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Swedish universities Scales of Personality: relationship to other personality instruments, patient-control differences and longitudinal stability in schizophrenia and related disorders

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THESIS FOR DOCTORAL DEGREE (Ph.D.)

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To my family and to all of you in the research team who made this possible.

POPULAR SCIENCE SUMMARY OF THE THESIS

Schizophrenia and other long-term treated psychotic disorders are often severe and involve a lasting change in the life situation both for the affected individual and for relatives. About one percent of the population suffers from this disease, which is considered lifelong. The underlying causes of the development of psychotic disorders are still partly unknown.

Personality can be explained as a characteristic set of different behaviors, cognitions and emotional patterns that develop from learning or genetic factors. There is no single model that can explain the whole personality of the human.

From a broader scientific perspective, the stability of personality traits over time has been discussed in detail. Some research results support the theory that personality traits can change over time. Other studies suggest stability of personality traits over time. There are some previous studies that have examined the stability of personality traits over a longer time period in people with long-term treated psychotic disorder and compared it with healthy individuals.

Personality can affect both symptoms and social function in individuals with long-term treated psychotic disorders. Only a few studies have analysed long-time stability of personality traits in individuals with long-term treated psychotic disorder. It is also important to investigate differences in personality traits in individuals with long-term treated psychotic disorder related to healthy individuals. These differences could be a clue in understanding the causes and why individuals fall ill with long-term treated psychotic disorder. They can also point out potentially helpful interventions for treatment. There is lack of previous studies that have focused on long-term follow-up in this group. In this thesis the individuals were examined with the personality instrument Swedish universities Scales of Personality (SSP). It is an instrument developed to measure personality related to psychopathology.

In Study 1 personality traits in individuals with established psychotic disorder were studied and the results were compared with healthy controls to investigate whether it is possible to measure personality in individuals with long-term treated psychotic disorder using SSP, and to see if individuals with psychotic disorder differ in their personality traits related to healthy individuals. The results show that it is possible to use SSP for this group of individuals. Individuals with psychotic disorder scored higher on scales related to neuroticism and lower on scales that were related to aggression than healthy controls. This is in accordance with studies where other personality instruments have been used.

Study 2 and 3 examined personality traits in patients with long-term treated psychotic disorder over a five- and 13-year period. They were then compared with healthy individuals in a control group. The individuals completed SSP at two or three occasions at five- and thirteen-year intervals, respectively. Individuals with psychotic disorder in Study 2 showed relatively stable personality traits, even though the stability of individuals with psychotic disorder was lower than that of healthy individuals. This is in line with previous research. In

Study 3, the survey was conducted on three occasions over thirteen years. To our knowledge no previous study has examined personality traits in individuals with long-term treated psychotic disorder for such a long time. The study showed that personality traits generally had a high level of stability. When examining between individuals with psychotic disorder and healthy people, the patients differed regarding neuroticism and interpersonal distance. This is in line with previous studies. In this study, a review was also made of previous long-term studies where SSP or its predecessor Karolinska Scales of Personality (KSP) were used.

The purpose of Study 4 was to compare the personality inventory SSP with other personality instruments. Only healthy individuals were included in this study. They had to fulfill SSP and at least one additional personality instrument. Correlations were calculated between the included scales in the different instruments. The personality instruments compared to SSP were revised Chapman scales, NEO-PI-R, SCID-II screen and STQ. The results show that SSP is useful in assessing personality traits related to temperament-like characteristics. The different personality instruments are not completely comparable with each other. Instead, they measure personality aspects in partly different ways.

In summary, the studies included in this PhD project show that SSP can be used to measure personality traits in individuals with schizophrenia and other long-term treated psychotic disorders who are in a stable remission. SSP is especially useful when measuring personality traits related to temperament-like functions and psychopathology. Different personality instruments measure personality aspects in partly different ways and are not completely comparable with each other. Personality traits showed relatively high stability among individuals with long-term treated psychotic disorder. Healthy individuals showed higher stability than individuals with long-term treated psychotic disorder. Research and a deeper understanding of personality traits are important to seek clues to the pathology and etiology of schizophrenia and other long-term treated psychotic disorders.

POPULÄRVETENSKAPLIG SAMMANFATTNING

Schizofreni och andra långtidsbehandlade psykossjukdomar är ofta allvarliga och innebär en varaktig förändring av livssituationen både för den drabbade individen och för anhöriga. Ungefär en procent av befolkningen drabbas av denna sjukdom, vilken betraktas som livslång. De bakomliggande orsakerna till utvecklandet av psykossjukdom är fortfarande delvis okända.

Personlighet kan förklaras som en karaktäristisk uppsättning av olika beteenden, kognitioner och emotionella mönster som utvecklas från inlärning eller genetiska faktorer. Det finns ingen enskild modell som kan förklara människans hela personlighet.

Ur ett vidare vetenskapligt perspektiv har stabiliteten hos personlighetsdrag över tid diskuterats ingående. Vissa forskningsresultat stöder teorin att personlighetsdrag kan förändras över tid. Andra studier tyder på stabilitet avseende personlighetsdrag över tid. Det finns några tidigare studier som har undersökt stabiliteten i personlighetsdrag över längre tid hos personer med långtidsbehandlad psykossjukdom och jämfört den med friska individer.

