Barrantes-Vidal et al., 2015; Claridge & Beech, 1995; M. T. Nelson et al., 2013; van Os & Reininghaus, 2016). A range of neuromotor, neuropsychological, and physiological endophenotypes also appear in attenuated form in relatives of individuals with psychotic disorders (A. J. Allen et al., 2009), suggesting that latent biological mechanisms are similar throughout the psychosis spectrum.

Although the psychosis spectrum is a continuous dimension, it can be subdivided roughly into sections. The mildest or earliest section is characterized by trait-like vulnerability to psychosis. This section would include samples labelled, for example, as nonclinical psychosis, schizotypy, psychometric risk, or unaffected family members. Trait vulnerability to psychosis captures a pre-existing pool of individual differences that confer elevated risk for psychosis, such as genetic factors, cognitive style, and personality traits (M. T. Nelson et al., 2013; van Os & Reininghaus, 2016). These variables are typically observed physiologically or psychometrically rather than clinically, as their associated psychotic-like experiences are not significant enough to warrant clinical attention. The middle section of the psychosis continuum is characterized by imminent risk for psychotic disorders. Terminology is evolving, but typical labels for samples in this section would be clinical high risk for psychosis (CHR), ultra high risk for psychosis, at-risk mental state, or *DSM-5* Attenuated Psychotic Syndrome. Individuals at imminent risk for psychosis may exhibit brief or attenuated psychotic symptoms and/or functional decline, warranting clinical attention but not meeting criteria for a psychotic disorder. Roughly 10-40% of these individuals will develop a diagnosable psychotic disorder within 24 months of identification (Fusar-Poli et al., 2013, 2016). I will refer to this section of the psychosis spectrum as the "Clinical High Risk for Psychosis (CHR) syndrome", matching the terminology in the instrument used to detect imminent psychosis risk in Studies 1 through 3 (the Structured Interview for Psychosis-Risk Syndromes; T. J. Miller et al., 1999). Finally, the most severe section of the spectrum is characterized by formal schizophrenia-spectrum disorders (SSD; most commonly schizophrenia, schizoaffective, and schizophreniform disorders), as discussed above.

Self-Disturbances in the Psychosis Spectrum

Self-disturbances are well-established features of schizophrenia (de Vries et al., 2013; Henriksen & Parnas, 2012; Hur et al., 2014; B. Nelson, Whitford, et al., 2014; B. Nelson, Parnas, et al., 2014; Parnas & Handest, 2003; Sass & Parnas, 2003), and are most often defined as dysfunction in the basic self. The mechanisms that produce phenomenological experiences of agency and ownership over internally generated events (e.g., thoughts, memories, inner speech, motor movements) are impacted, leading to many puzzling phenomena: inner experiences feel autonomous and anonymous; external or bodily experiences no longer feel inherently "mine"; boundaries between the self and the world are unclear and constantly shifting; awareness of experiences that would normally occur in the preconscious background (e.g., awareness of the inner speech that underlies thinking) is heightened (*hyper-reflexivity*); and the sense of a field of subjective perception centered on a first-person perspective fades away (*diminished self-affection*) (Kean, 2009; B. Nelson, Whitford, et al., 2014; B. Nelson, Parnas, et al., 2014; Sass & Parnas, 2003).

Theoretical relationships between the basic self and the autobiographical self predict that dysfunction in the basic self should spill over into downstream effects on the autobiographical self. Several lines of evidence suggest that this is the case. The most personally significant memories of individuals with schizophrenia are more likely to include psychotic episodes, hospitalizations, and traumatic events, whereas normative adults' significant memories are more likely to include achievement and relationships (Berna et al., 2011a, 2011b; Raffard et al., 2009, 2010; Wright et al., 2019). Individuals with pronounced delusions also describe delusion-related memories (e.g., memories of being spied on or conspired against) as being unusually vivid,

emotionally intense, and central to the self, highlighting the personal impact of these unusual experiences (Berna et al., 2017). Even more fundamentally, the basic developmental trajectory of the life story is altered by schizophrenia. Significant memories occur earlier in life (age 15-24 and especially age 15-19, compared to age 20-29 and especially age 20-24 in normative adults) (Holm et al., 2017; Raffard et al., 2009, 2010; Ricarte et al., 2017). This shift in the "reminiscence bump" (Koppel & Berntsen, 2015) is likely caused by the onset of psychosis during this crucial developmental stage: the proportion of significant memories increases steadily in the years immediately preceding a psychotic diagnosis, then drops to almost nothing in the years following diagnosis (Holm et al., 2017). Individuals with schizophrenia struggle to maintain coherent self-concepts and narrative identities throughout the life course in the face of altered life experiences and interrupted developmental trajectories. These autobiographical self-disturbances are important and understudied aspects of psychosis-spectrum experiences.

A fully dimensional model of psychosis has important implications for the study of autobiographical self-disturbances. It suggests that autobiographical self-disturbances and issues with lifespan identity development, observed most severely in SSD, probably also occur at varying intensities throughout the psychosis continuum. Moreover, individuals typically pass through intermediate stages of trait vulnerability and imminent risk before developing a full-fledged psychotic disorder (Barrantes-Vidal et al., 2015; M. T. Nelson et al., 2013; van Os & Reininghaus, 2016). Autobiographical self-disturbances likely follow the same pattern as other psychotic symptoms, originating in earlier or milder forms of psychosis before becoming severe enough to warrant clinical attention in SSD (Barrantes-Vidal et al., 2015; Debbané & Barrantes-Vidal, 2015). Thus, the CHR syndrome provides unique explanatory power on multiple

dimensions. Not only does this group shed light on the experience, antecedents, and consequences of moderate-severity psychotic-like experiences, but also on the developmental trajectories of processes which will lead to a psychotic disorder outcome in at least some of the individuals meeting criteria for a CHR syndrome.

Notably, the CHR syndrome overlaps with a key period of normative development in the self-concept and narrative identity. Adolescence and emerging adulthood are key developmental windows not only for psychotic disorders, but also for self-concept and narrative identity. In adolescence, beliefs about the self become more abstract, centered on global evaluations, personal beliefs, and standards (Harter, 1998; McAdams, 2015; Steinberg & Morris, 2001). At the same time, the self-concept becomes more differentiated into multiple domains (e.g., "I am a shy person in class but an outgoing person at recess") (Cole et al., 2001; Sebastian et al., 2008; Steinberg & Morris, 2001). In later adolescence, teenagers gain more experience in various roles and receive feedback from family, peers, and authority figures. This leads to pruning in the self-concept, with some beliefs discarded and others solidified, resulting in a more consistent self-concept and more stable self-esteem (Cole et al., 2001; Cooley, 1902; Mead, 1934; Steinberg & Morris, 2001).

Simple forms of autobiographical consciousness and situated storytelling can be observed in parent-child interactions in childhood (McLean et al., 2007; K. Nelson & Fivush, 2020). Adolescents independently engage in autobiographically reason about their experiences, although they do not yet construct a larger life story from those experiences (McAdams, 2015; McAdams & McLean, 2013). As young people move into emerging adulthood in their late teens and early twenties, their use of autobiographical reasoning expands: it is used not only to explain

single experiences, but also to tie together a lifetime of experiences into an integrative and cohesive life story (McAdams, 2013; McAdams & McLean, 2013). At this stage, a young adult can be said to have a fully formed narrative identity, one that explains how they came to be the person they are, and how they are becoming the person they will be in the future, providing life with some degree of unity and purpose (McAdams, 2013).

The CHR syndrome is typically identified in late adolescence or emerging adulthood (ages 16 – 25), against this normative backdrop of rich self-concept and narrative identity development. How might attenuated psychotic symptoms interact with the development of an emerging autobiographical self? The relevant research literature on self-disturbances in psychosis and the CHR syndrome will be reviewed in full where relevant in Chapters 3 through 5. In brief, research has documented disruptions to the self-concept, self-referential neural processing, and narrative identity in schizophrenia samples. However, these phenomena are typically studied separately, leaving it unclear how they might relate to one another. Similarly, the autobiographical self has been studied primarily in schizophrenia-spectrum disorders and in the general population (including samples with trait vulnerability to psychosis), leaving intermediate segments of the psychosis continuum less well understood. Specifically, little is known about the autobiographical self in the CHR syndrome.

To fill these gaps, this dissertation reports a series of studies of individuals at imminent risk of psychotic disorders integrating self-concept, narrative identity, and functional brain networks. These three paradigms each contribute novel and unique explanatory power. Preliminary evidence suggests that disturbances to self-concept, self-referential neural processing, and narrative identity may all be relevant for CHR populations. These self-referential

processes may even play etiological roles in psychotic disorders during a key developmental window for self-concept and narrative identity. There is considerable potential value in (a) extending these lines of research into CHR populations, and (b) integrated these lines of research to understand relationships between multimodal self-referential processes at multiple levels of analysis. Combining the three paradigms can lead toward an integrated understanding of autobiographical self-disturbances in a crucial developmental stage and risk period for psychotic disorders.

Research Plan

A series of three studies assessed self-referential variables in multiple CHR samples, at multiple levels of analysis, through multiple modalities (self-report, neuroimaging, and life story interviews). The primary aim of this research program was to define a nomological network of autobiographical self-disturbances in the CHR syndrome. To accomplish this primary aim, three subsidiary aims were to:

a. Define which aspects of the autobiographical self are altered in the CHR syndrome.
b. Investigate whether common mechanisms may account for variation across different aspects of the autobiographical self.
c. Determine key variables that may be viable early indicators of more serious autobiographical self-disturbances.

Study 1 (Chapter 3) examined disturbances in the self-concept in a sample of individuals meeting criteria for a CHR syndrome (n = 73), compared to a matched healthy comparison group

(HC; *n* = 73). This study tested whether positive and negative self-beliefs differed between the two groups, and how self-beliefs related to clinical symptoms and functional impairment.

Study 2 (Chapter 4) examined resting-state functional connectivity in intrinsic- and extrinsic-self networks in the brain to determine whether abnormal connectivity patterns could explain any abnormalities in the self-concept.

Study 3 (Chapter 5) examined the self-concept, resting-state functional connectivity, and narrative identity in a new sample (*n* = 50 CHR, *n* = 56 HC). By combining these methods in the same sample, Study 3 directly examined relationships between multiple aspects of the autobiographical self, and their shared and unique effects on clinical symptoms and functional impairment.

CHAPTER III

Study 1: The Self-Concept

Study 1 will examine the self-concept. The self-concept is an ideal entry point into the study of the autobiographical self because of its intermediate placement as a simpler mode of autobiographical self-experience (see Chapter 2). Thus, it is likely linked to more basic processes (i.e.., basic self-experience; neural processing of self-referential information) as well as more complex aspects of the autobiographical self (i.e., narrative identity). The self-concept has also been extensively studied in schizophrenia, with clinical descriptions and research reports appearing since the seminal work of Bleuler and Kraepelin (Bleuler, 1911; Kraepelin, 1919; Rogers, 1958; Sullivan, 1929). Many self-concept variables have been studied in the psychosis spectrum. Here, I will focus on three key aspects of the self-concept which are known to be affected in psychosis (self-esteem, self-concept clarity, and self-beliefs), and three key processes that maintain the self-concept (reflection, rumination, and self-enhancement).

Discussions of the self-concept typically begin with self-esteem, evaluations of one's own worth and competence. Self-esteem is found to be lower in individuals with schizophrenia compared to controls (Fowler et al., 2006; Lecomte et al., 2006; Moritz et al., 2010; Pruessner et al., 2011; Smith et al., 2006). Low self-esteem is associated with the positive symptoms of psychosis (Garety et al., 2001), particularly paranoia and persecutory delusions (Kesting & Lincoln, 2013), as well as anhedonia and negative symptoms (Strauss & Gold, 2012). A growing number of studies also find that individuals with schizophrenia report lower levels of self-concept clarity, the extent to which self-beliefs are clearly and confidently defined, internally

consistent, and stable (J. D. Campbell et al., 1996; Cicero et al., 2016; Cicero, 2017; Klaunig et al., 2018; Weinberg et al., 2012). Associations with symptoms and functioning have been mixed. Self-concept clarity correlates with positive symptoms in some studies (Cicero, 2017; Cicero et al., 2016; Klaunig et al., 2018) but not others (Berna, Göritz, et al., 2016; Weinberg et al., 2012). Although self-concept clarity seems to be relevant to schizophrenia in some way, its precise mechanisms and correlates remain unclear.

One limitation of traditional, unidimensional self-esteem measures is that they do not distinguish between the presence of positive self-beliefs and the absence of negative self-beliefs, which play different roles in contemporary theories of psychotic symptoms (Fowler et al., 2006; Garety et al., 2001; Rector et al., 2005). Accordingly, many studies now assess specific positive and negative self-beliefs (e.g., “I am valuable”, “I am weak”; Fowler et al., 2006). This approach has found negative self-beliefs to be heightened in individuals with schizophrenia, while positive beliefs may or may not be affected (Barrowclough et al., 2003; Fowler et al., 2006; H. E. Taylor et al., 2014). Similar to low self-esteem, negative core beliefs about the self are robustly associated with paranoia and persecutory delusions (Fowler et al., 2012; Freeman et al., 2013; Kesting & Lincoln, 2013; Tiernan et al., 2014). A lack of positive core beliefs may be associated with negative symptoms (Rector et al., 2005; Strauss & Gold, 2012), while their presence may be associated with grandiose delusions (Garety et al., 2013).

These components of the self-concept—self-esteem, self-beliefs, and self-concept clarity—are relatively well-studied in schizophrenia, with relatively well-documented dysfunctions. Less is known about processes that maintain the self-concept in schizophrenia, with some evidence suggesting that rumination, reflection, and self-enhancement are likely to be relevant.

Self-directed thinking often takes one of two forms. The first is rumination, or "brooding", repetitive thinking about threats, losses, injustices, or personal failings motivated by distress and associated with trait neuroticism (Trapnell & Campbell, 1999). Rumination is more common among individuals with schizophrenia than among healthy controls (for a review, see O'Driscoll et al., 2014). Rumination is associated with negative symptoms and depressive symptoms in schizophrenia (Halari et al., 2009; O'Driscoll et al., 2014; Thomas et al., 2014; Vorontsova et al., 2013), and it may also contribute indirectly to hallucination-proneness (Jones & Fernyhough, 2009) and the maintenance of persecutory delusions (Vorontsova et al., 2013).

By contrast, reflection entails intellectual exploration of the self motivated by epistemic curiosity and associated with trait openness (Trapnell & Campbell, 1999). This construct is distinct from basic self-referential processing, which is sometimes referred to as "self-reflection" in the cognitive neuroscience literature (see, e.g., van der Meer et al., 2010). In fact, cognitive neuroscience studies do not typically distinguish rumination from reflection. However, rumination and reflection have distinct and frequently opposite correlates (Trapnell & Campbell, 1999). For instance, individuals with major depressive disorder engage in both rumination and reflection, but rumination is more closely linked to suicidality (Crane et al., 2007; Miranda & Nolen-Hoeksema, 2007). Preliminary evidence suggests that rumination and reflection may also play somewhat different roles in hallucination-proneness (Jones & Fernyhough, 2009) and delusion proneness (Carse & Langdon, 2013). Thus, it is important to separate these two constructs in research on self-related thinking in psychosis.

Finally, consider this paradox: individuals with schizophrenia tend to report lower self-esteem and more negative self-beliefs, yet their clinical presentation often involves grandiose ideas and unrealistic boasting about the self (Epstein, 1955; Garfield et al., 1987; Havener &

Izard, 1962; Knowles et al., 2011). Two theories may account for this discrepancy. The "delusion as defence" model posits that self-enhancing delusions protect the individual from the negative emotion associated with negative self-beliefs. The "emotion-consistent" model posits that specific, genuine positive self-beliefs become exaggerated over time because they preserve positive emotions against a backdrop of global negative self-evaluation (Knowles et al., 2011). It may be possible to test these two theories by comparing measures of implicit and explicit self-esteem. However, that approach has been inconclusive in schizophrenia (Kesting & Lincoln, 2013; Knowles et al., 2011). Another solution is to compare measures of self-beliefs with measures of self-enhancement, the process of shoring up one's self-esteem against threatening feedback by seeking positive feedback and avoiding negative feedback (Swann et al., 1989). Self-enhancement can be individualistic, promoting infallible competence, or cooperative, promoting polite humility (Vecchione et al., 2013). Self-serving attributional biases like these tend to be elevated in individuals with schizophrenia (Janssen et al., 2006; Mehl et al., 2014; Morrison et al., 2007b; So et al., 2015). By comparing measures of self-beliefs and self-enhancement, it should be feasible to identify self-referential processes associated with grandiose ideas.[1]

In summary, a wealth of research data shows omnipresent deficits in the self-concept of individuals with schizophrenia, spanning self-esteem, core beliefs, and self-concept clarity, with clinical implications for symptoms and functioning. Less is known about processes that may

[1] Further support for this approach is provided by research on narcissism, which distinguishes vulnerable and grandiose subtypes of narcissism—analogous to the "delusion as defense" model and the "emotion-consistent" model—and identifies narcissism with individualistic but not cooperative self-enhancement strategies (W. K. Campbell et al., 2000; W. K. Campbell & Miller, 2013; J. D. Miller et al., 2011),

produce and maintain these deficits, and there is a need for research to examine specific relationships and potential mechanisms linking self-concept and self-referential processes.

Self-Concept and Self-Referential Processing in the CHR Syndrome

In various studies, CHR participants have reported lower self-esteem and more negative core beliefs than healthy controls (Addington & Tran, 2009; Stowkowy et al., 2016; H. E. Taylor et al., 2014). Negative core beliefs have been found to relate to attenuated positive symptoms (H. E. Taylor et al., 2014), depression (Addington & Tran, 2009), and transition to psychosis (Stowkowy et al., 2016). Negative self-beliefs have been linked to suspiciousness (Addington & Tran, 2009), which may be particularly etiologically relevant in the CHR syndrome because it motivates social withdrawal, contributing to delusion formation by eliminating social feedback that might disconfirm bizarre ideas (Garety et al., 2001). However, no studies have examined all these variables together in the same sample to determine their mutual relationships.

Few other self-concept variables have been examined in CHR samples, although some evidence from related populations suggests that they may be relevant in the CHR syndrome. Low self-concept clarity seems to be related to more psychotic-like experiences in non-clinical populations (Berna, Göritz, et al., 2016; Cicero et al., 2013, 2015). One mediation study suggests that this relationship may be explained in part by autobiographical reasoning (Berna, Göritz, et al., 2016), while two studies suggest that self-concept clarity interacts with aberrant salience to predict psychotic-like experiences (Cicero et al., 2013, 2015). Similarly, two studies have found rumination and reflection to differentially predict delusion-proneness (Carse & Langdon, 2013) and hallucination-proneness (Jones & Fernyhough, 2009) in non-clinical samples. The potential role of self-enhancement is unclear, with some studies (So et al., 2015) but not others (DeVylder et al., 2013; Janssen et al., 2006) reporting self-serving attributional styles among CHR samples.

However, the utility of separating individualistic from cooperative forms of self-enhancement is supported by one study finding that perceived social status and relational value were protective against low self-esteem in a first-episode psychosis sample (MacDougall et al., 2017). Self-concept and self-referential processes appear to be disrupted in CHR, with clear effects observed for some variables (self-esteem, self-beliefs), and a need for further research to clarify the role of others (self-concept clarity, rumination, reflection, self-enhancement).

Study 1 Aims and Hypotheses

In Study 1, the self-concept was operationalized as positive and negative self-beliefs. The aims of Study 1 were to confirm the clinical relevance of self-beliefs in an existing dataset of individuals who met criteria for a CHR syndrome; examine whether group differences in self-beliefs are better understood in terms of valence (i.e., self-beliefs are shifted to be more negative), intensity (i.e., both positive and negative self-beliefs are more intense), or a combination of both; and test whether positive and negative self-beliefs have unique or shared effects on clinical variables. Specific hypotheses were:

Hypothesis 1. Core beliefs will be abnormal in the CHR group, with fewer positive self-beliefs and more negative self-beliefs compared to the control group.

Hypothesis 2. The CHR group will report a more negative overall valence of self-beliefs, and possibly a higher overall intensity of self-beliefs.

Hypothesis 3a. Negative self-beliefs will correlate with attenuated positive symptoms, depression, anxiety, and functional impairment.

Hypothesis 3b. Low positive self-beliefs will correlate with attenuated negative symptoms, depression, and functional impairment.

Hypothesis 4. Positive and negative self-beliefs may have shared or unique effects on clinical variables. Unique effects will be indicated by significant coefficients in multiple regression models including positive and negative self-beliefs as predictors. Shared effects will be indicated by significant correlations for self-beliefs and the self-belief valence composite score, but no significant coefficients in regression models including positive and negative self-beliefs as predictors.

Method

Participants

Two groups of community participants were recruited through the Adolescent Development and Preventative Treatment (ADAPT) research program via newspaper, bus, and Craigslist ads, e-mail postings, and community professional referrals. One group of participants (n = 73) met criteria for a CHR syndrome based on the Structured Interview for Psychosis-Risk Syndromes (SIPS; T. J. Miller et al., 1999). The second group was a matched sample of healthy comparison participants (HC; n = 73). Exclusion criteria for the HC group included any psychotic disorder in a first-degree relative, a psychosis-risk syndrome as assessed by the SIPS, or any current DSM-IV-TR Axis I disorder. In both groups, participants with a history of head injury, neurological disorder, substance dependence, or any DSM-IV-TR psychotic disorder were excluded from the study. The protocol and informed consent procedures were approved by the Institutional Review Board (IRB). Participant demographic characteristics are shown in Table 3.1 below. Two-tailed t-tests found no group differences in any demographic variables.

Measures

All participants completed two standardized clinical interviews. First, to diagnose the presence and severity of attenuated psychotic symptoms, the SIPS (T. J. Miller et al., 1999) was

administered to all study participants. The SIPS is a semi-structured clinical interview that assesses positive (e.g. perceptual abnormalities), negative (e.g. emotional expression), disorganized (e.g. personal hygiene), and general symptoms (e.g. sleep disturbance), with a total score calculated for each category. As part of the interview, the Global Functioning Scales (Cornblatt et al., 2007) were administered. The GFS are clinician-rated assessments of functional impairment, with ratings assigned from 0 to 10 (10 indicating least impairment) on social and role functioning. The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-IV; First et al., 1997) was also administered to all participants to rule out formal psychotic disorders, and to rule out any DSM-IV Axis I psychopathology in the HC group. Clinical interviews were conducted in person by advanced doctoral students. Diagnostic decisions were made in team meetings, and incorporated data from the SIPS/SOPS as well as material, when available, from corroborative sources including parents, relatives, and treatment providers. Raters, consisting of advanced doctoral students, were trained with videos and then live cases until a high level of reliability was met (*Kappas* $\geq$ .80), and then this was regularly maintained through in-group consensus meetings and regularly held training meetings.