Personlighet kan påverka både symptom och social funktion hos individer med långtidsbehandlad psykossjukdom. Endast ett fåtal studier har analyserat långtidsstabilitet i personlighetsdrag hos individer med långtidsbehandlad psykossjukdom. Det är också viktigt att undersöka skillnader i personlighetsegenskaper hos individer med långtidsbehandlad psykossjukdom och friska individer. Dessa skillnader skulle kunna vara en ledtråd i att förstå orsakerna till och varför individer insjuknar i långtidsbehandlad psykossjukdom. De kan också peka ut potentiellt användbara insatser för behandling. Det saknas studier som har fokuserat på långtidsuppföljning hos denna grupp. Individerna har i avhandlingens studier undersökts med personlighetsinstrumentet Swedish universities Scales of Personality (SSP). Det är ett instrument framtaget för att mäta personlighet relaterad till psykopatologi.

I studie 1 studerades personlighetsdrag hos individer med etablerad psykossjukdom och resultaten jämfördes med friska kontrollpersoner för att undersöka dels om det är möjligt att mäta personlighet hos individer med långtidsbehandlad psykossjukdom med hjälp av SSP, dels för att se om individer med psykossjukdom har personlighetsdrag som skiljer sig från friska individer. Resultaten visar att det är möjligt att använda SSP för denna grupp av individer. Individer med psykossjukdom skattade högre i skalor relaterade till neurotisism och lägre i skalor vilka var relaterade till aggressivitet än friska kontrollpersoner. Det är i överenstämmelse med studier där andra personlighetsinstrument har använts.

I studie 2 och 3 undersöktes stabilitet i personlighetsdrag hos patienter med långtidsbehandlade psykossjukdomar över en fem- och 13-årsperiod. Dessa jämfördes sedan med friska individer i en kontrollgrupp. Individerna genomförde SSP vid två respektive tre tillfällen med fem och tretton års intervall. Individer med psykossjukdom uppvisade i studie 2 relativt stabila personlighetsdrag även om stabiliteten hos individer med psykossjukdom var lägre än hos friska individer. Detta i enighet med den tidigare forskning som finns. I studie 3

genomfördes underökningen vid tre tillfällen under tretton år. Såvitt vi vet har ingen tidigare studie har undersökt personlighetsdrag hos individer med långtidsbehandlad psykossjukdom under så lång tid. Studien visade att personlighetsegenskaper generellt hade en hög stabilitet. Vid undersökning mellan individer med psykossjukdom och friska personer skiljde sig patienterna avseende neurotisism och interpersonell distans. Detta är i överenstämmelse med tidigare studier. I denna studie gjordes också en genomgång av tidigare långtidsstudier där SSP eller dess föregångare Karolinska Scales of Personality (KSP) har använts.

Syftet med studie 4 var att jämföra personlighetsinventoriet SSP med andra personlighetsinstrument. I denna undersökning ingick endast friska individer. Dessa fick genomföra SSP och minst ett ytterligare personlighetsinstrument. Korrelationer beräknades mellan de ingående skalorna i de olika undersökningarna. De personlighetsinstrument som jämfördes med SSP var revised Chapman scales, NEO-PI-R, SCID-II-screen och STQ. Resultaten visar att SSP är användbart vid bedömning av personlighetsdrag relaterade till temperamentliknande egenskaper. De olika personlighetsinstrumenten är inte helt jämförbara med varandra. Istället mäter de personlighetsaspekter på delvis olika sätt.

Sammanfattningsvis visar studierna som ingår i det här forskningsprojektet att SSP kan användas för att mäta personlighetsdrag hos individer med schizofreni och annan långtidsbehandlad psykossjukdom vilka är i en stabil remission. SSP är särskilt användbart när man mäter personlighetsdrag relaterat till temperamentsliknande funktioner och psykopatologi. Olika personlighetsinstrument mäter personlighetsaspekter på delvis olika sätt och är inte helt jämförbara med varandra. Personlighetsdrag visade relativt hög stabilitet bland individer med långtidsbehandlad psykossjukdom. Friska individer uppvisade högre stabilitet än individer med långtidsbehandlad psykossjukdom. Forskning och en djupare förståelse av personlighetsdrag är av vikt i syfte att söka ledtrådar till patologin och etiologin vid schizofreni och andra långtidsbehandlade psykossjukdomar.

ABSTRACT

Objective

Schizophrenia and related disorders are often severe and chronic. They could also cause a lasting change in the life situation of the affected individual. Personality is an aspect that can affect symptoms and social function in schizophrenia spectrum disorder. The first aim of the thesis was to evaluate the use of the Swedish universities Scales of Personality (SSP) with regard to factor structure, internal consistency and case-control differences. The second aim was to investigate stability over five- and 13-year periods among patients with schizophrenia and related disorders and healthy individuals. The third aim was to investigate associations between SSP and scales from four other personality instruments among healthy subjects. A fourth aim was to investigate differences between patients with long-time treated psychotic disorder and control related to personality traits.

Method

Patients and controls were recruited as part of the larger Human Brain Informatics (HUBIN) study at Karolinska Hospital and Institutet in Stockholm, Sweden.

In order to investigate aspects of usability and differences between patients and controls using SSP, factor structure and internal consistency in patients with psychotic disorder and healthy controls were analysed by multiple analysis of covariance (MANCOVA) and Cronbach's alpha.

Stability of personality traits were investigated during a five-year follow up study and also during a 13-year period in a second follow up study. Patients with schizophrenia and related disorders and healthy controls completed SSP upon two or three occasions at baseline, after five years and after 13 years. The three factors and 13 scales of SSP were analysed for effect of time and case-control differences. MANCOVA, correlations, means and SD's were calculated.

To investigate SSP in relation to other personality constructs the healthy controls completed SSP and at least one of the personality instruments NEO-PI-R, revised Chapman scales, SCID-II screen or STQ. Correlations were calculated between SSP´s three factors as well as between the 13 different SSP scales and scales/subscales in revised Chapman scales, NEO-PI-R, SCID-II screen and STQ. Factor analyses and ICC were calculated.

Results

When measuring differences and aspects of usability with SSP internal consistencies were overall similar comparing patients and controls. The patients scored significant lower in three (Adventure Seeking, Physical Trait Aggression, Verbal Trait Aggression) and higher in seven (Detachment, Embitterment, Lack of Assertiveness, Mistrust, Psychic Trait Anxiety, Somatic Trait Anxiety, Stress Susceptibility) in the SSP inventory scales. There was no significant difference between controls and patients in the scales Impulsiveness, Social Desirability, and

Trait Irritability scales. SSP factor analyses among patients with schizophrenia spectrum disorder showed a three-factor model, as anticipated. Factor Neuroticism was similar to the Swedish normative study. Factor Aggressiveness also included high loadings from the scales Adventure Seeking, Impulsiveness and Mistrust, both scales which in the Swedish normative study loaded in third factor Extraversion (Adventure Seeking and Impulsiveness) and factor Neuroticism (Mistrust). Factor Extraversion consisted of the scales Detachment and Social Desirability scales. For Detachment that is as in the Swedish normative study. Social Desirability loaded on the Aggressiveness factor in the Swedish normative study.

At five-year follow up MANCOVA within-subjects analysis did not show any effect of time. Patients scored higher than controls in seven of the SSP scales, i.e. Detachment, Embitterment, Mistrust, Lack of Assertiveness, Psychic Trait Anxiety, Somatic Trait Anxiety and Stress Susceptibility. At 13-year follow up tests of within-subject correlations showed differences in the two scales Lack of Assertiveness and Physical Trait Aggression. Lack of Assertiveness were influenced by age and in Physical Trait Aggression the controls rated themselves less aggressive at higher age whereas the patients' ratings were stable. Between-subjects correlations showed differences in the factor Neuroticism and also in nine of the 13 scales of SSP.

When investigate SSP scales and factors in relation to scales in other personality instruments weaker correlations were common and strong correlations were sparse. SSP Aggressiveness factor correlated with NEO Agreeableness (r=0.62). SSP Extraversion factor correlated with NEO Extraversion (r=0.63) and SSP Neuroticism factor correlated with Chapman Social anhedonia (r=0.62), NEO Neuroticism (r=0.80) and SCID-II cluster C (r=0.71).

Conclusion

The personality inventory SSP can be used assessing personality traits in patients with schizophrenia and related disorders in stable remission. SSP is particularly useful when measuring personality traits related to temperament-like features. The different personality inventories measure personality aspects in partly different ways and are therefore not completely comparable to each other.

SSP personality traits showed relatively high stability among patients with schizophrenia and related disorders. Healthy controls showed a higher stability than the patients.

LIST OF SCIENTIFIC PAPERS

I. Fagerberg T, Söderman E, Gustavsson JP, Agartz I, Jönsson EG. Personality traits in established schizophrenia: aspects of usability and differences between patients and controls using the Swedish universities Scales of Personality. Nordic Journal of Psychiatry. 2016;70(6):462-9.

II. Fagerberg T, Söderman E, Gustavsson JP, Agartz I, Jönsson EG. Stability of personality traits over a five-year period in Swedish patients with schizophrenia spectrum disorder and non-psychotic individuals: a study using the Swedish universities scales of personality. BMC Psychiatry. 2018;18(1):54.