Participants completed several self-report scales in person at the ADAPT research lab. The Brief Core Schema Scale (BCSS) is a self-report scale developed to capture core evaluative schemas in psychotic disorders (Fowler et al., 2006). The BCSS is composed of 24 items, each of which is a brief positive or negative statement about the self or others (e.g. “I am valuable”, “Others are hostile”) rated on a 5-point scale ranging from “0: I do not believe this” to “4: I believe this totally”. Items are grouped into *Positive-Self, Negative-Self, Positive-Other*, and *Negative-Other* subscales, with six items on each subscale. The BCSS has been validated in adult psychosis populations (Fowler et al., 2006). It has also been used increasingly in CHR research.

Researchers have observed that youth meeting criteria for a CHR syndrome tend to report more negative and less positive beliefs, that core beliefs correlate with symptom measures, and that negative self-beliefs tend to increase as participants transition to psychosis (Addington & Tran, 2009; Stowkowy et al., 2016; H. E. Taylor et al., 2014). This study examined the positive-self and negative-self subscales of the BCSS.

Participants also completed self-report measures of depression and anxiety. The Beck Depression Inventory-II (BDI; A. T. Beck et al., 1996) is a commonly-used self-report scale for depression. It consists of 21 items assessing DSM-IV depressive symptoms (e.g. sadness, irritability). Each item is rated from not present (0) to severe (3), and a total score indicates subclinical, mild, moderate, or severe depressive symptomatology. In the CHR syndrome, the BDI shows good internal consistency, construct validity, and criterion validity (DeVylder et al., 2014). The Beck Anxiety Inventory (BAI; Beck & Steer, 1993) is a 21-item self-report measure of anxiety symptom severity, with each item rated from not present (0) to severe (3), and a total score indicating subclinical, mild, moderate, or severe anxious symptomatology. The BAI has seen increased use in youth populations in recent years (Bardhoshi et al., 2016), including in the CHR syndrome (e.g., Hui et al., 2013).

Statistical Analyses

Analyses were carried out in R version 3.6.3 Revised (R Core Team, 2018), primarily using the psych package (Revelle, 2018). Chi-squared tests and independent two-tailed *t*-tests examined group differences in demographics and study variables. Within the CHR group, relationships between self-beliefs, symptoms, and functioning were examined through Pearson correlations with FDR-correction for multiple comparisons (to test zero-order effects of self-beliefs) and simultaneous multiple linear regressions (to test independent effects of positive and

negative core beliefs). Finally, to test possible additive effects of positive and negative self-beliefs, two composite scores were calculated: self-belief valence (positive – negative) and self-belief intensity (positive + negative). These composites were tested using the same procedures as the positive and negative self-belief variables. A supplemental analysis examined relationships between self-beliefs and specific SIPS positive symptoms, using the same correlation and regression methods described above.

Results

Table 3.1

Demographic, Clinical, and Self-Report Measures

		Clinical high risk		Healthy comparison		Test statistic	*p*
N		73		73			
Gender	Female	29	(40%)	41	(56%)		
	Male	44	(60%)	32	(44%)	3.32	.068
Age		18.7	(1.8)	18.1	(2.6)	-1.50	.212
Race	White	50	(68%)	46	(63%)		
	Hispanic	11	(15%)	14	(19%)		
	Other	12	(17%)	13	(18%)	7.89	.342
Education	Years	12.4	(1.7)	12.2	(2.6)	-0.40	.718
Self-beliefs	Negative	0.90	(0.88)	0.17	(0.24)	-6.87	<.001
	Positive	2.06	(0.97)	2.77	(0.74)	4.98	<.001
	Valence	1.16	(1.62)	2.60	(1.62)	6.77	<.001
	Intensity	2.96	(0.91)	2.94	(0.70	-0.17	.865
Attenuated psychotic symptoms	Positive	12.0	(4.6)	0.45	(1.0)	-21.1	<.001
	Negative	9.90	(6.7)	0.41	(0.9)	-11.5	<.001
Other symptoms	Depression	17.1	(11.8)	3.7	(5.0)	-8.79	<.001
	Anxiety	23.9	(13.0)	5.5	(6.5)	-10.6	<.001
Functioning	Social	6.62	(1.70)	8.72	(0.63)	9.90	<.001
	Role	6.82	(1.69)	8.57	(0.67)	8.24	<.001

Note: Test statistics were χ^2 tests for categorical variables and two-tailed t-tests for continuous variables. Numbers in parentheses are percentages for categorical variables and standard deviations for continuous variables. Self-beliefs = Brief Core Schema Scale; Depression = Beck Depression Inventory-II; Anxiety = Beck Anxiety Inventory; Attenuated psychotic symptoms = Structured Interview of Prodromal Symptoms; Functioning = Global Functioning Scales

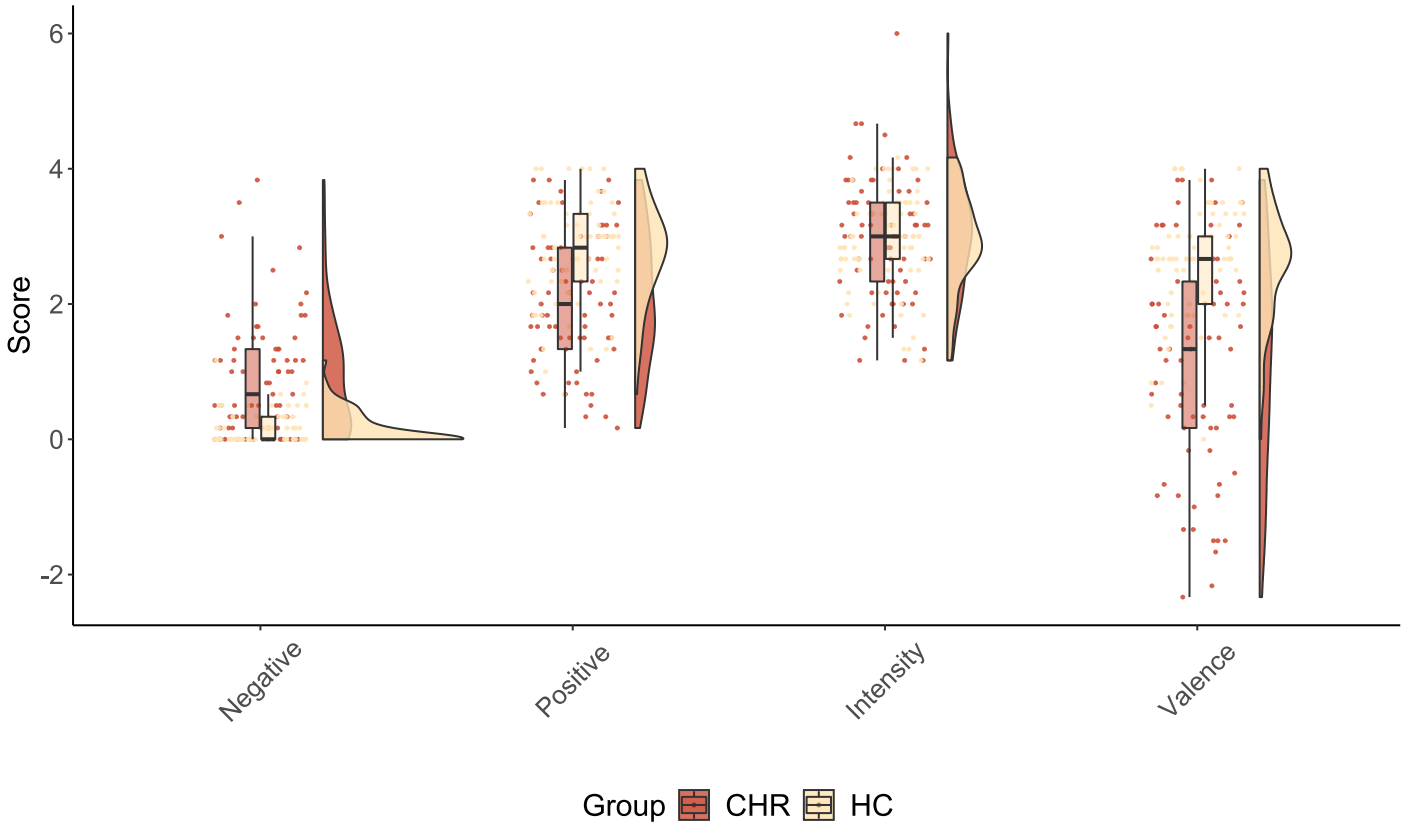

Figure 3.1. Self-beliefs were more negative, less positive, and more negatively valenced in the clinical high risk group (CHR), compared to the healthy comparison group (HC). Overall self-belief intensity did not differ between the two groups. Dots indicate individual participants; box plots and violin plots show the distribution in the CHR and HC groups.

Descriptive statistics for study participants are shown in Table 3.1. Two-tailed t-tests (continuous variables) and χ^2 tests (categorical variables) found no significant differences between demographic variables in the two groups. As shown in Figure 3.1, CHR participants reported higher negative self-beliefs than HC participants, lower positive self-beliefs, and more negatively valenced self-beliefs overall. Effect sizes for these group differences were large: negative beliefs, *Cohen's d* = 1.14; negative beliefs, *Cohen's d* = -0.82; self-belief valence,

Cohen's d = -1.12. CHR participants did not report more intense self-beliefs than controls (*Cohen's d* = -0.03), suggesting that effects were not driven by more extreme self-evaluations in the CHR group.

Table 3.2

Pearson Correlations for Study 1 Clinical Variables in the CHR Group

	1	2	3	4	5	6	7	8	9
1. Negative self-beliefs									
2. Positive self-beliefs	-.52***								
3. Self-belief valence	-.86***	.88***							
4. Self-belief intensity	.41**	.56***	.11						
5. Depression	.56***	-.61***	-.67***	-.12					
6. Anxiety	.26*	-.20	-.26*	.04	.51***				
7. Positive symptoms	.20	-.12	-.18	.06	.28*	.10			
8. Negative symptoms	.44***	-.56***	-.58***	-.17	.54***	.08	.44**		
9. Social functioning	-.37**	.39**	.44***	.05	-.44***	-.07	-.41**	-.74***	
10. Role functioning	-.21	.36**	.33**	.18	-.35**	-.06	-.28*	-.64***	.72***

Note. Self-beliefs assessed by the Brief Core Schema Scales. Depression assessed by the Beck Depression Inventory-II. Anxiety assessed by the Beck Anxiety Inventory. Positive and negative symptoms assessed by the Structure Interview for Psychosis-Risk Syndromes. Functioning assessed by the Global Functioning Scales. Values in square brackets the 95% confidence interval. *p_{FDR} < .05; ** p_{FDR} < .01; ***p_{FDR} < .001.

Did these negatively valenced self-beliefs have any bearing on symptoms or functioning? As shown in Table 3.2, within the CHR group, higher negative self-beliefs correlated with depression, anxiety, negative symptoms, and impaired social functioning; while lower positive self-beliefs correlated with depression, negative symptoms, impaired social functioning, and impaired role functioning. The self-belief intensity composite score did not correlate with any clinical variables, while the self-belief valence composite score correlated with depression, anxiety, negative symptoms, social functioning, and role functioning. In sum, within the CHR

group, the valence of self-beliefs related to negative psychotic symptoms, nonpsychotic mood symptoms, and real-world functioning.

Table 3.3

Regression models predicting clinical outcomes from self-beliefs: Standardized coefficients and model fit statistics

	Self-beliefs (*std.* β)		Model fit	
Dependent variable	Negative	Positive	*F*	*p*
Depression	.328**	-.439***	27.6	<.001
Anxiety	.216	-.085	2.68	.076
Positive symptoms	.188	-.024	1.49	.233
Negative symptoms	.203	-.458***	18.7	<.001
Social functioning	-.232	.267*	8.19	<.001
Role functioning	-.031	.348**	5.38	.007

Note: *$p < .05$; **$p < .01$; ***$p < .001$

Did positive or negative self-beliefs have any unique effects on symptoms or functioning? Separate simultaneous regression models tested the independent effects of positive and negative self-beliefs on each of the clinical outcome variables. As shown in Table 3.3, negative self-beliefs uniquely predicted depression, while low positive self-beliefs uniquely predicted depression, negative symptoms, impaired social functioning, and impaired role functioning. The Variance Inflation Factor was low in all models (VIF ≈ 1.35 for all models, where VIF > 3.0 may indicate collinearity; Imdadullah et al., 2016), suggesting that positive and negative self-beliefs provided non-redundant predictive power. The effect of negative self-beliefs on anxiety, negative symptoms, and functional outcomes largely seems to have been shared with or mediated by the effect of low positive self-beliefs. By contrast, the effect of low positive self-beliefs on these variables remained even when controlling for shared effects with negative self-beliefs. This suggests that lower positive self-beliefs may reflect more impactful self-referential

processes than negative self-beliefs in the CHR state. Overall, these analyses indicate that positive and negative self-beliefs exerted unique effects on clinical variables in the CHR state, that low positive self-beliefs were relevant for multiple outcomes, and that negative self-beliefs were uniquely relevant for mood symptoms.

Contrary to hypotheses, self-beliefs and self-belief valence did not correlate with positive psychotic symptoms. To explore this finding in more detail, a supplemental analysis examined relationships between self-beliefs and specific SIPS positive symptoms. The symptom of suspiciousness correlated with self-belief valence, $r(71) = -.36$, $p_{FDR} = .007$, and negative self-beliefs, $r(71) = .37$, $p_{FDR} = .007$, with a trend suggesting a possible correlation with low positive self-beliefs, $r(71) = -.26$, $p_{FDR} = .073$. A linear regression model predicting suspiciousness from positive and negative self-beliefs found a significant unique effect for negative self-beliefs (*std. beta* = .314, $p = .018$). Thus, although self-beliefs were not associated with positive symptoms overall, negative self-beliefs were uniquely associated with suspiciousness.

Discussion

Replicating past research (Addington & Tran, 2009; Stowkowy et al., 2016), Study 1 found the self-beliefs were notably disturbed in a sample of individuals meeting criteria for a CHR for psychosis syndrome. The CHR group reported substantially more negative and fewer positive self-beliefs, resulting in a more negatively valenced self-concept (see Figure 3.1). Interestingly, this group's self-beliefs were not more extreme than a matched healthy comparison group, suggesting that negative self-beliefs replace or stand in for normative positive self-beliefs.

Cognitive or schema theories predict that core beliefs and attenuated psychotic symptoms should mutually reinforce one another. The putative cognitive mechanism that links core beliefs to psychiatric symptoms is a feedback loop: core beliefs bias how a person interprets an event;

the person experiences the event in a way consistent with the core belief; and this provides further evidence to strengthen the core belief and make it more accessible in the future. This theory predicts that dysfunctional core beliefs (e.g., negative beliefs about the self) should intensify as symptoms increase. In a recent longitudinal study, Stowkowy and colleagues (2016) reported that self-schemas at baseline did not predict conversion to psychosis, but that participants who transitioned to psychosis had significantly more negative self-schemas at the time of transition. Participants' negative self-evaluations increased as their psychotic experiences intensified, and vice versa. The data in Study 1 shows a set of negative self-beliefs present in CHR participants and absent in HC participants. This would be consistent with a feedback loop between self-beliefs and attenuated psychotic symptoms.

The second goal of Study 1 was to examine self-beliefs' clinical relevance by testing relationships between self-beliefs and depression, anxiety, psychotic symptoms, and functional impairment. In the CHR group, negative self-beliefs were uniquely associated with depression and suspiciousness, while a lack of positive self-beliefs was uniquely associated with depression, negative symptoms, impaired social function, and impaired role function. This study is the first to link self-beliefs to functional impairment in a CHR syndrome sample, highlighting self-beliefs' relevance not only for clinical symptoms, but also for real-world outcomes in social and role functioning. One ongoing challenge in psychosis risk research is to disentangle mood symptoms from attenuated negative symptoms. Mood symptoms are often the first observable sign of psychosis risk (Cupo et al., 2021; Häfner et al., 2005), and negative symptoms may not be psychometrically distinct from mood symptoms in the CHR syndrome (Cowan & Mittal, 2021). In this context, it is interesting that negative self-beliefs uniquely predicted depression but

not negative psychotic symptoms. Negative self-beliefs may be one factor that differentiates depression from attenuated negative symptoms.

Surprisingly, Study 1 did not replicate a previously-reported association between self-beliefs and positive symptoms (Addington & Tran, 2009). However, a closer examination of positive symptoms showed a unique association between negative self-beliefs and suspiciousness. This relationship has been reported in adults diagnosed with psychotic disorders (Fowler et al., 2006). In fact, negative self-beliefs can be a key factor maintaining persecutory delusions among adults with a psychotic disorder diagnosis (Vorontsova et al., 2013). Negative self-beliefs and suspiciousness form a vicious circle in which negative self-beliefs justify suspiciousness, and suspiciousness leads to social isolation, removing opportunities to receive social feedback that might disconfirm negative self-beliefs (Garety et al., 2001). Thus, suspiciousness may be an important early correlate of worsening self-beliefs in the psychosis-risk state.

In sum, Study 1 found that self-beliefs were clinically relevant in this sample, with specific links to clinical symptoms and functional impairment. Theoretically, self-beliefs are a self-concept process occupying an intermediate explanatory level; that is, they should relate to underlying patterns of neural activity as well as more complex aspects of the autobiographical self such as narrative identity. However, these relationships have not been empirically defined in the psychosis spectrum. Therefore, Study 2 built on Study 1 by testing links between self-beliefs and neural function in the CHR for psychosis syndrome.

CHAPTER IV

Study 2: Intrinsic and Extrinsic Self-Networks

What mechanisms might drive the self-concept disturbances identified in Study 1? Functional connectivity of large-scale brain networks may provide some clues. Cognitive neuroscience has defined several functional brain networks that together support a coherent, integrated sense of self. Might activity within these networks, or interactions between these networks, relate to dysfunctional self-beliefs?

Normatively, multiple functional brain networks support the sense of self. This evidence comes from studies of resting-state functional connectivity and studies of self-referential tasks such as assigning traits to the self vs. another person (Damme et al., 2019), viewing one's own face vs. another person's face (Platek et al., 2008), or personally relating to vs. passively watching a scene (Nejad et al., 2013). Task-based analyses have identified a network of brain structures which are active in self-referential processing. This network, which runs from the medial prefrontal cortex (mPFC) through the anterior cingulate cortex (ACC) and posterior cingulate cortex (PCC), has been labelled the *cortical midline structures* (CMS). See Figure 4.1 for a map of CMS brain regions. The CMS has two key nodes. An anterior node in the mPFC and ACC is active when assigning self-relevance to stimuli, evaluating or affectively processing self-relevant stimuli, and reappraising or imagining self-relevant stimuli (D'Argembeau, 2013; D'Argembeau et al., 2007; Denny et al., 2012; Luber et al., 2012; Northoff et al., 2006; van der Meer et al., 2010). A posterior node in the PCC is involved in directing attention toward internally- or externally-directed cognition, accessing autobiographical memory, and integrating

multimodal information about the self from the CMS and other brain networks (Herbet et al., 2014; Leech & Sharp, 2014; van der Meer et al., 2010).[2]

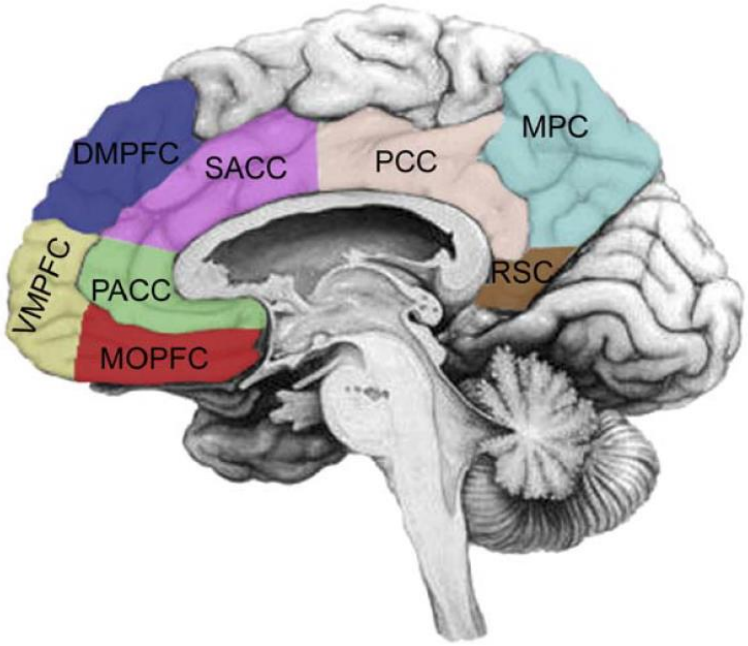

Figure 4.1. The cortical midline structures involved in self-referential processing. VMPFC = ventromedial prefrontal cortex; DMPFC = dorsomedial prefrontal cortex; MOPFC = medial orbital prefrontal cortex; PACC = pregenual anterior cingulate cortex; SACC = supragenual prefrontal cortex; PCC = posterior cingulate cortex; MPC = medial parietal cortex; RSC = retrosplenial cortex. Figure reproduced from Northoff, G., et al. (2006). Self-referential processing in our brain—A meta-analysis of imaging studies on the self. *NeuroImage*, *31*(1), 440–457.

One of these other networks is the sensorimotor network (SMN). The experience of self involves not only internal processing of self-relevant stimuli, but also agency and ownership in interactions with the environment (Christoff et al., 2011; Damasio, 1999; Ebisch & Aleman,

[2] It is worth noting that the CMS are a major component of the default mode network (DMN), a network of brain regions which are observed to be active at rest and deactivated during task-based activities. Some studies use the terms CMS and DMN interchangeably (e.g., Hua et al., 2019; van Buuren et al., 2012); however, the DMN includes regions outside the core CMS, and this study focuses exclusively on the core CMS regions which are most clearly associated with self-referential processing (mPFC, ACC, and PCC).

2016; Ferri et al., 2012; Gallese & Sinigaglia, 2010; Jeannerod, 2003). In contrast to the *intrinsic* self-processing associated with the CMS, this *extrinsic* self-processing has been associated with the SMN, centered on the precentral gyrus (primary motor cortex) and postcentral gyrus (primary sensory cortex) as well as other regions (Christoff et al., 2011; Ebisch & Aleman, 2016; Ferri et al., 2012; Gallese & Sinigaglia, 2010). Figure 4.2 shows overall maps of the CMS (including supplemental regions of the default mode network, which were not examined in Study 2) and SMN. Function in the SMN, and interactions between the CMS and SMN, support the experience of agency and ownership over the body, sensations, movement, and conscious action (Christoff et al., 2011; Ebisch & Aleman, 2016; Ferri et al., 2012; Gallese & Sinigaglia, 2010). Moreover, as Damasio and others have argued, self-reflective consciousness at its most basic level likely emerges from the co-occurrence of changes in internal bodily states and appraisals of self-relevant external stimuli (Damasio, 1999). Thus, it is important to consider both intrinsic and extrinsic self-processing, associated with the CMS and SMN.