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CONTENTS

LIST OF ABBREVIATIONS

A	Agreeableness
ANCOVA	Analysis of covariance
AS	Adventure Seeking
ASD	Autistic spectrum disorder
C	Conscientiousness
CNV	Copy number variation
CO	Cooperativeness
D	Detachment
DLPFC	Dorsolateral prefrontal cortex
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders, 3th version, revised
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4th version
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th version
E	Embitterment
E	Extraversion
E	Extraversion/Introversion
EPQ	Eysenck Personality Questionnaire
FFM	Five-Factor Model
GABA	Gamma-aminobutyric acid
GAF	Global Assessment of Functioning
HA	Harm Avoidance
HSV-2	Herpes simplex virus type 2
I	Impulsiveness
IPIP	International Personality Item Pool
IPIP-NEO	International Personality Item Pool Representation of the NEO PI-R
IPIP-NEO-60	International Personality Item Pool Representation of the NEO PI-R, 60 items

IPIP-NEO-120	International Personality Item Pool Representation of the NEO PI-R, 120 items
ICBT	Internet-based cognitive behavior therapy
ICC	Intraclass correlations
IQ	Intelligent quotient
KSP	Karolinska Scales of Personality
KSP-196	Karolinska Scales of Personality, 196 items
L	Lie/Social Desirability
LA	Lack of Assertiveness
M	Mistrust
MANCOVA	Multiple analysis of covariance
MB TI	Myers-Briggs Type Indicator
MGB	Microbiota-gut brain
MMPI-168	Minnesota Multiphasic Personality Inventory
N	Neuroticism
N	Neuroticism/Stability
NEO-FFI	NEO-Five Factor Inventory
NEO-I	Neuroticism-Extraversion-Openness Inventory
NEO-PI	NEO-Personality Inventory
NEO-PI-R	NEO-Personality Inventory Revised
NEO-PI-3	NEO Personality Inventory-3
NS	Novelty Seeking
O	Openness to experience
OCD	Obsessive compulsive disorder
P	Psychotism/Stability
PCA	Principal component analysis
PD	Personality disorder
PhTA	Physical Trait Aggression
PI	Personality Inventory
PRS	Polygenic risk scores
PS	Persistence

PsTA	Physic Trait Anxiety
r	Pearson correlation coefficient
RD	Reward Dependence
rho	Spearman Rank correlation coefficient
SANS	Scale for the Assessment of Negative Symptoms
SAPS	Scale for the Assessment of Positive Symptoms
SCID-II-screen	Structured Clinical Interview for DSM III-R, Axis II
SD	Self-Directedness
SD	Social Desirability
SI	Structure of Intellect
SNP	Single nucleotide polymorphism
SS	Stress Susceptibility
ST	Self-Transcendence
STA	Somatic Trait Anxiety
STA	Schizotypal personality
STB	Borderline personality
STQ	Psychotic traits questionnaire STQ
TCI	Temperament and Character Inventory
TCI-R	Temperament and Character Inventory-Revised
THC	Tetrahydrocannabinol
TI	Trait Irritability
TPQ	Tridimensional Personality Questionnaire
TWAS	Transcriptome wide association studies
VTA	Verbal Trait Aggression
16PF	Sixteen Personality Factor Questionnaire

1 INTRODUCTION

At present, the schizophrenia spectrum disorder research field has yet to answer the question of the underlying mechanisms for the disease. The underlying causes of illness and the development of psychotic illness are still partly unknown. Schizophrenia and related disorders are often severe and chronic. The disease affects about 0.5% of the world population (1). Schizophrenia spectrum disorders have a lifetime prevalence of 1% (2).

Personality could be explained as a characteristic set of different behaviors, cognition and emotional patterns that evolve from learning and genetic factors. However, personality traits can be described in different ways. There are a number of different personality traits theories, which all are constructed to explain human personality traits. The five-factor model have received more attention than other trait theories (3). A reason for this is that during the past 30 years consensus is that personality could be divided into five main factors, also known as the big five personality factors, e.g. Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness (4). Yet, there are so far no personality trait theories that can fully describe the whole of the human personality and a variety of different tests of mapping personality have been constructed. Some of the personality questionnaires focus on the relation to psychopathology. Swedish universities Scales of Personality (SSP) is an instrument developed to assess personality traits designed to be markers for different neurobiological processes related to mental illness and psychopathology, rather than evaluate the fullness of the human personality (5).

From a wider scientific perspective, the stability of personality traits over time has been widely discussed. Some findings suggest that personality traits are changeable over the life course (6-9), while other studies support the theory of stability of personality traits over the course of life, or stagnation of change in personality traits during the young adulthood (10, 11).

Personality can affect both symptoms and social functioning in schizophrenia spectrum disorders (12). Personality traits in schizophrenia spectrum disorders have earlier been investigated (13-16). Only a few studies have analysed putative stability of personality traits in patients with long-term treated psychotic disorder and there is lack of recent literature that have been focused on long-term follow-up investigations in this cohort.

Increased knowledge of these mechanisms is of great importance for understanding the role of personality traits related to schizophrenia spectrum disorders.

2 LITERATURE REVIEW

2.1 SCHIZOPHRENIA AND RELATED DISORDERS

Schizophrenia is considered as a common form of severe mental illness. The etiopathogenesis has not yet been fully identified. Schizophrenia is also associated with substantial personal and societal costs, morbidity, and mortality (17, 18). Schizophrenia spectrum disorders are present in both gender and found in all populations around the world. Schizophrenia is characterized by negative symptoms such as apathy, lack of emotion and poor social functioning and positive symptoms such as delusions and hallucinations. It could also cause cognitive dysfunction, disorganized thoughts, memory problems and poor concentration. The diagnosis of schizophrenia and related disorders are made from a series of criteria based on phenomenological description of behavior, clinical history, and symptoms (19, 20). There are no known biological markers for the disorders.

Both genetic factors and environmental factors are important in our understanding of the genesis of the overall risk of developing schizophrenia and related disorders (21). There is now more knowledge of the broad structure of the genetic architecture (22). Several key environmental risk factors have also been identified (23). Heredity points to an important role for hereditary genetic variants in the etiology of schizophrenia (24, 25). Still, much of the heritability of schizophrenia and other psychotic disorders remains unexplained. The environmental risk factors do not explain all the variances not attributable to known genetic risk factors. There is also evidence from previous research that schizophrenia is at least partly a neurodevelopmental disorder (26).

Similarities are found at both the genetic and clinical levels with neurodevelopmental disorders such as autistic spectrum disorder (ASD) and bipolar affective disorders (27-29), as well as in a variety of other mental disorders (30). There is a lack of stability of psychiatric diagnoses over time. Individuals with psychiatric diagnoses tend in some cases to convert to other diagnosis over time (31). It is also arguable if schizophrenia should be categorized as a distinct disorder or to be a part of a continuum (32-34) together with affective psychotic disorder and schizoaffective disorder (35, 36).

Pathology and pathophysiology of schizophrenia have been discussed and investigated. Postmortem brains of individuals with schizophrenia spectrum disorders have been studied and findings of abnormalities have been reported (37, 38), one of the most interesting findings are dysfunction of the gamma-aminobutyric acid (GABAergic) neuronal system (39). There are also functional and structural neuroimaging studies, as well as neurophysiological studies, who have reported abnormalities (40, 41). Recent research has identified consistent changes in brain structure at group level. Patients with schizophrenia have patterns of brain abnormalities including reduced subcortical gray matter volumes, reduced cortical thickness, smaller hippocampi and changes in cerebral white matter (42-44). The dopamine hypothesis has historically been an established explanation for the causes of schizophrenia (45). The dopamine hypothesis is supported by the fact that many

antipsychotic drugs work by blocking the dopamine D2 receptor (46, 47) in varying degrees. In this way, it was assumed that the dopamine neurotransmitter pathway or related pathways would in some way be affected in individuals with schizophrenia spectrum disorders. The fact that certain drugs such as amphetamine and cocaine increase the brain's dopamine levels and at the same time can cause psychosis also supports this theory (48). Other theories partly contradict the fact that the dopamine hypothesis has a decisive position regarding schizophrenia disease. As an example, it is emphasized that phencyclidine and ketamine can also cause psychosis and these substances block glutamate receptors (48). Thus, it can be assumed that there are several interacting factors that can cause psychosis. Therefore, it is of importance to consider the complexity of the causes behind schizophrenia and related disorders.

Environmental factors related to schizophrenia and related disorders are widely discussed. There are several of risk and protective factors for schizophrenia and other psychotic disorders. Radua et al (49) described in a meta-analysis over 170 risk and protective factors for psychosis. Still, there are many unknown risk factors for developing a psychotic disorder. Environmental exposures that increase the risk of schizophrenia can be divided into prenatal and postnatal factors. Prenatal factors are more difficult to study because of the time-period between conception and the debut of the psychotic disorder. There is also research that report findings in microbiota-gut brain (MGB) axis signaling and its effect on the brain and the development of schizophrenia and other psychotic disorders (50-52).

2.1.1 Prenatal factors

Prenatal environmental factors as advanced parental age at the time of conception, prenatal exposure to infections, the effects of prenatal malnutrition and the season of birth have received widely attention. Associations between advanced paternal age and schizophrenia spectrum disorders has been repeatedly reported (53-55). Also, there are researcher reports on associations between advanced maternal age at first birth and risk of schizophrenia spectrum disorders (56). The association between advanced age in parents and schizophrenia and related disorders support the theory of a role of de novo mutations among parents (48). Prenatal exposure to infections could be risk factors for schizophrenia and related disorders. Several papers report evidence for in utero exposure to influenza as a risk factor for schizophrenia (57-59), still the results are not fully convincing. Investigation in neonatal exposure to Herpes simplex virus type 2 (HSV-2) showed discrepant findings related to risk for schizophrenia spectrum disorder (60-62). Correlations between psychotic disorder and toxoplasmosis have been reported and discussed in several studies (58, 63-68). Toxoplasmosis is also reported as a risk factor for psychosis by Radua et al (2018) (49). The effects of prenatal malnutrition related to schizophrenia and related disorders are still inconsistent (69, 70). Some studies support the evidence for an increased risk of schizophrenia and related disorders from prenatal exposure to malnutrition (71-73). Related to season of birth there is some evidence for increased number of individuals with schizophrenia and related disorders born during winter and early spring (74-77). Similar

results occur in different parts worldwide. Approximate 5-8% more winter and spring births are reported among patients with schizophrenia and related disorders compared with the general population (78).

2.1.2 Postnatal factors

There are several postnatal environmental exposures that increase the risk of schizophrenia spectrum disorder. Investigated postnatal factors includes cannabis use (THC), childhood trauma, migration and urbanity.