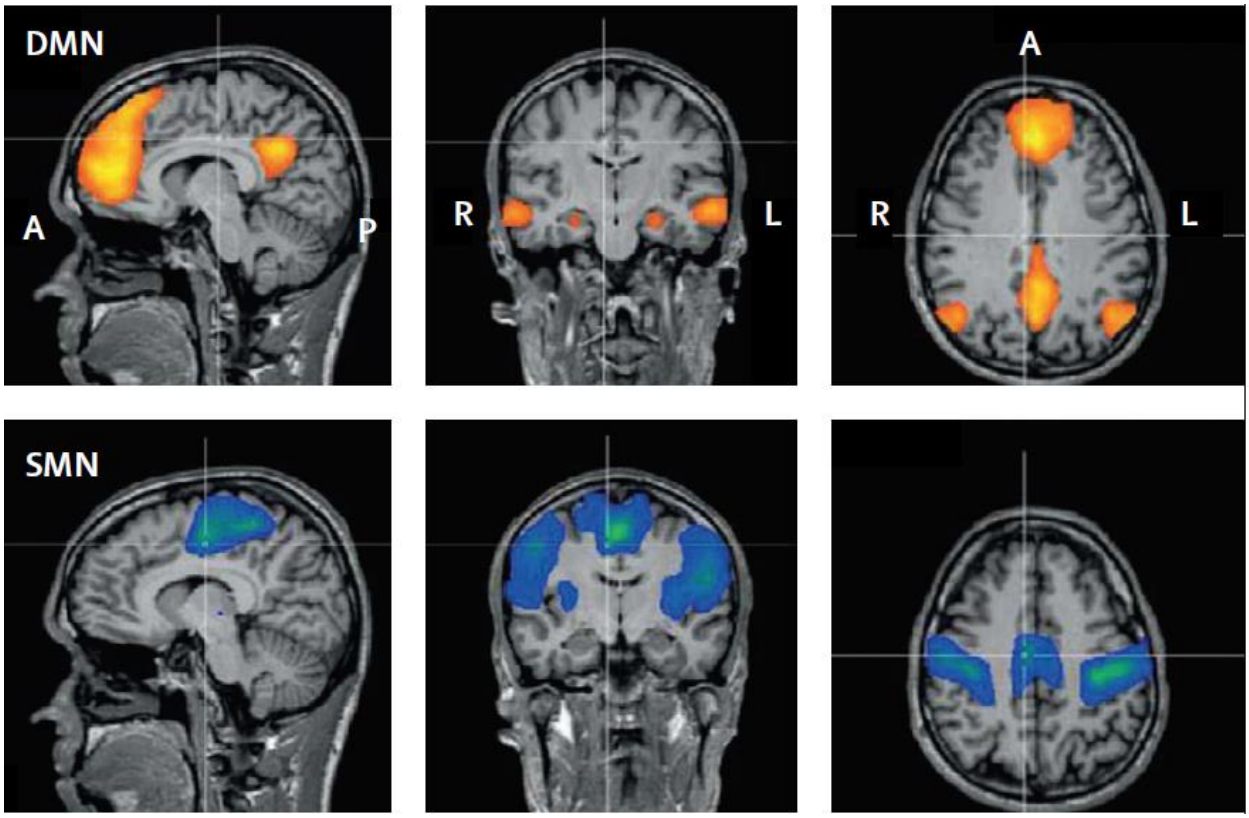

Figure 4.2. Key brain regions for intrinsic and extrinsic self-processing. The default mode network (DMN), which includes the cortical midline structures and several supplemental areas, is associated with intrinsic self-processing. The sensorimotor network (SMN) is associated with extrinsic self-processing. Figure reproduced from Ebisch, S. J. H., & Aleman, A. (2016). The fragmented self: Imbalance between intrinsic and extrinsic self-networks in psychotic disorders. *The Lancet Psychiatry*, *3*(8), 784–790. https://doi.org/10.1016/S2215-0366(16)00045-6

Both the CMS and SMN can be examined when the brain is "at rest"—typically, when participants are asked to relax and close their eyes. Resting-state data capture spontaneous neural activity, "observing where the mind naturally wanders" (Whitfield-Gabrieli & Ford, 2012, p. 60), revealing individual differences in how various participants tend to think and feel. Resting-state fcMRI data have several advantages: they capture individual differences in spontaneous neural

activity, they avoid confounds caused by any idiosyncrasies of experimental stimuli, and they produce data which are directly comparable across labs and studies (Whitfield-Gabrieli & Ford, 2012). They are also particularly well suited to analysis of self-referential processing. When participants are asked to relax and close their eyes, the mind typically wanders to self-directed thinking (Davey et al., 2016; Qin & Northoff, 2011; Whitfield-Gabrieli & Ford, 2012), so resting-state functional connectivity often reflects functional neural mechanisms associated with self-referential processing (Davey et al., 2016; Whitfield-Gabrieli & Ford, 2012).

This argument is most intuitive for intrinsic self-processing associated with the CMS, but surprisingly is also true for extrinsic self-processing associated with the SMN. The SMN is active not only when participants execute motor acts and perceive sensory stimuli, but also when participants remember or imagine motor acts and sensory stimuli (with some subtle differences, see Gerardin et al., 2000; Macuga & Frey, 2012; Oullier et al., 2005). Extrinsic self-processing occurs not only when physically interacting with the environment, but also when imagining interactions and their likely consequences. Thus, intrinsic and extrinsic self-processing are both amenable to resting-state analysis.

Self-Related Functional Neural Networks in the Psychosis Spectrum

Individuals with schizophrenia show functional CMS abnormalities both at rest and during experimental tasks. In resting-state scans, some studies report a pattern of hypoactivation and hypoconnectivity compared to controls (Garrity et al., 2007; Kuhn & Gallinat, 2013; Liemburg et al., 2012), but the more common finding is CMS hyperactivation and hyperconnectivity (Anticevic et al., 2012; Kindler et al., 2015; Penner et al., 2016; Rikandi et al., 2018; Whitfield-Gabrieli & Ford, 2012)—that is, the CMS network is more active than in controls, and its constituent regions are more tightly coupled to one another. Evidence is

somewhat mixed in self-referential experimental tasks. Some studies report CMS hyperactivation (e.g., Shad et al., 2012), but the more common finding is CMS hypoactivation (Bedford et al., 2012; Pankow et al., 2016; Pauly et al., 2014; Potvin et al., 2019; van der Meer et al., 2013).[3] Individuals with schizophrenia probably exhibit more intrinsic self-referential processing at rest, and less during self-referential tasks, compared to healthy controls. Similarly, individuals with schizophrenia show reduced deactivation of the CMS in non-self-referential tasks, suggesting that these individuals may continue to direct their attention toward internal self-referential processing even when presented with an external task (Tan et al., 2015; Whitfield-Gabrieli & Ford, 2012; Zhou et al., 2016).

Abnormal CMS function relates to positive, negative, and cognitive symptoms of schizophrenia. Resting-state CMS dysconnectivity is associated with positive symptoms (Meda et al., 2012; Pauly et al., 2014) including hallucinations (Garrity et al., 2007; Northoff & Qin, 2011; Wolf et al., 2011) and delusions (Holt et al., 2011; Larivière et al., 2017). CMS activation during an insight task has also been linked to clinical insight, i.e., the better an individual's clinical insight, the more CMS activation was observed during an insight task (Raij et al., 2012). Finally, lack of task-based CMS suppression is associated with impaired cognition (Zhou et al., 2016), insight (van der Meer et al., 2013), and emotional appraisals (Holt et al., 2011) as well as aberrant salience attribution (Pankow et al., 2016).

The SMN also functions abnormally in psychotic disorders. Reduced activity in the sensorimotor network has been associated with experiences of alien control (Spence et al., 1997;

[3] Note that the CMS are activated in controls during self-referential tasks, so this finding means that activation is attenuated in individuals with schizophrenia compared to controls. In other words, individuals with schizophrenia still have activation in the CMS in self-referential tasks, but this activation is less intense than that observed in healthy controls.

Walsh et al., 2015), thought insertion (Walsh et al., 2015), auditory hallucinations (Raij & Riekki, 2012), and severity of hallucinations (Shergill et al., 2014). These phenomena reflect a loss of agency and ownership over bodily and perceptual experiences (Ebisch & Aleman, 2016). Agency is a key element in models of the self-concept (see, e.g., Tafarodi & Swann Jr., 1995) and narrative identity (McLean et al., 2020), suggesting that activity in the sensorimotor network could be an underappreciated factor in schizophrenia's characteristic self-disturbances. Ebisch and Aleman (2016) have taken up this argument, suggesting that interactions between the CMS and sensorimotor network—passing through hub regions such as the posterior cingulate cortex (Leech & Sharp, 2014)—are important drivers of self-disturbances in schizophrenia. They suggest that a failure of integration between intrinsic and extrinsic self-networks leads to confusion about boundaries between "self" and "not-self". Neurocognitively, errors in source monitoring (identifying information as self- or externally-generated) are most closely tied to the phenomenological experience of self-disturbances (B. Nelson et al., 2019; B. Nelson, Whitford, et al., 2014). Failure to integrate intrinsic and extrinsic self-processing is a viable neural mechanism to explain this effect. Thus, although evidence is limited at present, there are theoretical reasons to suspect that SMN function, and interactions between the CMS and SMN, may be key mechanisms in basic and autobiographical self-disturbances

Self-Related Functional Neural Networks in the CHR Syndrome

There is considerably less evidence on intrinsic and extrinsic self-processing in CHR populations. So far, a small number of CMS imaging studies have reported CMS hyperactivation, hyperconnectivity, and attenuated task-based suppression, similar to common findings in schizophrenia (Clark et al., 2018; Damme et al., 2019; Shim et al., 2010; Wotruba et al., 2014). It is less clear how these disruptions relate to clinical symptoms and self-concept in

CHR, although two promising findings link CMS resting-state hyperconnectivity to impaired clinical insight (Clark et al., 2018) and reduced CMS task-based suppression to reality distortion and impaired cognition (Wotruba et al., 2014). Given that some of the links between self-referential processing and clinical symptoms are identifiable in the CHR syndrome, it is possible that all the effects observed in schizophrenia are present in attenuated form in the CHR syndrome. Alternatively, it is possible that some may emerge at a later developmental stage or a later stage of disease progression for those individuals who later go on to develop schizophrenia.

No studies have examined extrinsic self- processing in the SMN or interactions between intrinsic and extrinsic self-processing in the CHR syndrome. One study has reported that source monitoring errors are associated with basic self-disturbances in a CHR sample (B. Nelson et al., 2019), suggesting that interactions between intrinsic and extrinsic self-processing may be relevant in this population. However, no studies have directly examined intrinsic and extrinsic self-processing.

Study 2 Aims and Hypotheses

The aim of Study 2 was to examine neural correlates of the self-concept in the same sample as Study 1. Self-referential neural processing was examined through resting-state functional connectivity fMRI of relevant brain networks. Candidate brain networks were identified as those associated with the intrinsic self (cortical midline structures; CMS) and extrinsic self (sensorimotor network; SMN). Specific hypotheses were:

Hypothesis 1. Reflecting overactive self-referential processing at rest, the CHR group will have higher resting-state functional connectivity in the CMS and SMN compared to the control group.

Hypothesis 2. Overactive self-processing at rest is likely associated with dysfunction in the self-concept. Therefore, connectivity within the CMS will relate to both positive and negative self-beliefs within the CHR group, with attenuated hyperconnectivity associated with more positive and less negative self-beliefs.

Hypothesis 3. In Study 1, positive self-beliefs were strongly associated with functional outcomes. This suggests that SMN connectivity may relate specifically to self-beliefs. Specifically, attenuated hyperconnectivity in the SMN may be associated with higher positive self-beliefs.

Hypothesis 4. Elevated connectivity between the CMS and SMN are likely to produce psychotic-like experiences by impairing participants' ability to distinguish intrinsic from extrinsic phenomena. Similarly, self-beliefs may relate to connectivity between the CMS and SMN, with higher CMS-SMN connectivity associated with more positive and less negative self-beliefs.

Method

Participants

Participants were a subset of the Study 1 participants for whom resting state fMRI data were available. All participants with complete fMRI data were included, resulting in samples of 56 CHR and 59 HC. Subsample demographics were similar to the full sample. CHR participants were 39 (69%) Caucasian, 11 (20%) Hispanic/Latin, 3 (5%) Asian, and 3 (5%) other; 7 (13%) left-handed; with a mean age of 18.66 (SD = 1.74); a mean of 12.49 years of education (SD = 1.67); and a median annual household income of $40,000 – 59,999. HC participants were 36 (61%) Caucasian, 12 (20%) Hispanic/Latin, 8 (14%) Asian, and 3 (5%) other; 4 (7%) left-

handed; with a mean age of 18.36 (SD = 2.50); a mean of 12.39 years of education (SD = 2.48); and a median annual household income of $40,000 – 59,999.

Materials

Interview and self-report materials were the same as those used in Study 1. The SIPS assessed attenuated psychotic symptoms, the GFS assessed functioning, and the BCSS assessed positive and negative self-beliefs.

MRI Procedures

MRI Acquisition Parameters

Subjects were instructed to rest and close their eyes during a T2*-weighted echo planar imaging functional protocol (5 min 34 s; 3.8 x 3.8 x 3.5 mm voxels; 33 slices; FOV=240 mm; TR=2,000 ms; TE=29 ms; FA= 75°). MR images using a standard 12-channel head coil with a 3-Tesla Siemens Tim Trio MRI Scanner (Siemens AG, Munich, Germany). For registration to Montreal Neurological Institute (MNI) template space, structural images were collected using a T1-weighted 3D magnetization sequence (0.512 mm isotropic voxels; 224 interleaved slices; Field of View [FOV] 256 mm; time to repetition [TR] 2,400 ms; time to echo [TE] 2.01 ms; GRAPPA Factor 2; flip angle [FA] 8; collection orientation: sagittal plane).

Resting-State Data Processing

The FMRIB Software Library (FSL v6.0) (Jenkinson et al., 2012) was used to complete data processing. FSL was used to strip the skulls from images using brain extraction, high-pass filtering (100s), and spatial smoothing (6-mm FWHM). Functional images were aligned to the Montreal Neurological Institute (MNI) 2-mm brain template. Temporal derivative regressors were calculated with artifact detection software (ART) (Adolphs, 2002; Gallese & Goldman, 1998; Mitchell et al., 2006; Nickerson, 1999). Three translation and three rotation parameters

were derived, as well as additional image specific confound regressors based on brain activation and framewise movement. Brain activation outliers were calculated using the mean global brain activity, i.e., the *z*-normalized mean signal across all voxels as a function of time. Outliers were defined as any frames where global mean signal exceeded 3 SD. Framewise motion measures (composite measure of total motion, or maximum voxel displacement, across translation and rotation) were used to identify motion outliers, defined as frames where the absolute value of motion exceeded 1 mm. The resultant motion regressors were entered into the model as a temporal derivative nuisance covariate at the subject level. Anatomical images were segmented into gray matter, white matter, and CSF with SPM12 to create masks for signal extraction. The Conn toolbox extracts five temporal components from the segmented CSF and white matter, which were entered as confound regressors in the subject-level GLM. The temporal derivative of composite motion outliers (as described above) was calculated in the ART toolbox and included as a nuisance regressor.

Data Analysis

Interview and Self-Report. Chi-squared tests (categorical variables) and two-tailed *t*-tests (continuous variables) tested group difference on demographic variables and self-beliefs within the subsample of participants in Study 2.

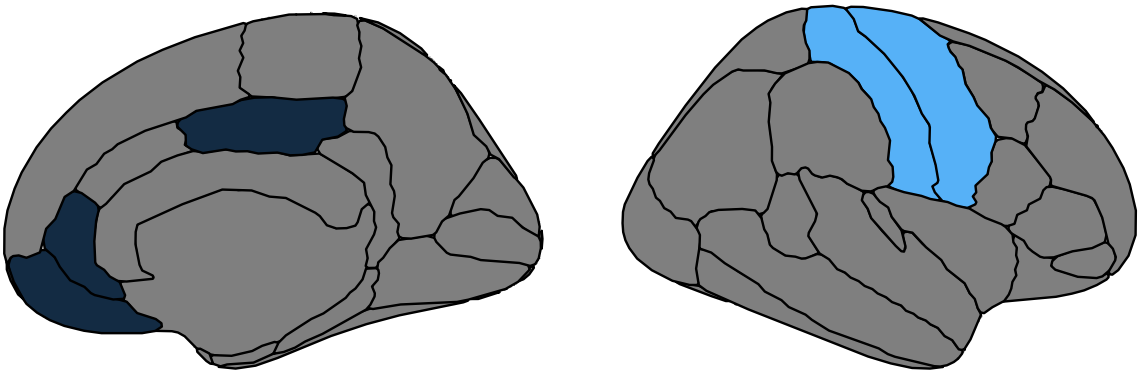

Figure 4.3. Regions of interest (ROIs) overlaid on the Desikan brain atlas (Desikan et al., 2006). CMS regions (in dark blue) were the medial orbitofrontal and rostral anterior cingulate regions (combined into one medial prefrontal mask) and the posterior cingulate region. SMN regions (in light blue) were the precentral region (primary motor cortex) and postcentral region (primary sensory cortex). ROIs were defined in both the left and right hemisphere; right hemisphere shown here.

Connectivity. CONN toolbox v.18.b (Whitfield-Gabrieli & Nieto-Castanon, 2012) and SPM12 (http://www.fil.ion.ucl.ac.uk/spm/software/spm12/) were used to conduct ROI-to-ROI analyses across regions in the CMS and SMN. CMS regions were the medial prefrontal cortex and posterior cingulate cortex. SMN regions were the primary motor cortex and primary sensory cortex (see Figure 4.3). ROIs were defined in FreeSurfer (Fischl, 2012), which uses cortical surface landmarks to delineate cortical areas defined in the Desikan atlas (Desikan et al., 2006). A separate mask was defined for each ROI in both hemispheres, resulting in a total of 8 masks.

Connectivity between ROIs was calculated by averaging across voxel in each ROI to create an ROI level time course. The connection between regions was then calculated with Fischer-transformed bivariate coefficient by correlating each ROI time course. To reduce noise each subject's anatomical image was segmented into gray matter, white matter, and cerebrospinal fluid (CSF) and used as masks for signal extraction of variance.

ROI-to-ROI connectivity matrices were extracted and analyzed in two steps. First, group contrasts compared connectivity patterns between groups (CHR vs. HC). Second, between-group interactions tested whether the CHR group's unusual distribution of self-beliefs (elevated negative and suppressed positive self-beliefs, found in Study 1) were associated with unique patterns of connectivity which were not present in the HC group. Interaction effects were defined in a general linear model in which the interaction of group and self-beliefs predicted connectivity between all 8 ROIs. Significant effects were defined at $p < .05$ for seed-level two-tailed *t*-tests with FDR-correction. Effects were not thresholded at the cluster level. Self-belief scores were grand-mean centered prior to analyses.

Finally, subject-level ROI-to-ROI connectivity coefficients were extracted from the model and plotted to examine significant interaction effects. As a supplemental analysis, self-belief scores were then divided by quartiles, with *t*-tests comparing the CHR and HC means within each quartile to examine the shape of the interactions.

Results

Interview and Self-Report

There were no significant differences between CHR and HC groups on any demographic variables (race, handedness, age, education, or income). As in the full Study 1 sample, CHR participants reported significantly more negative self-beliefs (mean = 0.92, SD = 0.85) than HC participants (mean = 0.19, SD = 0.26), $t(64) = 6.16$, $p < .001$, $d = 1.16$. CHR participants also reported significantly less positive self-beliefs (mean = 2.04, SD = 0.95) than HC participants (mean = 2.80, SD = 0.73), $t(103) = -4.87$, $p < .001$, $d = -0.90$ [95% CI -1.28, -0.51].

Resting-State Functional Connectivity

Group Contrast

As shown in Table 4.1 and Figure 4.4, the CHR group showed a pattern of interhemispheric hypoconnectivity within the CMS and SMN. This consistent pattern was found in the anterior node of the CMS (mPFC), the posterior node of the CMS (PCC), and the SMN (primary motor and sensory cortices). These effects may reflect broad reductions in interhemispheric connectivity or specific reductions in connectivity within these networks.

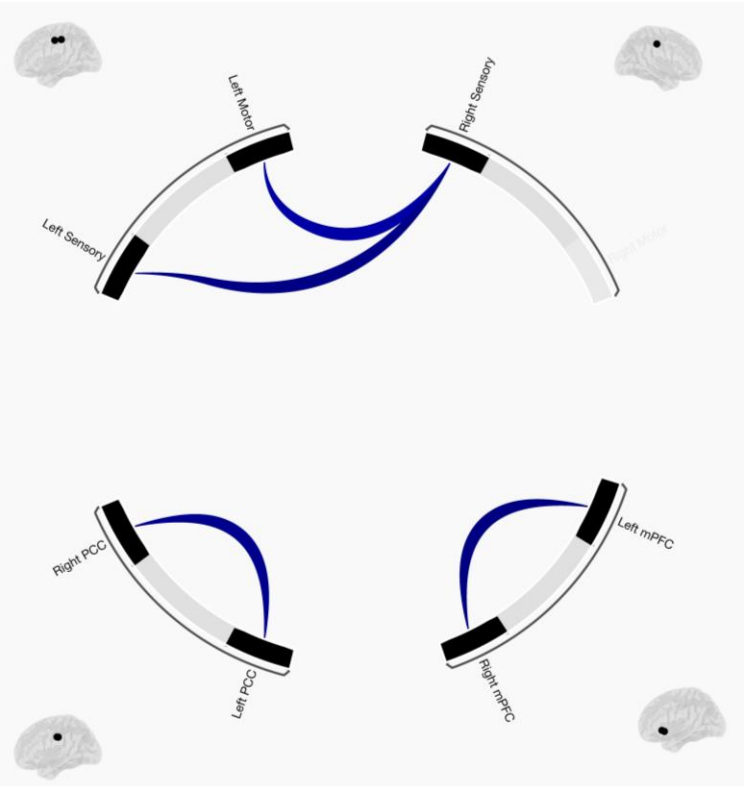

Figure 4.4. Group differences in functional connectivity (CHR > HC). Colors indicate t-statistics, with blue indicating negative effects (i.e., CHR has less connectivity than HC) and red indicating positive effects (i.e., CHR has more connectivity than HC). Effects were thresholded at $p_{FDR} < .05$, with no cluster-level thresholding.