Use of THC is well known as a risk factor for developing schizophrenia and other psychotic disorders, especially among young individuals (79-84). Childhood trauma, such as different kinds of separation or emotional, physical, or sexual abuse increase the risk for developing psychotic disorders (85-91). It also associated with higher rates of psychosis in the general population (92). Dose-response patterns are found (93). Childhood adversity and a family history of psychiatric disorders increase the risk of psychosis (94-96). Research support correlations between social migration and schizophrenia spectrum disorder both in those who migrates and their children born and brought up in the new country. Stress related to diminished social status, origin, poor background, or rural circumstances have been suggested as possible explanations (97-100). Urbanicity influences rates of psychotic disorders. Schizophrenia spectrum disorders are increased among city habitants, especially in high-income countries (101). The effect is only seen in individuals born and brought up in cities and the urban social environment is supposed to be the reason (102-104).

2.1.3 Microbiota-gut brain axis signaling

Microbiota-gut brain (MGB) axis signaling is of relatively new interest in the psychiatric research field and could influence brain function (50, 51). Zheng et al (2019) suggest altered gut microbiota profiles in schizophrenia (52). Further research needs to investigate the relation between MGB and psychotic disorders.

2.2 PERSONALITY

The term personality refers to individual differences of characteristic patterns of behaving, feeling, and thinking. Personality traits could be described as the relatively enduring patterns of behaviors, feelings and thoughts that reflect the tendency to respond in certain ways under certain circumstances (105). Personality lacks a common definition, instead it has been defined in several different ways. Most personality theories focus on motivation and psychological interactions related to the environment of the individual.

A common way to mapping personality traits is by using different personality questionnaires. A large number of personality constructs with associated questionnaires has been developed. Modern personality tests are valuable instruments in assessing personality (106). Despite this, there are still some difficulties in measuring the individual's entire personality with personality instruments (107). In personality tests based on dimensional scales, both reliability and validity are considered to be higher than in tests that use categorical scales

(108). Dimensional scales are considered to better represent reality. Personality tests can typically be divided into two types depending on how the test is performed. Structured personality tests are designed as tests with standardized questions and are often based on trait psychological ideas (5, 109-112). These are often self-report questionnaires. In some tests, observer-report questionnaires are also performed (113, 114). Some personality inventories could be used both as observer-report instruments and as self-report questionnaires. Projective tests are examples of tests based on psychodynamic theories. These are based on interpretations of, for example, images and thus differ from other psychological tests.

Inheritance and environment interact in the development of personality traits. About half of the measured differences between human personality traits are considered to have genetic causes and the remaining part of other causes such as growing up environment and unique life experiences (115, 116). The environment during growing up affects the personality only to a small extent. For certain personality traits such as antisocial behavior, the environment during childhood and adolescence, however, seems to have a greater significance compared to personality in general (117). Cultural differences seem to have little effect on personality. Less than 5 percent of the variation in personality can be explained by which country the individuals has spent most of their time (118).

Historically, different perspectives of personality have been presented. In order to measure different personality traits a wide variety of theories and scales have been developed. These theories include, among others, the self-report personality inventory Sixteen Personality Factor Questionnaire (16PF) by Raymond B Cattell and coworkers (119), Grays Biopsychological theory of personality (120), the introspective self-report inventory Myers-Briggs Type Indicator (MB TI) (121) and the Structure of Intellect (SI) theory by J. P. Guiford (122). Several other methods of personal assessment have also been developed, with a remarkable progress in methods and theories of personality assessment (3).

The Trait theory is one of the earlier modern approaches to study, describe and explain the human personality. The theory focuses on the measurement of traits, which are aspects of personality described as habitual patterns of behavior, thoughts, and emotions that are relatively consistent over situations and stable over time. They also differ between individuals and influence behavior. Gordon Allport was one of the leading researchers in the development of the Trait theory. The book "Personality: a psychological interpretation”, written by Allport and published in 1937, can be seen as a breakthrough for the subject of personality psychology. Allport also identified 17953 personal descriptive adjectives in the *Webster's New International Dictionary* which were considered to describe the various characteristics of the human. By using factor analysis, the researcher Raymond Cattell later came to identify basic personality traits by reducing the thousands of adjectives that Allport had collected. Cattell's research resulted in the self-assessment form Sixteen Personality Factor Questionnaire (16PF) (123).

The concept of trait differs in many respects from the concept of state. States could be described as characteristic patterns of behaving, feeling and thinking in a specific situation at a specific moment. States vary with time, in contrast to traits who are more stable.

Based on the Trait theory, several different alternative theories and scales have been developed. The commonly used NEO-Personality Inventory (NEO-PI), a revised version and NEO Personality Inventory-3 (NEO-PI-3) define the broad domains of the Five-Factor Model of personality (110, 111, 124-126). The Five-Factor Model includes the dimensions Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness to experience (Figure 1). It have received more attention than other personality theories during the last 50 years (4).

Figure 1. Simplified description of the five personality traits according to the Five-Factor Model. Low and high degrees describe the extremes of the personality traits.

Trait	Low degree	High degree
Neuroticism	Is calm, relaxed and satisfied with himself. Perceived to have good self-confidence.	Is anxious, insecure and emotional, which affects the mood and gives an unstable impression.
Extraversion	Is often reserved, distanced, task-oriented and withdrawn.	Is sociable, talkative and optimistic. Tends to be impulsive and likes to take risks.
Openness	Is conventional, down to earth and rarely analytical. Gives the impression of having limited interests.	Is curious, generally interested and unconventional. Experienced to be creative and imaginative.
Agreeableness	Is cynical, rude and suspicious. Often ends up in social conflicts and is rarely perceived as cooperative and accommodating.	Is benevolent, helpful and forgiving. Often liked by others, but happy to avoid conflicts.
Conscientiousness	Is unreliable, lazy, careless and negligent. Is happy to enjoy life, but without a clear goal orientation in life.	Is disciplined, punctual, reliable, ambitious and persistent. Works hard and rarely breaks rules.

Other theories of personality use the three-factor model Eysenck Personality Questionnaire (EPQ) and the seven-factor model Temperament and Character Inventory (TCI) as measure questionnaires (127). SSP is a three factor personality inventory focused in measuring personality traits related to psychopathology (5), partly developed from the inventory KSP. There is also a six-factor model, Hexaco, which has received attention. This model is similar to the Five-Factor Model, but also contains the personality factor Honesty-Humility (128). Furthermore, in the DSM-5, an alternative five-factor model has also been presented which can be used in classifying personality and psychopathology when assessing deviations in personality (129).

The Eysenck Personality Questionnaire (EPQ) developed by Sybil B. G. Eysenck and Hans Jürgen Eysenck is based primarily on genetics and physiology. The theory behind EPQ focus on the fact that personality differences are determined by genetic inheritance. EPQ is primarily interested in temperament and considered as a temperament-based theory. Initially EPQ were conceptualized with Extraversion/Introversion (E) and Neuroticism/Stability (N)

as two dimensions of temperament. After this the questionnaire were extended with the dimension Psychoticism/Socialisation (P). There is also a fourth scale named Lie/Social Desirability (L). A revised version, the EPQ-R, were published in 1985 (130). EPQ is criticized related to data fabrication and being based upon faulty data (131).

TCI is based on a psychobiological model and described by Robert Cloninger (127). TCI is a successor to Tridimensional Personality Questionnaire (TPQ) (109). TCI is available in a revised version, TCI-R. TCI is based on four temperament traits, Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD) and Persistence (PS), and three traits related to temperament features, Self-Directedness (SD), Cooperativeness (CO) and Self-Transcendence (ST). There is also a varying number of scales. TCI has been related to personality traits in the five factor model (132, 133) and in Eysenck´s models (134).

SSP is developed by Gustavsson and colleagues and was first published and described in year 2000 (5). A more detailed description of SSP can be found in the section Materials and Methods.

KSP, developed by Daisy Schalling and coworkers, is a 135-item personality questionnaire measuring personality with a four-point Likert scale. KSP consists of 15 different scales. Six of the fifteen KSP scales have been more extensively tested, they are called the basic KSP scales. These are the three trait anxiety scales (Muscular Tension, Psychic Anxiety and Somatic Anxiety), the two impulsivity scales (Monotony Avoidance and Impulsiveness) and the Socialization scale. The other scales are Detachment, Guilt, Indirect Aggression, Inhibition of Aggression, Irritability, Psychasthenia, Social Desirability and Suspicion. The KSP inventory is primary constructed to constitute as a tool finding biological correlates of relevant personality traits and to be useful in psychopathy research (135). There is also an extended 196-item version of KSP (KSP-196), which is used in this PhD-project.

One of the earlier scientific methods to measure personality, Neuroticism-Extraversion-Openness Inventory (NEO-I), was developed by Robert McCrae and Paul Costa and was based on three factors. This original version of the inventory included the factors Extraversion (E), Neuroticism (N) and Openness to Experiences (O) and was published in 1978. After this, Costa and McCrae recognized the factors Agreeableness (A) and Conscientiousness (C) and this was the start of what we now know as the Big Five personality traits. The first manual for the NEO including this five factors (NEO-PI) were published in 1985 (124). The three original factors (N, E, & O) also included six facet sub-scales. The Revised NEO Personality Inventory (NEO-PI-R) which included six facets for each factor was a further development of NEO-PI, published in 1992 (125). The latest version of the NEO Inventories, NEO-PI-3, is constructed also to be used among adults with lower educational levels and in younger populations. NEO-PI-3 was published in 2005 (126). Related to NEO-PI-R, the psychometric properties of the NEO-PI-3 were in some way improved.

Several of alternative versions of the Five-Factor Model exist. NEO Five-Factor Inventory (NEO-FFI), revised in 2004, is a shortened version of NEO PI-R comprising 60 items (136). A revised version of the NEO-FFI was also published related to the publication of the NEO-PI-3. Using items from the International Personality Item Pool (also known as IPIP-NEO or IPIP), Maples et al. have developed a 120-question version personality questionnaire (137). IPIP-NEO-60 (138) and IPIP-NEO-120 (139) are other examples of the development of personality forms based on the Five-factor model using the International Personality Item Pool.