Table 4.1

Functional Connectivity: Group Contrasts (CHR > Control)

Regions of interest	*t*	p_{FDR}
L mPFC – R mPFC	-3.01	.039
L Sensory – R Sensory	-2.97	.039
L PCC – R PCC	-2.92	.039
L Motor – R Sensory	-2.78	.044

Note: DF = 55.
Correlations shown here were significant at the ROI-to-ROI level ($p_{FDR} < .05$) with no cluster-level thresholding.
mPFC = medial prefrontal cortex; PCC = posterior cingulate cortex; Sensory = primary sensory cortex; Motor = primary motor cortex

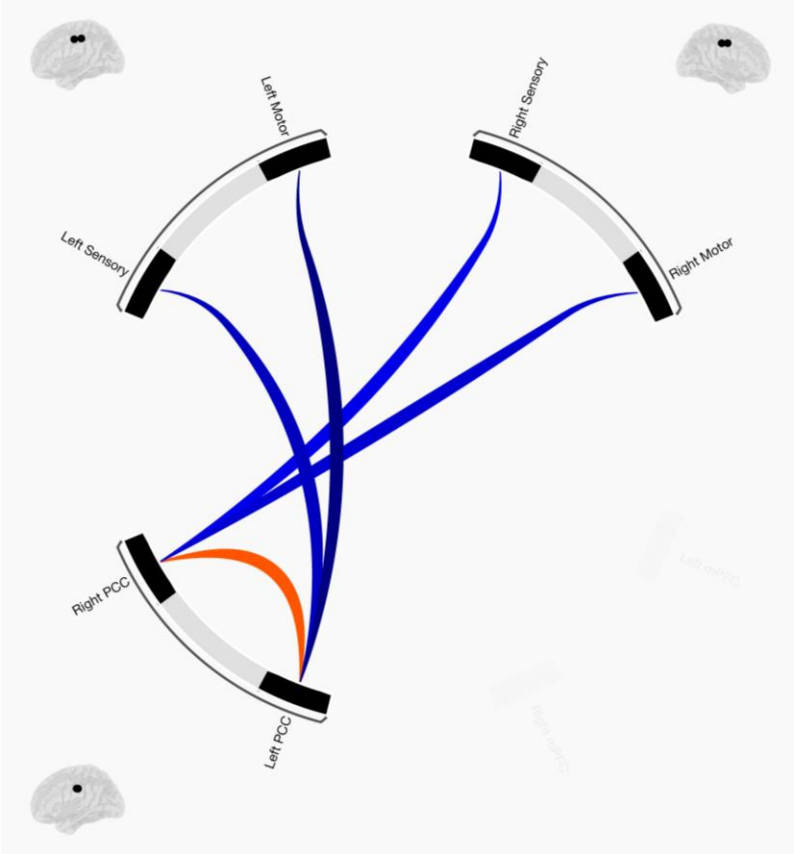

Figure 4.5. Group differences in the relationship between positive self-beliefs and functional connectivity. Effects plotted for the group (CHR > HC) x positive self-beliefs interaction. Negative effects (in blue) indicate that the relationship between positive self-beliefs and connectivity is more negative in CHR than HC, while positive effects (in red) indicate that the relationship between positive self-beliefs and connectivity is more positive in CHR than HC.

Table 4.2

Functional Connectivity: Positive Self-Beliefs by Group (CHR > Control) Interaction

Regions of interest	*t*	p_{FDR}
L PCC – L Motor	-4.66	<.001
L PCC – L Sensory	-4.06	.001
R PCC – R Motor	-3.91	.001
R PCC – R Sensory	-3.67	.002
L PCC – R PCC	2.75	.039

Note: DF = 113.
Correlations shown here were significant at the ROI-to-ROI level (p_{FDR} < .05) with no cluster-level thresholding.
PCC = posterior cingulate cortex; Sensory = primary sensory cortex; Motor = primary motor cortex

Positive Self-Beliefs

As shown in Figure 4.5 and Table 4.2, group interacted with positive self-beliefs in predicting hyperconnectivity between the left and right PCC and hypoconnectivity between the bilateral PCC and bilateral primary motor and sensory cortices. The CHR group's low positive self-beliefs were associated with unusually low levels of connectivity within the posterior CMS (left to right PCC) and high levels of connectivity between the posterior CMS and SMN.

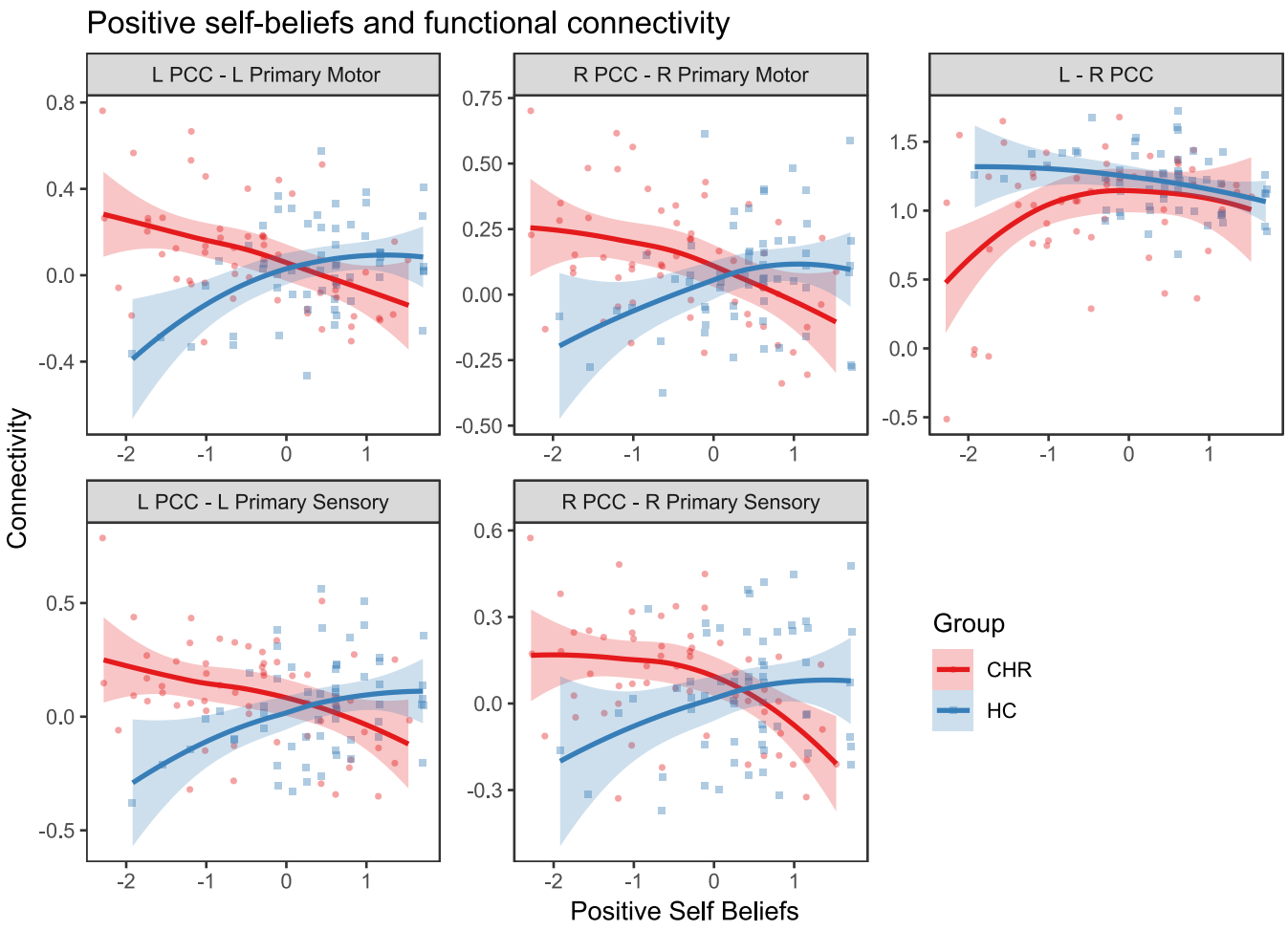

Figure 4.6. Associations between positive self-beliefs and functional connectivity in the CHR (red) and HC (blue) groups. Relationships plotted as LOESS (locally estimated slopes) regression lines to highlight any nonlinearity. Colored bands indicate the standard error of the LOESS regression lines.

What shape were these interactions? Interactions are plotted in Figure 4.6, with LOESS (locally estimated slopes) regression lines showing associations between positive self-beliefs and connectivity. LOESS regression lines follow local trends in the data rather than assuming linear relationships between variables. Visually, the interaction for left to right PCC connectivity appears to reflect a substantial difference between CHR and HC, but only at low levels of positive self-beliefs. By contrast, the interactions between bilateral PCC and sensorimotor

regions appear to be crossover interactions, with opposite relationships between self-beliefs and connectivity across the full range of positive self-beliefs.

To follow up on this observation, I calculated mean connectivity levels for each quartile of positive self-belief scores, then compared CHR and HC group means within each quartile. The resulting effect sizes are shown in Figure 4.7 as Cohen's *d* with 95% confidence intervals. For connectivity between the left and right PCC, connectivity scores differed between CHR and HC only in the bottom quartile of positive self-beliefs, $t(32) = -2.69$, $p = .011$. By contrast, for connectivity between the PCC and SMN regions, connectivity scores differed between CHR and HC in the bottom quartile (all $t > 3.46$, all $p < .002$) and the top quartile (all $t < -2.11$, all $p < .044$). While the L – R PCC interaction was driven by a local effect at low levels of positive self-beliefs, the PCC – SMN interactions were classic crossover interactions with opposite relationships between self-beliefs and connectivity across the full range of positive self-beliefs.

Negative Self-Beliefs

Group (CHR vs. HC) did not interact with negative self-beliefs in predicting functional connectivity between any ROIs (after FDR-correction). While the CHR group reported substantially higher levels of negative self-beliefs, these beliefs did not appear to relate to connectivity within or between the CMS and SMN.

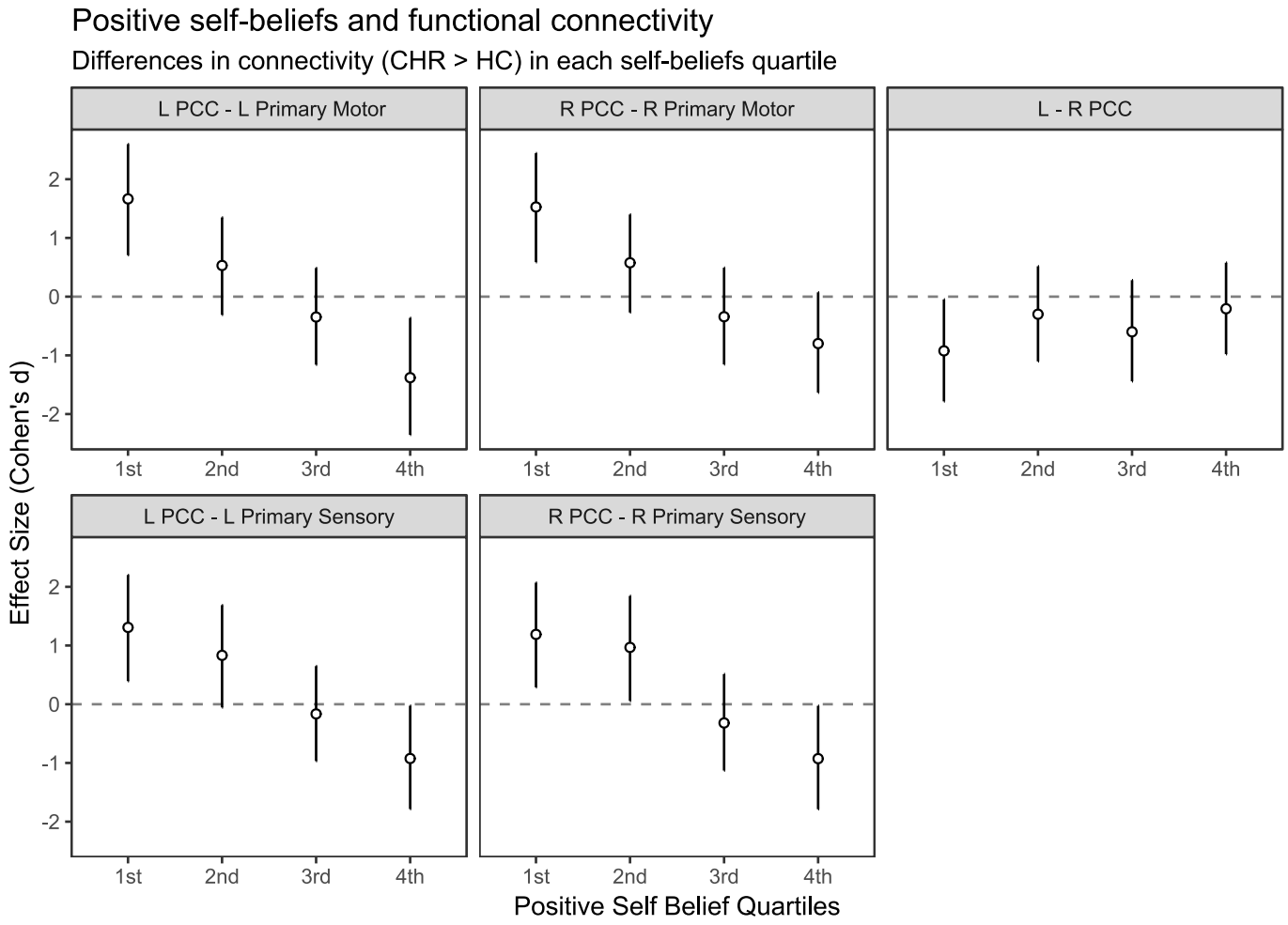

Figure 4.7. Interactions plotted as effect sizes of mean differences in connectivity (CHR > HC) within each quartile of positive self-belief scores. Effect sizes expressed as Cohen's *d*, with error lines indicating 95% confidence intervals.

Discussion

Young people meeting criteria for a CHR syndrome have a self-concept characterized by exaggerated negative self-beliefs and an absence of positive self-beliefs. Study 2 showed that this maladaptive self-concept is also associated with unusual patterns of functional connectivity in two critical brain networks: the CMS, thought to support an intrinsic self which processes self-referential information; and the SMN, thought to support an extrinsic self which processes actual

or imagined interactions between the self and the environment. Study 1 showed that the absence of positive self-beliefs was associated with depression, negative symptoms, and functional impairment. Study 2 showed that the absence of positive self-beliefs was also associated with unusual functional connectivity patterns in the CHR group: low connectivity within the posterior CMS at rest, and high connectivity between the CMS and SMN at rest.

The posterior node of the CMS is involved in directing attention toward internally- or externally-directed cognition, accessing autobiographical memory, and integrating multimodal information about the self from the CMS and other brain networks (Leech & Sharp, 2014; van der Meer et al., 2010). These are key functions of the intrinsic self, and functional connectivity between the left and right PCC was a factor in the CHR group's low positive self-beliefs. Multiple CHR studies have found abnormal resting-state connectivity in the PCC, notably reduced anticorrelations between the PCC and the task-positive network (Shim et al., 2010; Wotruba et al., 2014). This indicates less efficient switching between internally and externally directed cognition, reflecting CHR individuals' liability to get "caught up in" internal experience (Brewer et al., 2013). Deficits in integrating internally- and externally-directed cognition likely contribute to basic self- or ego-disturbance (Northoff & Duncan, 2016). The same processes could contribute to low positive self-beliefs. In schizophrenia, low positive self-beliefs are maintained in part by a lack of updating in response to belief-inconsistent information (e.g., positive feedback about the self) (Rector et al., 2005; Strauss & Gold, 2012). To update a belief in response to inconsistent information, it would be necessary to repeatedly switch focus between the belief and inconsistent experience, a function which is normatively associated with the PCC. Internal-external switching and integration could be key processes whose absence drives the formation and persistence of low positive self-beliefs in CHR youth. However, this effect was

only present at very low levels of positive self-beliefs, indicating that processing within the posterior CMS could not account for the full range of differences in self-beliefs between the CHR and HC groups.

More robustly, throughout the entire range of positive self-beliefs, the CHR and HC groups showed opposite associations between positive self-beliefs and connectivity between the posterior CMS and SMN. The SMN is involved in actual or imagined interactions with the environment, and represents the acting or extrinsic self (Ebisch & Aleman, 2016). Many sensorimotor functions are abnormal in psychotic disorders (Walther & Mittal, 2017), and alterations in motor coordination (Damme et al., 2021; Dean et al., 2018; Masucci et al., 2018), dyskinesia (Damme et al., 2021; Mittal et al., 2010), gesture perception (Gupta et al., 2021), and sensorimotor gating (Bo et al., 2021; Khan & Powell, 2018; Quednow et al., 2008) have all been observed in the CHR syndrome. These widespread dysfunctions in sensorimotor function may account for the opposite relationships between self-beliefs and functional connectivity in the CHR and HC groups. For normatively developing youth, the self-concept is based to a large extent on extrinsic domains such as academic and sports performance, physical appearance and grooming, and "good behavior" (e.g., "behaving themselves" and "acting as they are supposed to"; Cole et al., 2001). In the HC group, positive self-concept was highest when the posterior CMS and SMN were more connected, implying that these individuals may draw on the extrinsic self, imagining or remembering interactions with the environment, to support a positive self-concept. By contrast, in the CHR group, positive self-concept was lowest when the posterior CMS and SMN were more connected. When these individuals draw on the extrinsic self, they may become more aware of their faulty sensorimotor processes and functional impairment, leading to more negative self-evaluations. For CHR individuals with lower PCC-SMN

connectivity, a compensatory strategy of decoupling intrinsic and extrinsic self-processing may have preserved positive self-beliefs.

This mechanism could produce self-enhancing delusions over time, as positive self-beliefs become increasingly divorced from interactions with the environment (as predicted by the "emotion-consistent" model of self-enhancing delusions; Knowles et al., 2011). Moreover, this could be a pathogenetic mechanism for broader CMS and SMN dysconnectivity. The CMS and SMN are less functionally connected in schizophrenia compared to healthy controls (Alderson-Day et al., 2016; Alonso-Solís et al., 2015; Schilbach et al., 2016), particularly for individuals who experience auditory hallucinations. Following from this and other evidence, Ebsich and Aleman (2016) have proposed that reduced connectivity between the CMS and SMN reflects a fragmentation of intrinsic and extrinsic self-processing in schizophrenia, leading to self-disturbances, psychotic symptoms, and impaired insight in schizophrenia. If connectivity between the CMS and SMN is damaging to the self-concept when paired with attenuated psychotic symptoms, then a viable strategy to protect the self-concept would be to reduce functional interactions between these networks. This mechanism is unlikely to fully explain the origin of disconnection between the CMS and SMN in schizophrenia, but it may be one process among many leading toward disintegration of intrinsic and extrinsic self-processing.

Cognitive-behavioural treatments have been suggested to target schemas or self-beliefs (Grant & Beck, 2009; Kesting & Lincoln, 2013; Palmier-Claus et al., 2011; Rector et al., 2005; Stowkowy et al., 2016; Strauss & Gold, 2012; H. E. Taylor et al., 2014). Study 2 suggests that positive self-beliefs may respond to interventions differently in the CHR syndrome than in other populations. Interventions for self-beliefs in CHR may need to focus on activating and attending to effective behavior (extrinsic self-processing) more so than in other populations. Furthermore,

antipsychotic medication seems to alter functional connectivity in the CMS. One study of pre- to post-treatment changes in functional connectivity in schizophrenia patients found that antipsychotic medication increased functional connectivity in the medial prefrontal cortex and decreased functional connectivity in the posterior cingulate cortex (Wang et al., 2017). This may have the unintended side effect of decreasing positive self-beliefs. Self-doubt and low self-esteem contribute to poor subjective quality of life in individuals prescribed antipsychotic medication (Chou et al., 2014; Moritz et al., 2010), and decreased positive self-beliefs may be one mechanism for these effects. Self-beliefs may be an important outcome or mediator when examining the effects of antipsychotic medication.

This study's main strengths include its reasonable sample size, inclusion of a normatively developing comparison group, administration of a measure of specific positive and negative self-beliefs, and anatomical definition of regions of interest in line with prior theory. This study's main limitations include its cross-sectional design, which limits causal inferences; a floor effect in the negative self-concept variable, which may have suppressed true associations with functional connectivity; and its lack of a self-concept experimental task to compare to resting-state findings.

In sum, Study 2 found that the absence of positive self-beliefs was associated with unusual functional connectivity patterns in the CHR group, suggesting potential mechanisms for the negatively-valenced self-concept observed in these individuals. This suggests that other aspects of the autobiographical self, in addition to self-beliefs, may be important components of symptoms and functioning in the CHR syndrome. Therefore, Study 3 built on Studies 1 and 2 by replicating their analyses in a new sample of individuals meeting CHR criteria, while adding several new measures of self-concept and narrative identity.

CHAPTER V

Study 3: The Autobiographical Self—Self-Concept, Narrative Identity, and Self-Networks

Study 1 identified alterations in the self-concept in the CHR syndrome—more negative and less positive beliefs about the self, linked to symptoms and functional impairment. Study 2 suggested specific neural mechanisms for these effects, showing that coordination between intrinsic and extrinsic self-processing enhanced the self-concept in healthy participants but undermined the self-concept in participants meeting criteria for a CHR syndrome. Both studies relied on a relatively simple self-concept model (positive and negative beliefs about the self). However, the self-concept is much more complex than simple self-beliefs. Are autobiographical self-disturbances observable in other aspects of the self-concept in the CHR syndrome? If so, might the same neural mechanism account for these disturbances? Moreover, the autobiographical self includes not only the semantic self-concept, but also narrative identity. Do episodic disturbances in narrative identity accompany the semantic disturbances in the self-concept?

Self-concept

The self-concept contains various kinds of semantic information about the self. The first goal of Study 3 was to obtain a more holistic view of the self-concept than that provided by positive and negative self-beliefs. Specifically, Study 3 assessed various aspects of the self-concept and determined their relationships to one another and to symptoms and functioning in a new CHR sample. These variables included self-beliefs, self-esteem, self-concept clarity,

rumination, reflection, and self-enhancement. See the introduction to Chapter III (Study 1) for a complete discussion of these variables and their relevance to the CHR syndrome. Similarly, the second goal of Study 3 was to replicate the functional connectivity findings from Study 2 and test whether other self-concept variables may track these neural mechanisms even more closely than positive self-beliefs. Thus, the first two goals of Study 3 were to replicate Studies 1 and 2 in a new sample and extend their methods to consider more aspects of the self-concept.

Narrative Identity

The third goal of Study 3 was to examine alterations in narrative identity in the CHR syndrome. In addition to maintaining a semantic sense of self (self-concept), the autobiographical self also incorporates episodic context. At this level, the autobiographical self resembles an autobiographical author mining personally significant experiences to construct a life story connecting the present self to the remembered past and the imagined future (McAdams, 2013, 2015; McAdams & McLean, 2013). Human beings evolved to make sense of themselves and their worlds through language and storytelling (Donald, 1991; Dor, 2015; Leary & Buttermore, 2003; McAdams, 2019; McAdams & Cowan, 2020). Psychological research has found that life stories not only record the facts of our lives, but also provide our lives with meaning, purpose, and continuity through time (Adler et al., 2016; McAdams, 2013; McAdams & McLean, 2013). The study of narrative identity, the experience of self as an autobiographical author crafting an "internalized and evolving life story" (McAdams & McLean, 2013, p. 233), has extended personality and developmental research into the arena of life stories, generating a robust empirical and theoretical literature on the psychological processes that make up the self as author of a life story.

Narrative identity takes the form of stories—broad stories about a person's entire life, or specific stories about events or episodes. These stories, or life narratives, have all the hallmarks of a good novel or biography. They are populated by characters, most importantly the protagonist, the self-as-character who progresses through the story, perhaps changing along the way—for better or worse. The characters in a life narrative live through plotlines with beginnings, middles, and ends, made up of scenes in which characters face conflicts, express emotions, and strive to live up to values or carry out motivational agendas. And life narratives have themes, often supplied by the self-as-narrator, reflecting on the plot and deriving meaning from various scenes to connect them together into a coherent whole that not only recounts but also explains the person's life experiences. Thus, a life narrative is not only about episodic experiences, but about the semantic details extracted from those experiences that provide a coherent account of how the person became who they are, and who they might become in the future.

Psychologists typically study narrative identity by studying stories and quantifying their characteristics. A prototypical narrative identity study would follow this sequence: 1., participants are interviewed using questions designed to elicit personally relevant life stories; 2., trained raters score narrative identity variables from the interview transcripts (e.g., a rater might assign a score from 1-5 on the variable of "agency"; sometimes dichotomous ratings, computerized ratings, or self-ratings are also used); 3., narrative identity variables are analyzed through descriptive and inferential statistics, typically by relating them to psychological variables outside the narrative identity paradigm such as traits, demographics, or clinical symptoms. See Adler (2017) for an accessible guide to narrative identity research methods.

Three distinct dimensions of narrative identity have been identified in nonclinical populations (McLean et al., 2020). The first dimension captures basic structural elements that provide the facts, context, and temporal sequencing to make a life narrative comprehensible. The second dimension captures motivational and affective themes in the recalled episodic experiences of the self-as-character. For instance, is a personal story dominated by positive or negative emotion; is the protagonist an active or passive participant in events? The third dimension captures the metacognitive efforts of the self-as-narrator to integrate semantic and episodic autobiographical memory, make sense of experiences, and connect them to the present self. For instance, does the individual express a lesson learned or insight gained from an experience; do they feel that the experience revealed or changed something about themselves? These three dimensions were derived empirically in several factor analytic studies (Adler et al., 2018; Cowan et al., 2019; McLean et al., 2020), most notably in a large-scale study examining 16 narrative identity variables in 2,565 autobiographical episodes narrated by 855 participants (McLean et al., 2020). The three dimensions provide a taxonomy of psychological processes supporting narrative identity in healthy populations. Moreover, they can also organize findings on dysfunctions of narrative identity in clinical populations (Adler & Clark, 2019), as in a recent review of narrative identity processes in personality disorders (Lind et al., 2020).

Narrative Identity in The Psychosis Spectrum

The symptoms of psychotic disorders are known to impact many of the processes that maintain narrative identity. These include deficits in episodic and semantic memory (Berna, Potheegadoo, et al., 2016; Chen et al., 2016; Danion et al., 2005, 2007; Dimaggio et al., 2012; Kircher et al., 2003; Raffard et al., 2016; Ricarte et al., 2014, 2017; Riutort et al., 2003; Zhang et al., 2019), temporal perception and indexing (Alle, Gandolphe, et al., 2016; Ben Malek et al.,

2019; Berna, Potheegadoo, et al., 2016; Kircher et al., 2003; Martin et al., 2014; Pauly et al., 2014; Potheegadoo et al., 2012), imagining hypothetical futures (Chen et al., 2016; D'Argembeau et al., 2008; Hazan et al., 2019; Raffard et al., 2013, 2016), speech complexity (Buck et al., 2015; Buck & Penn, 2015; Minor et al., 2015), and metacognition (Lysaker, Molly Erickson, et al., 2010; Lysaker et al., 2013; Morrison et al., 2007a). Each of these deficits likely impacts individuals' ability to construct rich, coherent self-narratives. Moreover, the fully dimensional model of psychosis predicts that milder or earlier forms of psychotic-like experiences would also impact self-narratives in an attenuated fashion. Many authors have therefore begun to examine life stories and narrative identity in the psychosis spectrum, and many of the narrative identity variables studied in healthy populations have now also been studied in SSD.

Studies of autobiographical memory, neurocognition, identity, and self-disturbances in the psychosis spectrum have examined many variables which map onto the three-dimensional model of narrative identity. Focusing on six of the most widely studied variables, we can construct a model of narrative identity disturbances observed to date. Broadly speaking, as shown in Figure 5.1, narrative identity in SSD is characterized by a focus on suffering, disjointed structure, and a detached narrator. In the following sections, I will first review the research evidence for the six variables representing the three dimensions, then discuss the three dimensions' relevance to the CHR syndrome.

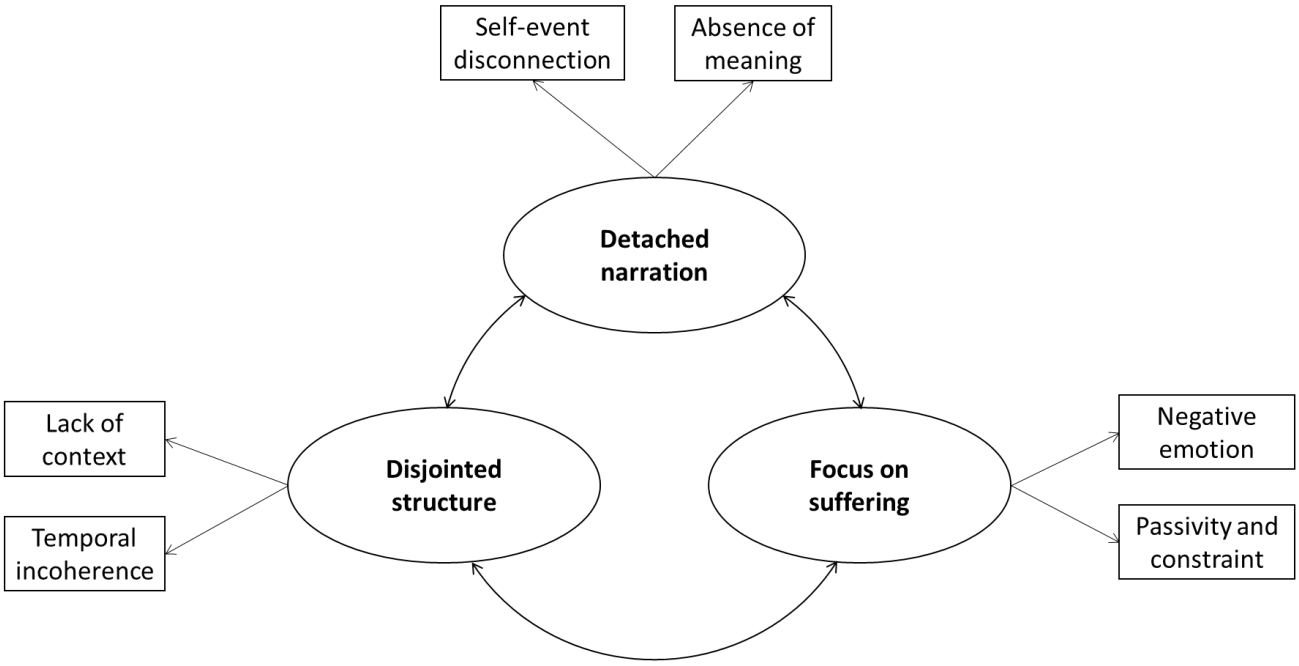

Figure 5.1. A structural model of narrative identity disturbances in schizophrenia-spectrum disorders.

Structural Variables: Disjointed Structure

A coherently structured narrative requires a certain amount of contextualized detail. Broad-based impairments in memory specificity (the ability to recount events as happening in a specific place and time) have been observed in many SSD studies (for a review, see Zhang et al., 2019). Interestingly, memory specificity may be preserved in narratives of self-defining memories (i.e., vivid, familiar memories which occurred at least one year in the past, have been frequently recalled, are personally significant, and help the individual know who they are as a person) (Raffard et al., 2009, 2010; Wright et al., 2019). Narrative identity prompts such as the self-defining memory may facilitate specific recall, as they ask participants to identify personally significant memories rather than arbitrary memories such as those associated with a particular emotion (c.f. Neumann et al., 2007).

However, specificity is only one component of structurally cohesive narratives. Cohesive narratives also require a certain amount of contextual detail. Several studies have found impoverished levels of detail and impaired context coherence (i.e., background information to contextualize a story, including information about location and time) in the personal narratives of individuals with SSD (Gruber & Kring, 2008; Moe et al., 2016, 2018; Raffard et al., 2010; Willits et al., 2018). For instance, as a schizophrenia patient described his relationship with his father, "no, that happened there, where my father took out gold, and we were happy, we used to get up early, and it was fantastic….cleaning. The thing is that my father had some NOUGAT, some NOUGAT" (quoted in Saavedra, 2010, p. 352, emphasis in original). Although the participant seems to be narrating a specific memory, and attempting to situate the memory in autobiographical context, the resulting story is not structurally coherent. Deficits in contextual coherence have been linked to clinical symptoms and functional outcomes including negative symptoms, cognitive symptoms, poor insight, and lower subjective quality of life (Lysaker et al., 2002; Lysaker, France, et al., 2005; Lysaker et al., 2008; Raffard et al., 2010; Wright et al., 2019).

Furthermore, a coherently structured narrative also requires events to be temporally ordered in a logical sequence. Several studies have reported lower levels of temporal coherence in individuals with SSD compared to controls, notably at the level of global temporal coherence (i.e., how clearly a listener can understand the order of various events in relation to one another) (Alle et al., 2015; Alle, Gandolphe, et al., 2016; Raffard et al., 2010). Lower level of temporal coherence may be explained by higher rates of anachronies (deviations from a narrative's temporal sequence) in individuals with SSD (Alle et al., 2015; Alle, Gandolphe, et al., 2016). Individuals with SSD often describe a sense of getting lost in their own experience—"adrift in an

anchorless reality" (Jordan, 1995, p. 501), "slipping and sliding around when I thought" (Payne, 1992, p. 727), or "multiple realities permeat[ing] and penetrat[ing] through me, bringing more and more confusion and instability" (Kean, 2009, p. 1035). Amid this instability, individuals with SSD are often unable to maintain temporal sequences in their life stories. An individual might tell a story that skips between painful childhood memories, mundane present experiences, and grandiose future plans, leaving listeners adrift and unable to follow the temporal flow.

Temporal coherence has been linked with hopelessness, negative symptoms, cognitive symptoms, and impaired insight in various studies, and different operationalizations of temporal coherence may be associated with different kinds of symptoms (Alle et al., 2015; Holm et al., 2016, 2018; Lysaker et al., 2002; Lysaker, France, et al., 2005). Outside SSD samples, one study has examined temporal coherence using a self-report questionnaire in a trait vulnerability sample, finding no difference between high and low trait vulnerability on temporal coherence (Hallford & Burgat, 2014).

In sum, individuals with SSD show marked deficits in their ability to construct structurally coherent and comprehensible narratives. Their disjointed life narratives are lacking in context and temporal coherence. In SSD, these deficits may relate to negative and cognitive symptoms. Structural deficits have not been observed in trait vulnerability samples, and the limited data available in first-episode psychosis suggest that structural deficits may relate to functional outcomes. To date, structural variables have not been examined in the CHR syndrome.

Motivational/Affective Themes: A Focus on Suffering

Affectively, the emotional tone of a personal narrative is a basic, primary affective theme. Positive emotional tone is robustly related to mental health and well-being in healthy adults (Adler et al., 2016; Cowan et al., 2019; McLean et al., 2020) and adults with personality

disorders (Lind et al., 2020). Several studies have examined personal narratives' emotional tone in SSD, finding that personal narratives take on a more negative tone in SSD, particularly when assessed by trained raters (Alle, Gandolphe, et al., 2016; Bennouna-Greene et al., 2012; Holm et al., 2016). Two studies have also compared SSD and clinical comparison samples, finding that life chapters are narrated with roughly equal negative emotion in SSD and major depressive episodes (Jensen et al., 2020; Moe & Docherty, 2014). Similar to a depressed individual, an individual with SSD might tell a life story about personal failures and losses suffused with sadness and regret. As one chronic schizophrenia patient expressed this mood, "If I had studied, then I probably would have done something important. What a shame!...I've spent 16 hours with the books in front of me…for NOTHING" (quoted in Saavedra, 2010, pp. 353–354, emphasis in original).

With respect to earlier or milder forms of psychosis, studies in trait vulnerability have found conflicting findings, with one reporting more negative valence in the high trait vulnerability group (Berna, Göritz, et al., 2016) and another reporting no group difference between high and low trait vulnerability groups (Hazan et al., 2019). One study in first-episode psychosis has also found inconclusive results (Wright et al., 2019). Although evidence is currently much weaker outside SSD, negative emotional tone may be present to some extent in milder or earlier forms of psychosis.

Motivationally, one of the most fundamental narrative themes is agency, or the autobiographical protagonist's ability to act autonomously, initiate changes, and exert some degree of control over their experiences. Several theoretical perspectives recognize agency as a fundamental human motivation. White (1959) proposed that effective interaction with the environment ("competence") is intrinsically satisfying, leading to feelings of efficacy. Bandura's

social cognitive theory extended this argument, placing self-efficacy at the centre of human motivation, development, and behavior (Bandura, 1986, 2006). Similarly, Deci and Ryan's (1985) self-determination theory argued that autonomy, competence, and relatedness were the three universal human needs. For Deci and Ryan, two of the three basic human needs are aspects of agency. And these are only a sampling of influential theories centered on agency: Wiggins (1991) documents twenty theorists who defined agency and communion/relatedness as fundamental human drives—not to mention the multiple personality psychologists who have derived two higher-order factors resembling agency and communion from Big Five personality scales (e.g., Digman, 1997). Unsurprisingly, then, agency is one of the primary motivational themes expressed in narrative identity (McAdams et al., 1996). The amount of agency expressed in life narratives is closely linked to mental health and well-being (Adler et al., 2016; Cowan et al., 2019; McLean et al., 2020). Moreover, the process of recovery from SSD has also been described as discovering a more agentic self (Davidson & Strauss, 1992; Lysaker et al., 2003), suggesting that narrated agency may be particularly relevant in the psychosis spectrum.

Several studies have compared narrated agency between SSD and healthy controls, finding that individuals with SSD narrate their lives with less agency than healthy controls (Bennouna-Greene et al., 2012; Holm et al., 2018; Lysaker, Wickett, et al., 2005; Moe & Docherty, 2014). For instance, one individual with SSD felt education was personally important, but "it has been a while since I have pursued an education because so many things have gone wrong for me. Every time I start something new, then after 6 months or so, things start to go astray" (quoted in Holm et al., 2018, p. 775). Another described their lack of agency in more global terms: "I am powerless to resist the frenzied subjection of alien beings…[schizophrenia]

can break down any strengths, often leaving behind only a fragmented shell" (Bayley, 1996, p. 728)

Two studies have compared individuals with SSD against clinical control groups, finding that individuals with SSD report lower levels of agency than HIV-positive individuals (Holm et al., 2020), and similar levels of agency to depressed individuals (both groups reported less agency and communion than healthy controls; Jensen et al., 2021). Notably, the cited studies used various prompts and coding methods to converge on similar findings. Impaired narrative agency has been linked to a host of clinical variables including negative symptoms (Jensen et al., 2021; Lysaker, Wickett, et al., 2005), impaired cognition (Jensen et al., 2021; Lysaker, Wickett, et al., 2005), functional impairment and lower quality of life (Jensen et al., 2021; Lysaker et al., 2006; Lysaker, Ringer, et al., 2010), lower self-esteem (Holm et al., 2020), and greater hopelessness (Holm et al., 2020; Lysaker et al., 2006; Lysaker, Ringer, et al., 2010).

Two studies have also examined agency in trait vulnerability samples (Hazan et al., 2019; See et al., 2020). Both studies found lower agency in the high trait vulnerability group compared to the low trait vulnerability group, suggesting that passive and non-agentic life stories may appear throughout the psychosis spectrum.

In sum, individuals throughout the psychosis spectrum tell life stories in which the autobiographical protagonist suffers through painful emotions, passively accepting his or her inability to change events. This focus on suffering is seen not only in SSD but also in trait vulnerability and first episode psychosis. To date, motivational and affective variables have not been studied in the CHR syndrome.

Autobiographical Reasoning: Detached Narration

Self-event connections, or connections between the events in a personal narrative and the present-day self, are essential to autobiographical reasoning. Two studies have found lower levels of self-event connections in the self-defining memories of individuals with SSD compared to controls (Alle, d'Argembeau, et al., 2016; Raffard et al., 2010). Kean's experience that, "my thoughts, my emotions, and my actions, none of them belong to me anymore" (Kean, 2009, p. 1034), would naturally impair her ability to draw connections between remembered events and herself. For example, an individual with SSD might narrate a self-defining memory of a first psychotic episode and hospitalization as if it bears no relation to the present self who lives with a schizophrenia-spectrum diagnosis. Studies in which participants have self-rated connections, personal impact, or subjective centrality in their own narratives have been inconclusive (Alle et al., 2015; Berna et al., 2011a, 2011b; Holm et al., 2016). However, one study has compared self-rated and experimenter-rated self-event connections in a SSD sample, finding fewer self-event connections when rated by experimenters but not when self-rated by participants (Bennouna-Greene et al., 2012). This result suggests that individuals with SSD may have incomplete metacognitive insight into thematic links between memories and the present self. Supporting this interpretation, Raffard and colleagues (2010) found that SSD outpatients with poorer insight and more negative symptoms discussed fewer self-event connections in their self-defining memories. Impaired insight may impact individuals' ability both to construct self-event connections and to metacognitively evaluate those connections.

Meaning-making, the tendency to derive lessons or insights from past events, represents a more complex form of autobiographical reasoning. Meaning-making also appears to be impaired in SSD, with studies of meaning-making in self-defining memories consistently finding lower

meaning-making among individuals with SSD compared to healthy controls (Berna et al., 2011a, 2011b; Raffard et al., 2009, 2010; Wright et al., 2019). Individuals with SSD are less likely to extract lessons or insights from their personal experiences. For instance, an individual might tell a story of being hospitalized after stopping their medication regimen, without deriving any lessons to guide future behaviour. Several studies have tested links between meaning-making and clinical variables, finding that impairments in meaning-making are not associated with neurocognition (Wright et al., 2019) but are associated with severity of negative symptoms (Berna et al., 2011b; Raffard et al., 2010).

In trait vulnerability samples, two studies found no differences between high and low trait vulnerability groups on self-rated event centrality (Berna, Göritz, et al., 2016) or experimenter-rated self-event connections (See et al., 2020). Similarly, there were no differences in meaning-making between high and low trait vulnerability groups, and no relationship between meaning-making and a nonclinical measure of negative symptoms (negative subscale of the Community Assessment of Psychic Experiences) (Berna, Göritz, et al., 2016). In fact, two studies have reported that individuals with high trait vulnerability reported thinking about their lives more frequently and retrieving more autobiographical memories to maintain a sense of self-continuity (Berna, Göritz, et al., 2016; Hallford & Burgat, 2014). If anything, individuals with high trait vulnerability may be more interested in autobiographical reasoning than their peers.

In sum, individuals with SSD have difficulty interpreting life events, assigning meaning to them, and connecting them to each other and to the present self. Notably, these deficits have not been observed in trait vulnerability samples. Thus, the available evidence suggests that autobiographical reasoning deficits accompany the symptoms of SSD, and do not occur

throughout the psychosis spectrum. As yet, no studies have examined autobiographical reasoning variables in the CHR syndrome.

Table 5.1

Narrative identity throughout the psychosis spectrum

	Trait Vulnerability	First-Episode Psychosis	Schizophrenia-Spectrum Disorders
Motivational/ Affective Themes	Possibly more negative emotional tone Less agency	Possibly more negative emotional tone	More negative emotional tone Less agency More themes of unfulfilled agency and communion
Structure	Intact memory specificity *(in self-defining memories)*	Intact memory specificity *(in self-defining memories)* Specificity mediates cognition's effect on functioning	Intact memory specificity *(in self-defining memories)* Less context coherence Less temporal coherence
Autobiographical Reasoning	Intact self-event connections and meaning-making	Less meaning-making	Fewer self-event connections Less meaning-making

Note: Unless otherwise noted, all findings are compared to healthy control groups. Thus far, no studies have examined narrative identity in imminent risk samples (e.g., clinical high risk, attenuated psychotic syndrome).

Narrative Identity in the CHR Syndrome

Table 5.1 summarizes key findings on narrative identity in the psychosis spectrum. Despite the wealth of research evidence on narrative identity in schizophrenia and related disorders, there is no evidence at all on narrative identity in the CHR syndrome. It is unknown whether the disturbances identified in clinical disorders may have their early roots in the CHR syndrome. There is some evidence on narrative identity variables in trait vulnerability groups—those identified, e.g., by psychometric measurement of normative psychotic-like experiences.

This evidence allows us to speculate about how narrative identity may be affected in the CHR syndrome. Whereas broad disturbances in narrative identity have been observed in SSD, only motivational/affective disturbances—or a narrative focus on suffering—have been observed in individuals with trait vulnerability for psychosis. Importantly, this suggests that disturbances along the three dimensions of narrative identity may originate in different sections of the psychosis spectrum. However, research has not yet examined narrative identity in imminent risk populations such as the CHR syndrome. As the CHR syndrome coincides with a crucial developmental window for narrative identity (McAdams, 2013; McAdams & McLean, 2013), research on narrative identity in the CHR syndrome represents an important next step for understanding the emergence of autobiographical self-disturbances in the psychosis spectrum.

Study 3 Aims and Hypotheses

The aims of Study 3 were to replicate Studies 1 and 2 in a new dataset, examine narrative identity variables, and examine independent and shared effects of self-concept, self-referential neural processing, and narrative identity on symptoms and functioning. Specific hypotheses were:

Hypothesis 1. The self-concept (operationalized as self-beliefs, self-esteem, and self-concept clarity) will be more negative and less stable in the CHR group. This will replicate the results of Study 1 and extend them to related self-concept constructs.

Hypothesis 2. Resting-state neural function in intrinsic and extrinsic self-networks will be hypoactive in the CHR group; and will correlate with self-beliefs and possibly other self-concept variables. This will replicate the results of Study 2 and extend them to related constructs.

Hypothesis 3. Following the patterns identified above, narrative identity in the CHR group will be clearly more negative, more passive, and less coherent in the CHR group; structural variables may be somewhat altered; and autobiographical reasoning will be unaffected.

Hypothesis 4. In linear regression analyses, self-concept variables and narrative identity variables will each account for significance variance in negative attenuated psychotic symptoms and functional impairment. This will again replicate the results of Study 1 and extend them to related self-concept and narrative identity constructs.

Method

Participants

Two new groups of community participants were recruited through the Adolescent Development and Preventative Treatment (ADAPT) research program via newspaper, bus, and Craigslist ads, e-mail postings, and community professional referrals. One group of participants (n = 50) met criteria for a CHR syndrome based on the Structured Interview for Psychosis-Risk Syndromes (SIPS; T. J. Miller et al., 1999). The second group was a matched sample of healthy comparison participants (HC; n = 56). Participant demographic characteristics are shown in Table 5.3 below. Exclusion criteria for the HC group included any psychotic disorder in a first-degree relative, a psychosis-risk syndrome as assessed by the SIPS, or any current DSM-IV-TR Axis I disorder. In both groups, participants with a history of head injury, neurological disorder, substance dependence, or any DSM-IV-TR psychotic disorder were excluded from the study. The protocol and informed consent procedures were approved by the Institutional Review Board (IRB).

Due to the research disruptions of the COVID-19 pandemic, not all participants completed all study components. To be included in analyses, participants had to have completed a clinical interview (including measures of symptoms and functioning) plus either narrative identity or self-concept measures. Most participants (n = 42 CHR and 44 HC) completed the narrative interview. Numbers of participants completing self-concept measures varied by measure and are shown in Table 5.3 below. Only a small and unbalanced subsample of participants completed a resting-state fMRI scan (n = 25 CHR, 12 HC). To account for the fMRI subsample's reduced power, Study 3's functional connectivity analyses did not test interaction effects, as in Study 2. Instead, these analyses tested (a) main effects of group, and (b) correlations between study variables and connectivity within the CHR group.

Measures

As in Studies 1 and 2, participants completed the SIPS to assess the presence and severity of attenuated psychotic symptoms; the GFS to assess functional impairment; the SCID to rule out psychotic diagnoses; and the BCSS to assess self-beliefs. In addition, participants completed self-report measures of self-concept and a brief life story interview.

Self-concept. To assess self-esteem, participants completed the Rosenberg Self-Esteem Scale (RSES). The RSES is a 10-item scale that measures self-esteem (Rosenberg, 1965). Participants rate how much they agree with various statements (e.g., "I think that I have a number of good qualities"). on a scale from 1 ("strongly disagree") to 4 ("strongly agree"). To assess self-concept clarity, participants completed the Self-Concept Clarity Scale (SCC): The SCC is a 14-item measure of self-concept clarity, or the extent to which self-beliefs are clearly and confidently defined, internally consistent, and stable (Campbell et al., 1996). The SCC is often included in social psychological research on self-esteem, including longitudinal

developmental research (Van Dijk et al., 2014). Participants rate the extent to which they agree with various statements about themselves (e.g., “My beliefs about myself seem to change very frequently”) on a scale from 1 (“strongly disagree”) to 5 (“strongly agree”).

To assess rumination and reflection, participants completed the Rumination and Reflection Questionnaire (RRQ). The RRQ is a 24-item measure of tendencies toward rumination and reflection, two types of self-focused attention that are relevant for psychological health and functioning (Trapnell & Campbell, 1999) For instance, rumination predicts depressive symptoms while reflection does not (Trapnell & Campbell, 1999). Participants rate how much they agree with various statements about self-focused attention (e.g., “I often find myself re-evaluating something I’ve done”), on a scale from 1 (“strongly disagree”) to 5 (“strongly agree”). The rumination and reflections subscales were internally consistent ($\alpha_{rumination}$ = .92, $\alpha_{reflection}$ = .90) and uncorrelated with one another (r = .12, p = .26). Therefore, the subscales were analyzed as separate variables.

Finally, to assess self-enhancement, participants completed the Egoistic and Moralistic Self-Enhancement Scale, short form (EMS). The short form of the EMS is composed of two subscales assessing individualistic (e.g. “I have always been absolutely sure of all my actions”) and communal (e.g. “I have never criticized anyone”) self-enhancement (Vecchione et al., 2013). Each subscale is made up of 4 items, and participants rate each item from 1 (“very false for me”) to 5 (“very true for me”). The individualistic and communal subscales had low to moderate internal consistency ($\alpha_{individualistic}$ = .71, $\alpha_{collectivistic}$ = .54) and were strongly correlated (r = .61, p < .001). Therefore, the subscales were combined and analyzed as a single variable.

Life story interview. Participants also completed a brief life story interview in which they narrated several key scenes and a significant challenge. The interview consisted of four

questions, three of which were adapted from previous narrative identity research, and one of which was created for this project to assess narrative identity processes in narratives of psychotic-like experiences. Participants were instructed that the interview was not diagnostic or clinical, and that the researchers were simply interested in hearing them tell their stories. For each question, interviewers followed up with several scripted prompts about the participant's thoughts and feelings during the experience, and the experience's significance in the participant's overall life story. The four questions are summarized in Table 5.2, and the full text of the life story interview appears in Appendix A.

Table 5.2

Summary of the Brief Life Narrative Interview (LNI)

Question	Summary	Source
Self-defining memory	A scene or an episode that happened at least 1 year ago, is clear and familiar, and is important for how the participant sees him- or herself.	Self-defining memory interview (McLean & Fournier, 2008)
Turning point	An episode that marks an important change in the direction of the participant's life, or an important change in how the participant seems him- or herself.	Life Story Interview (McAdams, 2008)
Life challenge	The single greatest challenge the participant has ever faced, including how it developed, how the participant addressed it, and its significance in the overall life story.	Life Story Interview (McAdams, 2008)
Psychotic-like experience	An unusual, strange, or profound experience that is hard to explain, in which it seems like the participant's mind is playing tricks, the world is not as it seems, or boundaries between the self and the world have become unclear.	Based on content of CAPE-Positive subscale and SIPS Positive symptoms

Narrative coding. Narrative interviews were audio recorded and transcribed. Interview transcripts were then coded for six narrative identity variables by three independent raters who were blind to participants' diagnostic status and questionnaires. Variables were selected to correspond to known disturbances in the narrative identities of individuals with schizophrenia (see Chapter II), with coverage of the three-factor structure of narrative identity found in recent empirical research (Adler et al., 2018; Cowan et al., 2019; Graci et al., 2018; McLean et al., 2020). Each narrative identity variable was coded using an established narrative coding manual (i.e., raters assigned a numerical rating for each variable, based on the coding manual). During a training phase, raters modified these pre-existing coding systems by consensus. Changes were primarily made to adapt the essence of each code to narratives collected from a new population which has never been studied in a narrative identity framework. All changes are documented in the coding notebook in Appendix B. The three raters then coded all participants' transcripts, assigning scores on each narrative identity variable for each of the four episodes described in the interview.

Two codes assessed motivational/affective themes. Emotional tone captures the overall balance of emotional content in a narrative, ranging from strong negative emotion (coded as -2) to strong positive emotion (coded as 2). Agency captures the autonomy of the protagonist to initiate changes and exert some degree of control over their experiences, ranging from complete powerlessness with all action motivated by external forces (coded as -2) to strong agency with most or all action motivated by an active protagonist (coded as 2).

Two codes assessed narrative structure. Context coherence captures the extent to which events can be placed in a specific time and location, ranging from no information about time or location (coded as 0) to specific information about both time and place (e.g., "in the summer of

2015 I started attending the North Shore Baptist Church in Chicago"; coded as 3). Temporal coherence captures the extent to which events can be placed in a clear chronological sequence, ranging from a list of actions with no temporal ordering (coded as 0) to a clear timeline in which most or all actions can be sequenced, with any deviations from the narrative's temporal sequence clearly marked and/or repaired (coded as 3).

Two codes assessed autobiographical reasoning. Self-event connections capture relationships between a given experience and one's sense of self, ranging from an absence of self-event connections (coded as a 0) to an explicit or strong self-event connection (coded as a 2). Previous research has shown that two specific types of connections are closely linked to other autobiographical reasoning variables. These are the extent to which an experience reveals something about the self and the extent to which an experience changes something about the self, (McLean et al., 2020). Raters scored these two types of connections independently, then scores were summed to create an overall self-event connections score ranging from 0 to 4. Finally, meaning-making captures the degree to which the participant derives new semantic knowledge from past experience by learning lessons (e.g., "don't disobey my parents") or gaining insights (e.g., "my parents have my best interests at heart"). Meaning-making scores ranged from a total absence of meaning-making (coded as 0) to a clear effort to make meaning, resulting in generalizable meaning about the self or the world (i.e., applicable beyond the specific circumstances of the narrated episode; coded as a 3).

Interrater reliability for the narrative codes (measured as the three raters' intraclass correlation)[4] was in the good to excellent range: emotion = .90, agency = .79, context coherence

[4] Scores were assessed in terms of their generalizability to any set of three similarly trained raters (i.e., raters treated as random effects); final scores were averaged across all three raters; and absolute agreement was prioritized over

= .89, temporal coherence = .77, meaning-making = .70, self-event connections = .81. Group differences were examined at the level of individual episodes (i.e., 4 episodes nested within each participant), with linear mixed-effects models testing the main effect of group (CHR/HC) and the interaction between group and scene (self-defining memory, turning point, etc.). Mean scores for each participant (i.e., the mean of the four scenes for each participant) were then calculated and used in correlational analyses with other person-level variables (e.g., self-concept and clinical variables).

fMRI Procedures

MRI acquisition parameters, procedures, and resting-state data processing followed the same procedures as in Study 2. See Chapter IV for a complete discussion of these methods.

Data Analysis

Preliminary Analyses

Chi-squared tests and two-tailed t-tests tested group differences on demographic, clinical, and self-report variables.

Narrative Identity

Group differences in narrative identity variables were tested through mixed-effects models. Mixed-effects models were chosen because they: (a) improve statistical power by nesting four interview questions within each participant, resulting in a Level 1 (within person) n = 320 and a Level 2 (between person) n = 86; and (b) allow tests of interactions between group and question type. Two mixed-effects models were calculated for each narrative variable. First, a model tested for overall group differences in narrative variables, with group entered as a fixed

consistency. Thus, ICCs reported are two-way, random-effects, absolute agreement ICCs with multiple raters, aka. ICC (2, 3) (McGraw & Wong, 1996; Shrout & Fleiss, 1979).

effect and participant ID and interview question entered as random effects. In addition, due to the possibility that the different groups might answer specific questions differently (e.g., the CHR group might provide longer and more detailed responses than the HC group to the "psychotic-like experience" prompt), a second model examined the interaction between group and interview question. In this model, group, interview question, and the group x interview question interaction were entered as fixed effects, and participant ID was entered as a random effect. In all models, effects were estimated by Type III ANOVA tables, with probabilities calculated by *F*-tests with degrees of freedom estimated by Satterthwaite's method. This method allows interactions between categorical variables to be assessed by an overall *F*-test, similar to a standard ANOVA. Significant or marginal interaction effects were further explored by post hoc *t*-tests of least squared mean differences.

To examine correlations between narrative variables and other study variables, mean scores were calculated for each participant on each narrative variable (i.e., the mean of the four scenes for each participant). To minimize the number of comparisons in correlational analyses, I tested whether narrative variables could be condensed into broader measures of the three narrative dimensions (motivational/affective themes, narrative structure, and autobiographical reasoning). In the CHR group, correlations within each of the three dimensions were substantial (emotion-agency $r = .48$, context coherence-temporal coherence $r = .63$, self-event connections-meaning-making $r = .75$, all $p < .001$), while correlations across dimensions were negligible (all $r < .24$, all $p > .15$). Therefore, correlational analyses report mean scores for the three narrative dimensions rather than scores for the six individual narrative variables.

Functional Connectivity

Study 3 applied the same study functional connectivity procedures used in Study 2, with one key difference. Eight ROIs were defined in the CMS and SMN, and groups were compared in terms of coactivation of ROIs through *t*-tests with FDR-correction. Because the subsample of participants who completed an fMRI scan was smaller than in Study 3, and groups were unbalanced (n = 25 CHR and 12 HC), interaction effects were not tested (as in Study 2). Instead, correlations between study variables and connectivity were examined within the CHR group.

Linking Self-Concept, Narrative Identity, and Functional Connectivity

Relationships between self-concept, narrative identity, and resting-state functional connectivity were examined through Pearson correlations within the CHR group, with FDR-correction for multiple comparisons. As a supplementary analysis to examine relationships among the self-concept variables, I also calculated a principal components analysis with a single unrotated principal component, to model a latent variable explaining shared variance across various self-concept measures. By examining the amount of shared variance between the latent variable and each self-concept measure, we can infer which measures were closely associated with the latent variable and which were more distinct from it.

Clinical Outcomes

Finally, regression models examined variables' unique and shared effects in predicting clinical outcomes. In separate models for self-concept variables and narrative identity variables, linear regression models were computed with each outcome of interest entered as the dependent variable and the full set of predictors entered as independent variables (e.g., the model for narrative identity predicting positive symptoms had motivational/affective themes, narrative structure, and autobiographical reasoning as IVs and positive symptoms as the DV). Results

were examined in terms of variables' shared predictive power (i.e., model fit for the full model) and unique predictive power (i.e., standardized regression coefficients). Some variables were excluded from these analyses due to multicollinearity (see below for details).

Table 5.3

Demographic, clinical, and self-report variables

	CHR			HC			Comparison		
Variable	*n*	Mean	SD or %	*n*	Mean	SD or %	*t* or χ^2	*p*	*d*
Age	50	20.78	2.76	56	21.57	3.29	-1.34	.182	-0.26
Education (years)	50	14.34	2.36	56	14.54	2.20	-0.44	.661	-0.09
Sex (male)	27		54%	19		34%	**3.94**	**.047**	
Race									
White/Caucasian	18		36%	24		43%			
African American	16		32%	11		20%			
Asian	8		16%	11		20%			
Other	8		16%	9		16%	2.08	.555	
Hispanic	12		24%	5		9%	3.59	.058	
Family income									
Less than $39,999	16		32%	17		30%			
$40,000 - $99,999	18		36%	19		34%			
$100,000 or more	10		20%	15		27%			
Don't know/refused	6		12%	5		9%	1.22	.748	
Symptoms & functioning									
Positive symptoms	50	10.50	3.64	56	0.79	1.29	**17.8**	**<.001**	**3.63**
Negative symptoms	50	7.42	5.25	56	1.09	1.56	**8.20**	**<.001**	**1.68**
Social functioning	50	7.50	1.53	56	8.82	0.93	**-4.96**	**<.001**	**1.04**
Role functioning	50	7.81	1.42	56	8.86	0.75	**-4.37**	**<.001**	**0.91**
Self-concept									
Negative self-beliefs	40	0.91	0.98	36	0.20	0.21	**4.50**	**<.001**	**0.99**
Positive self-beliefs	40	2.09	1.09	36	2.59	0.91	**-2.14**	**.035**	**-0.50**
Self-esteem	36	2.77	0.67	49	3.27	0.41	**-3.93**	**<.001**	**-0.95**
Self-concept clarity	42	2.79	0.94	50	3.54	0.77	**-4.13**	**<.001**	**-0.90**
Rumination	39	3.61	0.90	50	3.10	0.82	**2.73**	**.007**	**0.60**
Self-reflection	39	3.75	0.81	50	3.38	0.78	**2.09**	**.040**	**0.47**
Self-enhancement	40	1.91	0.77	50	1.92	0.58	-.074	.925	-0.02

Results

Group Comparisons

Demographics

As shown in Table 5.3, participants in the CHR group did not significantly differ from participants in the HC group on age, race, ethnicity, education, or family income. The groups differed slightly on sex, with a higher proportion of males in the CHR group. Sex was not associated with any study variables except positive symptoms, which were higher in males than females, $t(87.5) = 2.11$, $p = .037$, $d = 0.43$. However, this effect was fully mediated by group (CHR vs. HC). A linear regression model with group and sex predicting positive symptoms found a strong independent effect for group, $\beta = -.87$, $p < .001$, and no independent effect for sex, $\beta = .007$, p = .90. The relationship between sex and positive symptoms was therefore considered to be an artifact of group differences in positive symptoms, and sex was not included as a covariate in further analyses.

Clinical Variables

As shown in Table 5.3, participants in the CHR group reported substantially higher positive and negative symptoms than participants in the HC group, and significantly worse social and role functioning (all $p < .001$, all $d > .91$).

Self-Concept

As shown in Table 5.3, participants in the CHR group reported more maladaptive levels of positive and negative self-beliefs, self-esteem, self-concept clarity, and rumination, with effect sizes in the moderate to large range ($.50 \leq d \leq .99$). The CHR group also reported higher levels of self-reflection compared to the HC group ($d = .47$), but similar levels of self-enhancement ($d = .02$).

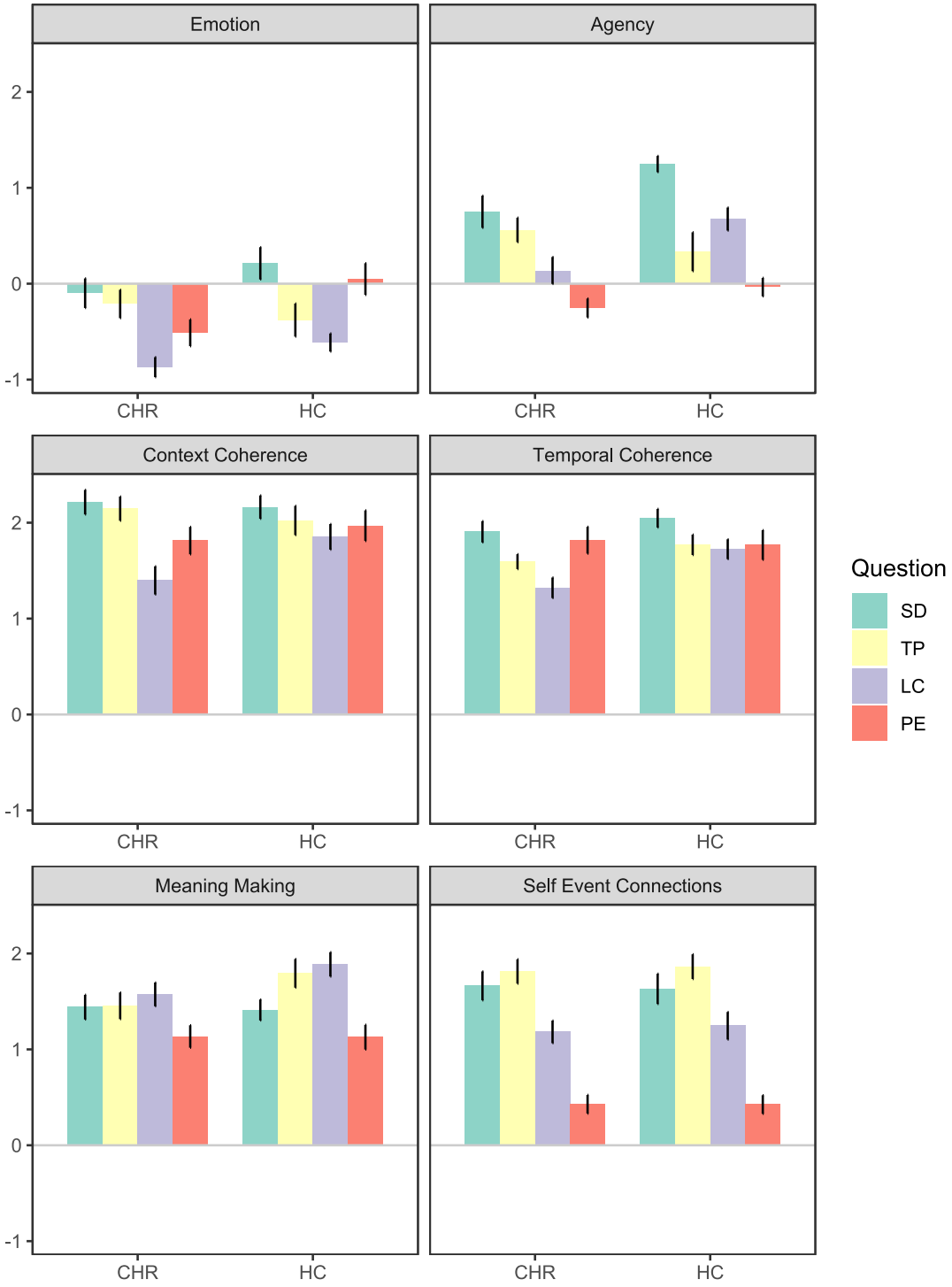

Figure 5.2. Narrative identity themes of emotional tone and agency differentiated the life stories of individuals in the clinical high risk group (CHR, on the left of each panel) and the healthy comparison group (HC, right). Narrative themes are shown separately for the four questions in the brief life story interview: self-defining memory (SD); turning point (TP), life challenge (LC), and psychotic-like experience (PE). Error bars indicate the standard error of the mean.

Table 5.4

Group differences in narrative identity variables: Fixed effect estimates from linear mixed effects models predicting narrative identity variables

	Model 1: Overall Effect	Model 2: Interaction Effect		
Outcome	Group (CHR vs. HC)	Group	Question	Group x Question
Emotional tone	3.86*	3.29*	9.24***	1.66†
Agency	5.62**	4.62**	17.89***	2.19*
Context coherence	0.52	0.42	5.16***	1.35†
Temporal coherence	1.20†	1.16†	2.99***	0.73
Meaning-making	0.85	0.93	5.51***	0.81
Self-event connections	0.04	0.04	30.71***	0.06

Note: Fixed effects shown as mean sums of squares in Type III ANOVA tables; *p*-values calculated by *F*-tests with degrees of freedom estimated by Satterthwaite's method.
In Model 1, group was entered as a fixed effect, while interview question and participant ID were entered as random effects.
In Model 2, group, question, and the group x question interaction were entered as fixed effects, while participant ID was entered as a random effect.
Models were run separately for each narrative identity outcome variable (2 models x 6 variables = 12 total models).

Narrative Identity

To account for the effect of different interview questions on participants' responses, group differences in narrative identity were tested through mixed effects models with interview questions nested within participants (see "Data Analysis" above). As shown in Table 5.4, one set of models tested the overall group effect. Emotional tone was lower in the CHR group, $F(83.0) = 5.04$, $p = .027$. A CHR group participant, describing a self-defining memory of a past abusive relationship, told the story with strong negative emotional tone: "during that time, I was depressed, I was suicidal…there was no one being supportive of me…no one was ever going to believe me. So, I felt useless, I felt hopeless, I felt worthless, I felt like everything was wrong with me" (ID 865).

Similarly, agency was also lower in the CHR group, $F(82.6) = 8.49$, $p = .004$. A CHR group participant, describing a self-defining memory of being overweight in high school, told the story with passive and non-agentic language: "it's no longer coming from my peers, like telling me that I'm fat, but also coming from people above me, like adults who are supposed to…teach us right from wrong and then they were like, I think you're just fat and then we don't want you…it really shaped some of my strong beliefs toward myself and [I'm] not able to get out of it" (ID 245).

Finally, temporal coherence may have been lower in the CHR group, $F(82.6) = 2.98$, $p = .088$. A CHR group participant, describing a psychotic-like experience, told the story as a list of events without a clear temporal sequence: "Just scenes of the, like not usual…maybe, like, shadows, I head somebody talking to me in my head or like it's weird to kind of explain…a last one, a family, a family member that like passed away and if it was like, I still see them and they're talking to me and…it feels like a dream" (ID 309). In sum, the CHR group narrated their life stories with more negative emotion, less agency, and possible less temporal coherence.

A second set of models tested the interaction between group and interview question. These models replicated the same overall group effects of lower emotional tone, agency, and possibly temporal coherence in the CHR group. These models also found large effects for interview question on every narrative variable, indicating that the four questions prompted different kinds of narration. Finally, group interacted with interview question in predicting agency, $F(237.37) = 3.37$, $p = .019$, and marginally interacted with interview question in predicting emotional tone, $F(236.2) = 2.21$, $p = .087$, and context coherence, $F(234.3) = 2.40$, $p = .068$. In other words, the CHR and HC groups engaged in different kinds of agentic, emotional, and contextual narration in specific sections of the interview.

Which interview questions accounted for these interactions? Post-hoc *t*-tests of least squares mean differences found that CHR participants expressed less agency than HC participants in their life challenges, mean difference = -0.53, $t(310.7) = -2.99$, $p = .003$, and self-defining memories, mean difference = -0.48, $t(310.6) = -2.79$, $p = .005$. CHR participants also expressed a more negative emotional tone in their memories of psychotic-like experiences, mean difference = -0.56, $t(306.4) = -2.77$, $p = .006$, and poorer context coherence in their life challenges, mean difference = -0.46, $t(262.0) = -2.44$, $p = .015$.

In sum, the CHR group expressed less agency and more negative emotion than the HC group throughout the interview, with low agency particularly pronounced in life challenges and self-defining memories, and negative emotional tone particularly pronounced in memories of psychotic-like experiences. The CHR group may also have expressed marginally poorer temporal coherence throughout the interview, and poorer context coherence specifically in their life challenges. Finally, the CHR group expressed similar levels of meaning-making and self-event connections to the HC group throughout the interview.

Functional Connectivity

Functional connectivity analyses found no significant group differences in connectivity patterns between CHR and HC. No correlations between connectivity patterns and study variables (positive self-beliefs, negative self-beliefs, motivational/affective themes, narrative structure, autobiographical reasoning) were significant within the CHR group. These negative results can likely be attributed to the small and unbalanced subsample in the fMRI analyses.

Relationships Between Self-Concept and Narrative Identity

Correlations between self-concept and narrative identity within the CHR group are shown in Table 5.5 and Figure 5.3. Self-concept variables appeared to be highly intercorrelated with one

another, suggesting that they may have tapped into a shared latent variable. To investigate this possibility, I calculated a supplemental principal components analysis with a single unrotated principal component. I then examined items' squared loadings on the principal component to determine the amount of variance shared between each variable and the shared latent variable. This analysis found that negative self-beliefs, positive self-beliefs, self-esteem, self-concept clarity, and rumination (reversed) all shared more than half of their variance with the common principal component, while self-enhancement (shared variance = .23), and self-reflection (shared variance = .06) were more unique. In this sample, most of the self-concept variables appeared to tap a common latent dimension reflecting general self-concept negativity and uncertainty. Self-enhancement and self-reflection, however, appeared to be distinct from this core self-concept dysfunction.

Motivational/affective themes correlated with self-esteem, $r(25) = .42$, $p = .037$, and rumination, $r(28) = -.40$, $p = .034$. Although these correlations did not survive FDR correction for multiple comparisons ($p_{FDR} = .12$ and .12, respectively), the point estimates suggest that these may be meaningful effects. Moreover, motivational/affective themes also correlated with the principal component reflecting core self-concept dysfunction, $r(39) = -.33$, $p = .037$. Narrative structure and autobiographical reasoning did not correlate with self-concept variables.

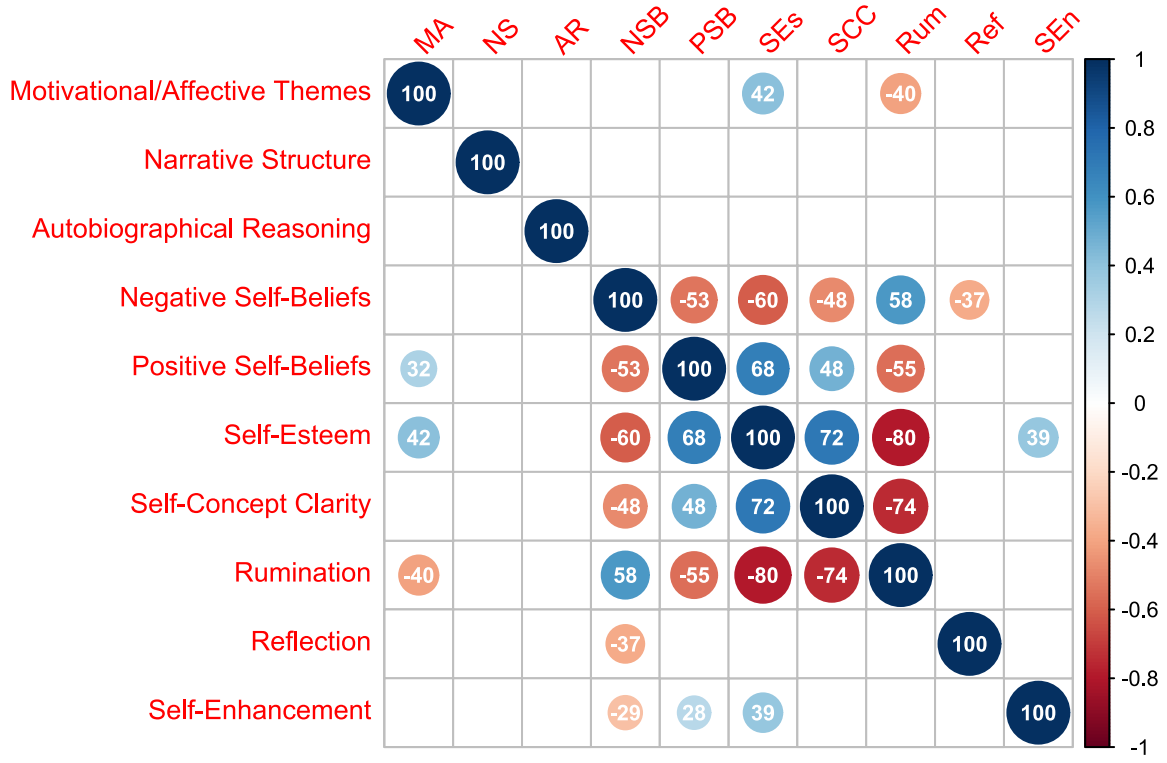

Figure 5.3. Correlations between narrative identity and self-concept variables in the CHR group. Correlations with $p > .10$ (uncorrected below the diagonal and FDR-corrected above the diagonal) are omitted for clarity.

Table 5.5.

Correlations Between Narrative Identity and Self-Concept in the CHR Group

	1	2	3	4	5	6	7	8	9	10
1. Motiv./aff. themes	-									
2. Narrative structure	.02	-								
3. Autobio. reasoning	.09	.14	-							
4. Negative self-beliefs	-.25	.02	-.09	-	**	**	*	**		
5. Positive self-beliefs	.32	-.26	.11	-.53**	-	***	*	**		
6. Self-esteem	.42*	-.04	.17	-.60***	.68***	-	***	***		
7. Self-concept clarity	.18	-.07	-.12	-.48**	.48**	.72***	-	***		
8. Rumination	-.40*	-.11	.00	.58***	-.55**	-.80***	-.74***	-		
9. Self-reflection	.18	-.09	.24	-.37*	.25	.19	-.15	-.05	-	
10. Self-enhancement	.11	-.03	.12	-.29	.28	.39	.26	-.28	.18	-

Note: Stars below the diagonal indicate uncorrected significance and above the diagonal indicate significance after FDR-correction.
*$p < .05$, **$p < .01$, ***$p < .001$

Clinical Symptoms and Functional Outcomes

Regression models examined variables' unique and shared effect on symptoms and functioning. Because the self-concept variables appeared to largely tap a common construct (see above), the set of self-concept variables was examined for multicollinearity. Variables were trimmed until the variance inflation factor was reduced below 2.0 for all predictors. Based on this procedure, self-esteem, self-concept clarity, and rumination were dropped from the regression models. The resulting models for self-concept variables predicting symptoms and functioning are shown in Table 5.6. As a set, self-concept variables predicted negative symptoms, social functioning, and possibly role functioning. A more negative and uncertain self-concept was associated with negative symptoms and functional impairment. Furthermore, negative self-beliefs also uniquely predicted negative symptoms and possibly social impairment. Despite their strong association with a common self-concept latent variable, negative self-beliefs were still the best predictor of negative symptoms in this sample.

Table 5.6

Regression models predicting symptoms and functioning from self-concept variables

	Positive symptoms	Negative symptoms	Social functioning	Role functioning
Negative self-beliefs	.37	.56*	-.41†	-.26
Positive self-beliefs	-.08	-.03	.24	.33
Self-reflection	.21	.06	-.23	-.21
Self-enhancement	.10	-.14	.08	-.04
Model fit statistics				
R^2	*.16*	*.36*	*.33*	*.24*
F	*1.42*	*4.20*	*3.47*	*2.23*
p	*.25*	*.008*	*.02*	*.091*

Note: *$p < .05$, †$p < .10$

Regression models for narrative identity variables predicting symptoms and functioning are shown in Table 5.7. As a set, narrative identity variables did not significantly predict any clinical or functional outcomes. However, trends suggested three possible independent effects. Within the CHR group, individuals who narrated their lives with more agency and positive emotion may also have reported fewer positive and negative symptoms, and individuals who narrated their lives with more autobiographical reasoning may also have reported better role functioning.

Table 5.7

Regression models predicting symptoms and functioning from narrative identity variables

	Positive symptoms	Negative symptoms	Social functioning	Role functioning
Motivational/ affective themes	-.27†	-.27†	.18	.18
Narrative structure	-.07	.03	.06	-.18
Autobiographical reasoning	.17	-.01	.06	.30†
Model fit statistics				
R^2	*.10*	*.07*	*.04*	*.15*
F	*1.45*	*1.06*	*0.56*	*2.12*
p	*.24*	*.38*	*.64*	*.11*

Note: †p < .10

Discussion

Autobiographical self-disturbances in the CHR syndrome extend to multiple aspects of the self-concept and narrative identity. In Study 3, the CHR group reported more negative self-beliefs, lower self-esteem and self-concept clarity, and higher rumination and self-reflection compared to the HC group. Moreover, their narrative identities were marked by negativity and passivity, and possibly subtle disruptions to contextual and temporal coherence. These findings have three main implications. First, they establish a nomological network for autobiographical self-disturbances in the CHR syndrome. Second, they highlight key features of this network that may capture relevant mechanisms of psychosis risk. And third, they suggest possible applications in early identification of self-disturbances.

Study 3 connected many aspects of the self-concept in the CHR syndrome that had not previously been studied in a single sample. Most self-concept variables (positive and negative self-beliefs, self-esteem, self-concept clarity, and a tendency toward rumination) were highly interrelated. Individuals in the CHR group experienced a core dysfunction in the self-concept, marked by negativity and uncertainty about the self, that appeared across multiple methods of operationalizing the self-concept. Several lines of research have found broad effects for negativity and uncertainty in the self-concept. Negativity and uncertainty predict greater paranoia in psychotic disorders (Kesting & Lincoln, 2013), highlighting their importance in diagnosable psychotic disorders. Yet they also appear to be important outside of diagnosable psychotic disorders. Self-concept negativity and uncertainty predict greater self-disturbances in schizotypy (Cicero et al., 2021) and mediate the relationship between childhood adversity and psychosis (Williams et al., 2018), suggesting that they may relate to etiological factors preceding the onset of psychotic disorders. Study 3 lends further evidence to this interpretation. Not only were broad

self-concept disturbances present in this imminent risk period, but they also appeared to reflect a single underlying dimension, suggesting that they may have been affected by common mechanisms.

Two variables were notably distinct from this pattern. Self-reflection—which captures a tendency toward cognitive, epistemically curious exploration of self-relevant experiences—was elevated in the CHR group but did not cohere with the latent self-concept variable. Individuals with trait vulnerability to psychosis also score higher on the self-continuity scale of the thinking about life experiences scale (TALES; Berna, Göritz, et al., 2016; Hallford & Burgat, 2014), which reflects a tendency to think about memories for the purpose of maintaining a sense of self. The TALES and the RRQ, used in Study 3, presume different motivations behind self-reflection (TALES: to maintain a consistent sense of self; RRQ: to learn new things about the self), but otherwise seem quite similar. Perhaps these scales reflect a separate dimension from core self-concept dysfunction. This dimension is less about negative and inconsistent content in the self-concept, and more about tendencies to cognitively consult, examine, or update the self-concept. It is intriguing that this dimension seems to be increased in individuals at risk for psychosis, as cognitive deficits are one of the most robust risk factors for psychosis (Kahn & Keefe, 2013). People at risk for psychosis seem to maintain a strong interest in self-reflection despite cognitive issues which may impair their self-reflective abilities. This could be a mechanism for increasing self-disturbances during the prodromal and early stages of psychotic disorders, as individuals increasingly understand themselves through faulty cognitive processes. Future research could begin to examine the role of cognitive impairment by separating the ability to self-reflect from interest in self-reflection in imminent risk and early-course psychosis samples.

Self-enhancement was also distinct from the core self-concept dysfunction. The fact that CHR participants reported heightened negative self-evaluations, but did not report heightened self-enhancement, provides further evidence for the "emotion-consistent" model of grandiose delusions (Knowles et al., 2011). In this model, authentic positive self-beliefs become exaggerated over time because they preserve positive emotions against a backdrop of global negative self-evaluation. The "delusions as defence" model, by contrast, predicts that CHR participants endorsing negative self-evaluations would engage in self-enhancement as a protective strategy. Study 3 found no evidence for this model. Self-enhancement did not differ between CHR and HC groups, nor did it correlate with self-beliefs or clinical variables within the CHR group. It is also possible that the specific scale used in this study (the EMS) was not ideal for capturing self-enhancement in this sample. The EMS was explicitly designed as a culturally sensitive scale to capture both egoistic (independent) and moralistic (interdependent) aspects of self-enhancement. However, it was developed in Italy and may not be culturally sensitive to forms of self-enhancement endorsed in the United States. This could explain why the egoistic and moralistic subscales were highly correlated in Study 3's sample. Self-enhancement, as measured by the EMS, may not be an optimal variable in self-concept analyses with CHR samples. Nevertheless, Study 3 did provide further evidence against the "delusions as defence" model and in favor of the "emotion-consistent" model.

Similarly, the fMRI analyses in Study 3 found no effects. These analyses were underpowered (both due to sample size and an unbalanced sample), and their results do not provide strong evidence for or against the presence of an effect. Essentially, these analyses were inconclusive. Further research with new, larger sample sizes would be necessary to replicate Study 2's findings and extend them to other aspects of the autobiographical self.

In contrast to the negative results in the fMRI analyses, Study 3 found the hypothesized pattern of narrative identity disturbances in the CHR group. Motivational/affective themes were more negative and passive throughout the narrative interview, while contextual and temporal coherence possibly showed more subtle impairments, and autobiographical reasoning was unaffected. Negative and passive themes have been observed within the psychosis spectrum in trait vulnerability and psychotic disorder samples (Bennouna-Greene et al., 2012; Berna, Göritz, et al., 2016; Hazan et al., 2019; Holm et al., 2016, 2020; Jensen et al., 2020, 2021; Lysaker, Wickett, et al., 2005), in nonpsychotic mood disorders (Adler, 2012; Singer et al., 2013) and personality disorders (Lind et al., 2020), and in nonclinical samples with low well-being and subclinical depressive symptoms (Adler et al., 2016; Cowan et al., 2019). Individuals in the CHR syndrome experience attenuated psychotic symptoms as well as substantial mood symptoms (Cowan & Mittal, 2021; Fusar-Poli et al., 2014), all of which would predispose them toward painful and passive life narration. Moreover, these motivational/affective themes were associated with the broad disturbances in the self-concept observed in self-report measures, possibly reflecting similar mechanisms. Taken together, these findings suggest that negativity/uncertainty in the self-concept and negativity/passivity in narrative identity may reflect common mechanisms related to general distress and functional impairment.

Unlike motivational/affective themes, structural narrative variables are not commonly found to be impaired in nonpsychotic samples. Study 3 may have found early warning signs of psychosis-spectrum impairments in narrative structure, with trend-level effects hinting at subtle disturbances in the CHR group's ability to coherently structure their life narratives. Rounding out this picture of narrative identity, autobiographical reasoning was unaffected in the CHR group. These findings fill in an important gap in the literature. Previous studies have found disruptions

in narrative structure and autobiographical reasoning in SSD samples (Alle, d'Argembeau, et al., 2016; Berna et al., 2011b; Raffard et al., 2010; Wright et al., 2019) but not in trait vulnerability samples (Berna, Göritz, et al., 2016; Hallford & Burgat, 2014; See et al., 2020). The current results suggest that structural issues may begin to emerge before autobiographical reasoning issues. Structure may begin to break down in earlier or milder forms of psychosis, whereas autobiographical reasoning may only break down amid the severe symptoms and impairment of a diagnosable psychotic disorder. An exciting future direction would be to collect repeated narratives from individuals over the course of illness to definitively show when in the progression of a psychotic disorder these deficits might appear. Similarly, studies could follow trajectories of change in structure and autobiographical reasoning in CHR individuals who do or do not go on to develop a psychotic disorder.

Methodologically, it is worth noting that the four narrative prompts in Study 3 resulted in different patterns of narration. The psychotic-like experience prompt resulted in the least autobiographical reasoning of any prompt across both CHR and HC groups. In general, participants did not narrate these events as shaping the self or holding any special meaning. However, these stories were affectively neutral in the HC group but affectively negative in the CHR group. One CHR group participant described the experience of thinking events on TV held a special personal meaning, an experience that, "became really weird to me…I would also become really, really stressed out about it…I'm like, this is super-duper weird and this is not okay. You know, this is not okay for me to be feeling this way" (ID 940). Negative affective responses to perplexing experiences may be an important marker of psychosis risk. Similarly, self-defining memories resulted in particularly low agency in the CHR group. These are some of the most used prompts in psychosis studies (Zhang et al., 2019) and their focus on memories'

personal significance may help to elicit motivational themes. Finally, the life challenges prompt was the only section of the interview where temporal coherence differed between the two groups. This prompt asked participants to narrate a less constrained and episodic story The more temporally open-ended nature of this prompt may have brought out subtle deficits in the CHR group's ability to coherently sequence autobiographical events. Less structured prompts, by providing less scaffolding, may be more effective in assessing participants' ability to coherently structure their own life stories.

Considering their relationships to attenuated psychotic symptoms and functioning, several variables are candidates for early indicators of autobiographical self-disturbances. The core self-concept dysfunction was associated with attenuated psychotic symptoms and functional impairment. Negative self-beliefs may also be a particularly important mechanism linking self-concept disturbances to clinical symptoms. By contrast, although weak evidence suggested a potential link between motivational/affective themes and negative symptoms, for the most part the narrative identity disturbances identified in this study were not related to symptoms. This suggests that motivational/affective themes and structural incoherence may be early indicators of self-disturbance that do not yet affect functioning or contribute to manifest symptoms. If they predict later symptoms or transition to psychosis, this would be an exciting new axis on which to consider psychosis risk. The same is true for self-reflection, which was also elevated in the CHR group without a clear link to symptoms or functioning. Self-reflection captures an interest in looking inward and exploring one's inner experience, which is also a component of autobiographical reasoning. Would self-reflection continue to be elevated in more severe psychosis-spectrum experiences? How would deteriorating abilities to autobiographically reason

impact individuals' interest in self-reflection? These would be interesting questions for future research in SSD populations.

This study's strengths include its multiple measures of self-concept collected in the same sample, which facilitated a nomological network of self-concept processes; its comprehensive assessment of narrative identity across all three empirically supported dimensions in four different narrative prompts; and its high standard of interrater reliability across three independent raters. Its main limitations include missing data issues due to the COVID-19 pandemic, which impacted statistical power and may have resulted in false negative results, particularly in the fMRI analyses; possible effects of common method variance in completing many self-concept questionnaires at once; and lack of a qualitative component (e.g., using grounded theory) to identify potential new and unique themes in the CHR group's narratives. Future research with larger and more consistent sample sizes, multiple methods of assessing the self-concept (e.g., using behavioural tasks), and qualitative analysis of participants' experiences would be valuable in addressing these limitations.

In sum, Study 3 found that individuals meeting criteria for a CHR syndrome reported a broad disturbance in the self-concept, with a common latent variable accounting for unusually negative and uncertain self-concept across multiple measures (positive and negative self-beliefs, self-esteem, self-concept clarity, and rumination). Self-reflection was also elevated, but did not cohere with the common factor, suggesting that these individuals remained cognitively interested in self-examination despite negativity and uncertainty about the self. Narrative identity was also affected, with clear and robust differences in motivational/affective themes (negative and passive life stories) and potential subtle differences in narrative structure (context and temporal

coherence). These results suggest that disturbances in the self-concept and narrative identity are relevant markers of autobiographical self-disturbances in the CHR syndrome.

CHAPTER VI

General Discussion

Robert Bayley, Clara Kean, and many other individuals with schizophrenia have described profound challenges in maintaining a coherent autobiographical self. But how do these phenomena manifest in the CHR syndrome? And how do various aspects of autobiographical self-disturbances relate to one another? Importantly, do their relationships suggest any underlying dimensions, common mechanisms, or early indicators of more severe autobiographical self-dysfunction?

Autobiographical Self-Disturbances in the CHR Syndrome

This series of studies examined the autobiographical self in the CHR syndrome from multiple perspectives. Figure 6.1 graphically depicts the nomological network defined in this series of studies. The nodes indicate variables which significantly differed between CHR and HC groups, and the lines indicate relationships between variables. A core dysfunction emerged, characterized by an uncertain self-concept centred on negative self-beliefs. This dysfunction was linked to symptoms and functional impairment across multiple studies. Compared to their normatively developing peers, participants in the CHR group thought about themselves more frequently but yet felt more uncertain about themselves. Moreover, the beliefs they did hold about themselves tended to be negative and self-critical. This core self-concept dysfunction also reached into narrative identity, accompanying negative and passive life stories in Study 3's CHR sample. Intriguing functional connectivity findings suggested that the core self-concept dysfunction related to unusual interactions between intrinsic and extrinsic self-processing,

suggesting one potential underlying mechanism. Finally, self-reflection and narrative structure were affected in the CHR group but did not relate to the core self-concept dysfunction, suggesting that other aspects of the autobiographical self may also be affected in the CHR syndrome—and in the psychosis spectrum more broadly.

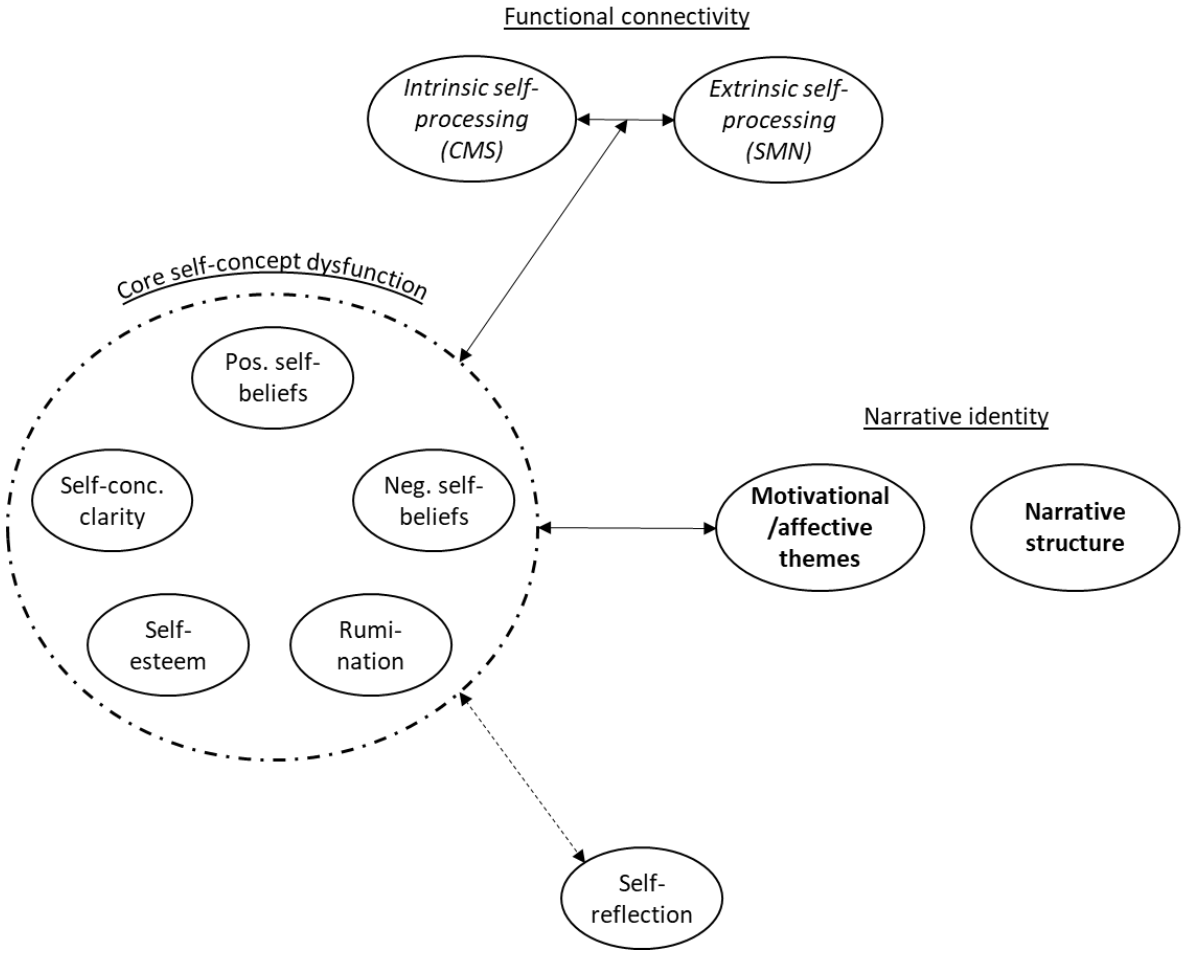

Figure 6.1. Observed relationships between autobiographical self-disturbances in the CHR syndrome. Variables which differed between CHR and HC are shown here, with clear associations indicated by solid lines and weak or uncertain associations indicated by dashed lines. Variables which did not differ between CHR and HC are omitted. Note that not all paths were adequately tested, e.g., it is unclear whether functional connectivity indices may relate to narrative identity variables, because the fMRI analyses in Study 3 were uninterpretable.

Study 3 also found some evidence for another dimension of variation in the self-concept. Self-reflection, the tendency to explore one's self-experiences from a stance of epistemic curiosity, was elevated in the CHR group but largely unrelated to the core self-concept dysfunction. Two studies have found similar results with the TALES, a measure of autobiographical thinking directed at maintaining a consistent view of the self (Berna, Göritz, et al., 2016; Hallford & Burgat, 2014). Individuals meeting CHR criteria seem unusually interested in cognitively consulting, examining, and updating the self-concept. Notably, in Study 3, variation in self-reflection was not associated with clinical symptoms or functional impairment, suggesting that this dimension is not inherently dysfunctional. One interesting avenue for future research would be to examine relationships between measures of self-reflection and narrative identity throughout the psychosis spectrum. In personal accounts, individuals with schizophrenia have described "a fundamental need to be understood" (Bayley, 1996, p. 728) and noted that "schizophrenia can cause a form of exaggerated self-consciousness" (Kean, 2009, p. 1034). Does an elevated interest in self-reflection persist in more severe or chronic forms of psychotic experience? As narrative structure and autobiographical reasoning break down in more severe psychosis, how is self-reflection affected? A preserved interest in self-reflection would be a key strength facilitating therapeutic change in metacognitive treatments for psychosis (Lysaker et al., 2018).

Individual Differences

What role might individual differences in the autobiographical self play within the CHR syndrome (and the psychosis spectrum more broadly)? Studies 1 through 3 conceptualized autobiographical self variables as indicators or covariates of psychosis risk at the group level. However, to recognize people with schizophrenia as individuals rather than collections of

symptoms, we must recognize that these self-concept and narrative identity variables will vary substantially within any one clinical sample. An important next step will be to examine subgroup-level or individual-level variation on these dimensions within clinical samples. For instance, previous studies have identified reliable subgroups of individuals with schizophrenia who endorse different affective traits (e.g., “I am a nervous person”; “I am an enthusiastic person”) and experience markedly different symptom profiles (Cowan et al., 2020; Dickinson et al., 2018). On time scales longer than 2 weeks, people rely on semantic self-knowledge to report their affective traits (Robinson & Clore, 2002), meaning that these traits reflect variation in the self-concept. Overall negativity/uncertainty in the self-concept may be another trait dimension that can help to explain heterogenous experiences in psychosis spectrum samples. Aspects of the autobiographical self could be modeled through dimensional analyses, for example through factor analysis or structural equation modeling, or through classification analyses, for example through cluster analyses, latent class analyses, or machine learning classification. Studies 1 through 3 identified several dimensions that may be valuable to examine at the individual level: negative/uncertain self-concept, cognitive interest in the self-concept, narrative structure, autobiographical reasoning, and CMS-SMN functional connectivity. A move from group-level analyses to individual-level analyses would be an important next step in recognizing the individuality of people who live with psychosis or psychotic-like experiences.

Possible Mechanisms

Two results suggested potential common mechanisms: the presence of a latent core self-concept dysfunction; and its relationships to intrinsic and extrinsic neural self-referential processing. Latent dimensions often imply underlying mechanisms. One well-known example is the five-factor model of personality, which has facilitated studies of underlying causes for

variation in personality traits. Extraversion, for example, is closely associated with reward sensitivity through cortical-subcortical dopaminergic signaling ("wanting") and the endogenous opioid system ("liking") (T. Allen & DeYoung, 2017; Depue & Collins, 1999). Because a latent dimension explained variation in the self-concept in the CHR syndrome, it is likely that various self-concept measures may share common mechanisms.

Cognitive theories of psychosis suggest that self-referential processes interact in feedback loops with psychotic symptoms. For instance, negative beliefs about the self can bias people toward believing hallucinations and delusions that fit those pre-existing beliefs (Garety et al., 2001). Similarly, a lack of positive beliefs about the self can lead people to believe that they cannot effectively interact with the environment, motivating the disengagement that is characteristic of negative symptoms (Rector et al., 2005). Perhaps the dysfunctional self-concept processes identified in this dissertation also mutually reinforce one another. One possible feedback loop could be between low self-concept clarity, rumination, and negative self-beliefs. Why do people ruminate? We have a need for self-verification, even when learning negative information about the self (Swann et al., 1989). In other words, we tend to seek out information that confirms pre-existing negative beliefs about ourselves (J. S. Beck, 2011). Rumination also tends to accompany low self-concept clarity (Willis & Burnett, 2016; see also Study 3), and may in fact be an attempt to enhance self-concept clarity (Vine et al., 2014). In the current studies, low self-concept clarity may have motivated rumination, which may have reinforced negative self-beliefs and damaged self-esteem. When individuals experiencing attenuated psychotic symptoms feel uncertain about themselves, they may search for information to confirm their self-beliefs. If self-beliefs are negative, then the information retrieved will confirm and strength these negative self-beliefs. This is only one of many possible feedback loops between aspects of the

self-concept in CHR. Detailed longitudinal study designs (e.g., ecological momentary assessment designs) could explore potential feedback loops in more detail.

What about factors outside these feedback loops? What exogenous factors—outside the self-concept—might initiate or maintain them? In Study 3, the core self-concept dysfunction was linked to negativity and passivity in the life story. Negative self-beliefs and poor self-concept clarity have been linked to childhood adversity; in fact, they appear to mediate the link between childhood adversity and later psychotic experiences (Evans et al., 2015; Noone et al., 2015). Similarly, negativity and passivity in the life story has been observed in diverse psychopathology samples and even in healthy adults with low well-being (Adler, 2012; Adler et al., 2016; Cowan et al., 2019; Lind et al., 2020; Singer et al., 2013). Overall distress is a key component of the proposed general factor of psychopathology (Caspi et al., 2014), suggesting that distressing adverse experiences may predispose people toward negativity in the self-concept and narrative identity. In CHR populations, early adverse experiences may initiate negative and uncertain views of the self, motivating rumination and biasing narrative identity toward negative and passive personal stories.

The functional connectivity evidence in Study 2 suggests another potential mechanism. Whereas normative youth seemed to gain a clearer and more positive self-image from the interaction of intrinsic and extrinsic self-processing, the opposite was true for participants in the CHR group. When these individuals reflect on the extrinsic self, they may become more aware of their ineffective interactions with the world, leading to more dysfunctional self-evaluations. In Study 3, positive self-beliefs were one indicator of the core self-concept dysfunction. Although fMRI results in Study 3 were inconclusive, the close associations between positive self-beliefs and other indicators of the core self-concept dysfunction imply that all these variables should

relate to CMS-SMN hyperconnectivity. This neural mechanism is not so much associated with positive self-beliefs, in other words, but rather the broad experience of negativity and uncertainty about the self.

But one important piece of evidence does not fit this interpretation. Negative self-beliefs were another key component of self-concept negativity/instability in Study 3. However, negative self-beliefs were not associated with any functional connectivity patterns in Study 2. This may be a psychometric artifact of a floor effect in negative self-belief scores. In Study 2, most participants in both groups reported very low levels of explicit negative self-beliefs (or none at all). The BCSS were developed to assess core beliefs in adults with chronic schizophrenia (Fowler et al., 2006), and may not be sensitive enough to more subtle negative self-evaluations in the CHR syndrome. Alternatively, different self-concept variables may relate to slightly different mechanisms. Similar to the agentic aspect of extraversion, which is more closely associated with dopaminergic than opioid signalling (Depue & Collins, 1999), there may be an "acting" aspect to the self-concept that promotes positive self-beliefs and relates to interactions between intrinsic and extrinsic self-processing. Larger sample sizes and more detailed analyses of self-concept measures (e.g., with multiple measures of negative self-beliefs, or item-level analyses) could evaluate these competing hypotheses.

Early Indicators of Autobiographical Self-Disturbances

What are the practical implications of Studies 1 through 3 for early identification and treatment? Several variables emerged as potential early indicators of autobiographical self-disturbances: positive and negative self-beliefs, narrative motivational/affective themes, connectivity between intrinsic extrinsic self-networks, self-reflection, and narrative structure. Each variable may give somewhat different information about autobiographical self-

disturbances. In Studies 1 and 3, positive self-beliefs, negative self-beliefs, and narrative motivational/affective themes were linked to distress and clinical symptoms. Hyperconnectivity between intrinsic- and extrinsic-self networks in the brain may be a key mechanism accounting for these patterns. These variables may aid in identification of individuals for CHR research and treatment.

Self-reflection and narrative structure, by contrast, were altered in the CHR group (with narrative structure altered at the trend level only) but were unrelated to clinical symptoms and functional impairment. This suggests two questions for future research. Cross-sectionally, are these variables related to basic self-disturbances? If so, they could provide entirely new tools to identity early warning signs of self-disturbances. Longitudinally, do these variables predict worsening symptoms, increasing self-disturbances, or conversion to psychosis? If so, they suggest entirely new dimensions on which to evaluate psychosis risk. Similarly, the narrative identity method is a novel approach by which to examine the CHR syndrome. Narrative identity appears to be a promising method for detecting subtle disturbances that would be difficult to detect by other methods. For instance, automated methods of detecting narrative incoherence have shown mixed results in CHR samples (Hitczenko et al., 2021). Narrative identity methods may provide a sensitive measure of subtle disruptions in narrative coherence, provided that Study 3's trend-level findings on narrative structure are replicated in future studies.

These early indicators also suggest several treatment implications. First, they seem to be viable targets for metacognitive and mentalization-based treatments such as Metacognitive Reflection and Insight Therapy (MERIT; Lysaker & Klion, 2017). Metacognitive treatment addresses fragmentation of the self (a state in which thoughts, emotions, and perceptions are experienced as scattered fragments rather than an integrated whole) by building more complex

and integrated understandings of the self and others (Hamm et al., 2017; Lysaker et al., 2020). Metacognitive interventions can leverage a heightened interest in self-reflection to effect meaningful change in individuals' experience. These interventions can build a more adaptive self-concept and narrative identity by promoting agency over one's own behaviors and experiences, and improve narrative structure by promoting narrative cohesion, elaboration of memories, and temporal sequencing.

Several other therapeutic approaches may also be valuable for early intervention in autobiographical self-disturbances. Self-esteem and schema-focused treatments may directly affect the self-concept (C. D. J. Taylor et al., 2017; H. E. Taylor et al., 2014). Study 2's findings on intrinsic- and extrinsic-self processing suggest that behavioral activation may also be an important element of self-concept change in the CHR syndrome. Mindfulness-based and third-wave cognitive therapies such as dialectical behavior therapy may be helpful in improving self-concept clarity (Hanley & Garland, 2017; Roepke et al., 2011). Finally, trauma and adversity are prominent factors linking self-concept clarity, core beliefs, and metacognition (Appiah-Kusi et al., 2017; Evans et al., 2015; Gaweda et al., 2019; Hamm et al., 2021; Leonhardt et al., 2015; Wigman et al., 2012). Trauma-focused therapies, including trauma-focused metacognitive therapies, may be beneficial in addressing autobiographical self-disturbances. Future studies employing self-concept and narrative identity variables as outcomes for metacognitive, schema-focused, mindfulness-based, and trauma-informed treatments would be highly informative.

Generalizability

How generalizable are these findings? Challenges in identifying and recruiting participants meeting CHR syndrome criteria tend to suppress sample sizes in CHR research (Addington et al., 2008), and there may be idiosyncrasies to any CHR sample that hinder

generalizability. Notably, these studies collected samples from different populations in two American cities (Chicago, Illinois and Boulder, Colorado) sharing few regional or demographic similarities. The demographic profiles of the two CHR samples had several notable differences (particularly in gender and race/ethnicity). Links between self-beliefs, clinical symptoms, and functioning were similar across both samples, suggesting that these effects (and possibly the other self-concept effects) may be more consistent across various CHR samples. Regardless, the samples shared many variables (e.g., American cultural norms, study setting in a university research laboratory, recruitment and assessment methods), and it is unclear how characteristics of the two communities could influence results. Ideally, continued research with samples from various sites would help to define appropriate demographic or cultural variables to include as random effects or moderators in future analyses.

Conclusion

This dissertation built a nomological network of autobiographical self-disturbances in the CHR syndrome, showing that multiple measures of self-concept, narrative identity, and functional connectivity reflect related aspects of autobiographical self-disturbance. Moreover, common mechanisms may underlie a core dysfunction in the self-concept characterized by negativity and uncertainty about the self. Finally, several key variables may be early indicators of more serious disturbances in the autobiographical self. The CHR syndrome captures a difficult period in which attenuated psychotic symptoms overlap undermine the normative development of self-concept and narrative identity. This dissertation's findings shed light on the unique challenges that individuals face as they attempt to maintain coherent selves and identities during this difficult period. By working to understand dimensions of variability in these processes, researchers may better understand etiological mechanisms of psychosis and identity

development, and clinicians may better treat their patients as individuals rather than collections of symptoms.

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APPENDIX A. BRIEF LIFE NARRATIVE INTERVIEW

Note to interviewer: *Before starting the interview, turn to question 4 and fill in the blank with the participant's highest-scoring item from the SIPS (if applicable).*

Introduction: In this 20- to 30-minute interview, we are interested in hearing about the story of your life. This is not a test or a clinical interview, and it will not be used to evaluate you in any way. It has nothing to do with any diagnosis or intervention. Our goal is just to hear you tell your story. Specifically, I will ask you about 4 different memories from your past. In each memory, I'll ask you what happened, how you felt at the time, and why this memory is significant for you. There are no right or wrong answers, and anything you choose to say is voluntary, anonymous, and confidential. We can skip anything you don't want to answer. Do you have any questions?

I will be recording the interview. Is it OK if I start recording now?

Begin recording and say: This is [interviewer name], conducting the baseline life narrative interview with participant [participant ID] on [today's date].

I'll remind you that everything you say in this interview is voluntary, anonymous, and confidential. As we go along, please let me know if anything is unclear, or if there's anything that you would prefer not to answer. Do you have any questions before we get started? *(Answer any questions).* Great, I hope you'll enjoy the interview.

Question 1 (Self-Defining Memory): My first question is about a self-defining memory. A self-defining memory is a scene or an episode from your life that is very important for how you see yourself. This would be something that happened at least 1 year ago, that you have thought about many times since it happened, so that the memory of it is clear and familiar to you now. This scene or episode helps you know who you are as a person. You might even tell this story to a friend if you wanted to help them understand you better. Right now, I'd like you to take a moment to think of a self-defining memory like this, and tell me the story of that memory. What happened, when and where did it happen, and who was involved?

Wait for the participant to respond, then ask:

- □ *(Reminder, if needed)* What happened?
- □ *(Reminder, if needed)* When/where did that happen/who was involved?
- □ *(Reminder, if needed)* What about this episode is important for how you see yourself?

- □ Could you tell me what you were thinking and feeling during this episode?
- □ What do you think this episode says about who you are as a person?
- □ I'm about to move on to the next question. Would you like to add anything else about this memory?

Thank you.

Question 2 (Turning Point): Next, I would like to ask about a turning point memory. In most people's lives, we experience episodes that change the direction of our lives, or change how we see ourselves in some important way. We call these memories, "turning points". Looking back over your life, there may be a few key moments that stand out as turning points – episodes that marked an important change in you or in your life story. Please identify a particular episode that you see as a turning point in your life, and tell me the story of that turning point. What happened, when and where did it happen, and who was involved?

(If participant is unable to identify a turning point after 30 seconds) If you can't think of a turning point, please describe an event where you went through an important change of some kind. What happened, when and where did it happen, and who was involved?

Wait for the participant to respond, then ask:

- □ *(Reminder, if needed)* What happened?
- □ *(Reminder, if needed)* When/where did that happen/who was involved?
- □ *(Reminder, if needed)* How did you or your life change as a result of this experience?

- □ Could you tell me what you were thinking and feeling during this experience?
- □ What do you think the scene says about who you are as a person?
- □ I'm about to move on to the next question. Would you like to add anything else about this experience?

Thank you.

Question 3 (Life Challenge): Now, I'd like to ask you about a problem or challenge that you have had in your life. In fact, I would like to ask about the biggest challenge you have ever faced. Looking back over your life, what do you think is the single greatest challenge you have ever faced? Please tell me the story of that challenge. What is or was the challenge or problem? How did the challenge or problem develop? And how did you address or deal with this challenge or problem?

Wait for the participant to respond, then ask:

- □ *(Reminder, if needed)* What is or was the challenge or problem?
- □ *(Reminder, if needed)* How did the challenge or problem develop?
- □ *(Reminder, if needed)* How did you address or deal with the challenge or problem?

- □ What is the significance of this challenge or problem in your overall life story?
- □ I'm about to move on to the next question. Would you like to add anything else about this challenge?

Thank you.

Question 4 (Psychosis-Spectrum Experience): Finally, I'd like to ask about an unusual experience that you've had. Many people experience unusual, strange, or profound things that are hard to explain – for example, coincidences, supernatural events, seeing visions or spirits, feeling like you're the centre of attention, like you have special powers, like one of your dreams might have really happened, or like boundaries between yourself and the world have become unclear. These experiences might be hard to explain. It might feel like the world is not as it seems, like you've glimpsed something hidden about reality, or like your mind is playing tricks on you. I'd like you to think of an unusual experience like this, and tell me the story of that experience. What happened, when and where did it happen, and who was involved?

If needed: Please tell me about a time when

_____

[before starting the interview, fill in this blank with the participant's highest-scoring item on the SIPS, if applicable].

Wait for the participant to respond, then ask:

- □ *(Reminder, if needed)* What happened?
- □ *(Reminder, if needed)* When/where did that happen/who was involved?
- □ *(Reminder, if needed)* Why was this experience unusual?

- □ Could you tell me what you were thinking and feeling during this experience?
- □ What do you think this experience says about who you are as a person?
- □ We're about to wrap up the interview. Would you like to add anything else about this experience?

Thank you. That brings us to the end of our interview. Do you have any questions about this interview? (*Answer any questions they have)* I want to thank you for taking the time to tell us about your life. We really appreciate hearing your stories, and we're open to your feedback. Is there anything in this interview that you think we could improve in the future?

If "yes", write down their feedback below: Thanks for the input. I'll talk with the team and see if that's something we can work on. *(bring up their feedback in lab meeting or supervision)*

If "no": Great!

That concludes this interview. Thanks again for your time.

Appendix B

Narrative Coding Notebook

This notebook documents changes to the previously-validated coding systems used in Study 3 to better capture variability in the CHR dataset.

Emotional Tone

For this code, coders are allowed to use their own emotional state after reading a narrative as a tiebreaker between two adjacent levels of the code.

Agency

Consider showing vs. telling, if a P says they're agentic but doesn't show it, this is more likely to be a 1. A rating of 2 requires that the P demonstrates agency in the narrative.

A 2 on agency doesn’t require that the whole story be agentic. In fact, a 2 may start from a heavily constrained situation, and involve the protagonist developing agency during the story. It may have a sense of triumph--breaking free from a difficult situation to assert agency and build an agentic life.

0 can be used for narratives with an equal mixture of agentic and non-agentic language and no strong movement toward agency.

Context Coherence

No modifications required to this code.

Temporal Coherence

"Gestalt" rating outline for this code (as a trained rater, to expand on the “naïve listener” standard in the original codes)

- 0: Trained rater can't even get a broad outline of events
- 1: Trained rater can get a broad outline of events but can't order details
- 2: Trained rater can order details, but has to work hard to do it
- 3: Trained rater can order details without much effort

Meaning-Making

Note that we want this code to capture the reflexive process of searching for semantic meaning in episodic experience.

Modification to code:

- 0: no meaning making
- 1: reflexive act of making some effort to explain the meaning of events
- 2: effort + contextualized meaning that makes sense within the context of the particular example (*lesson*)
- 3: effort + generalizable meaning, using the experience as an example of bigger ideas or themes that reach beyond the example to other aspects of the self, the world, or human living (*insight*; "bigger" = either depth or breadth of insight)

Self-Event Connections

Note that these represent the outcomes of events (changes or revelations about the self because of experience), regardless of how this comes about.

Reveal connections: make sure to differentiate these from explain/illustrate, the difference being whether the experience itself revealed something or led to a revelation about the self, as opposed to the experience illustrating something

Note that one example can be both revealing AND inducing, if it reveals something about the self AND induces change. E.g., 104 TP, P realizes that she has been likeable all along, and this realization causes her to change how she approaches social interactions. This example should be coded as both a reveal connection and an induce connection.

Scale anchors:

- 0 = absent
- 1 = weak, ambiguous, or vague
- 2 = explicit or strong.