The Five-Factor Model has shown strength in several areas and has become by far the most common way of measuring personality traits. It has been dominant in personality research for the last decades. One strength of the model is that it has been identified in different cultures around the world (140), which may be due to human common genetics and biology (141).

2.2.1 Personality and psychopathology

Psychiatric diseases could be characterized as extremes of normal tendencies, including specific personality traits. Personality disorders are characterized by enduring maladaptive patterns of inner experience, cognition and behavior seen in different contexts and which are different from those accepted by the individual's culture. They are inflexible and occurs in many different situations. Individuals with personality disorders also often are in lack of insight into their condition.

Figure 2. Personality disorders according to DSM-5

Cluster	Specific personality disorder
Cluster A	Paranoid
	Schizoid
	Schizotypal
Cluster B	Antisocial
	Borderline
	Histrionic
	Narcissistic
Cluster C	Avoidant
	Dependent
	Obessive-compulsive

A common way of diagnosing personality disorders is by using the Diagnostic and Statistical Manual of Mental Disorders (DSM) by the American Psychiatric Association. DSM defines psychiatric diagnoses based on expert consensus and underlying research (19, 20). DSM-5,

the latest version of DSM, lists ten specific personality disorders as follow: Paranoid, Schizoid, Schizotypal, Antisocial, Borderline, Histrionic, Narcissistic, Avoidant, Dependent and Obsessive-compulsive personality disorder. Each of the specific personality disorders could be related to one of three personality clusters (Figure 2).

Strong phenotypic correlations between personality traits and psychopathological conditions have been reported, especially in Neuroticism (142). Research indicate that neuroticism can be a fundamental personality trait in wide range of psychiatric diagnoses (143). Furthermore, the factor Agreeableness has strongly been associated with psychopathology (144). Different studies have pointed out high level of comorbidity among psychiatric disorders (145, 146) and one explanation is that personality mediates part of this comorbidity (147-149).

Considering genetics in human personality, family and twin studies have showed that personality traits are moderately heritable (116), although the genetic variants that influence personality are only beginning to be identified. Personality traits can also predict psychopathology and various kinds of lifetime outcomes. Analyses have showed genetic correlations between personality and psychopathology (150). When taking heritable variation in personality traits in account, this implies that variation in personality traits, such as neuroticism, would share a common genetic basis with psychiatric diseases (151). The genetic etiology of personality is considered as highly polygenetic. Further genetic studies of personality can shed light on the etiology of several diseases.

2.3 LONG-TIME FOLLOW-UP OF PERSONALITY TRAITS

Stability of personality over time has been discussed and investigated in a wider perspective. Most often are consistencies of personality traits analysed using mean-level change or rank-order stability. Some findings, especially when investigating rank-order stability, support the theory that personality traits are relatively stable in a long-term perspective, or at least stabilized from early adulthood.

Rank-order stability has been investigated in several studies. Ferguson (2010) meta-analysed longitudinal studies related to both normal and disordered personality. Findings reported high stability during adulthood both for disordered and normal personality, especially after correction for measurement error (10). As anticipated, personality during childhood is more changeable. When meta-analyzing a multitude of longitudinal personality studies Roberts and Del Vecchio (2000) reported that test-retest correlations were lower in childhood, then rising during adolescence, and to then be relatively stable and high from about 50 years of age (152). Using the Big Five Inventory Sprecht et al (2011) followed around 15000 individuals over four years and found a substantial rank-order stability (8).

Roberts et. al. (2006) used mean-level change, the other major investigation method in the analyses of personality stability over time, when meta-analyzing longitudinal studies and adapting them to the Five-Factor Model (7). Extraversion was divided into Social Dominance and Social Vitality and therefore the study came to include six trait categories. Four of them showed significant change in midlife and during old age. Participants increased in measures

of Conscientiousness, Emotional Stability, and Social Dominance. This occurred especially in young adulthood. In contrast to this, participants increased on measures of Social Vitality and Openness in adolescence, and these were later decreased at older ages. The factor Agreeableness only changed in old age. There was greater change in studies based on younger cohorts and in longer studies. Attrition and gender had low effects on change. Sprecht et. al. (2011) investigated a sample consisting of the whole age range of adulthood and found that mean-level change during four years were significant, although relatively modest, for the Big Five personality traits (8). In order to analyse the plaster theory of the Five-factor theory Srivastava et. al. (2003) studied a sample of more than 132000 individuals aged between 21-60 years who completed a Big five personality questionnaire, stating that the personality changes up to 30 years of age, and thereafter remains stable (9). However, the results in this cross-sectional study support the theories proposing change of personality even during adulthood, such as a continuous increase in Agreeableness and Conscientiousness. Findings also showed a continuous decline in neuroticism during the ages 21-60 years among women (9).

None of the meta-analyses above found any significant female-male mean-level (7) or rank-order (10, 152) stability differences. Also, Roberts et. al. (2017) did not find any significant effect of gender when meta-analyzing the effect of interventions on personality (112). This suggest that female-male differences of personality stability are minimal.

2.4 PATIENTS WITH PSYCHOTIC DISORDERS: PERSONALITY ASPECTS AND LONG-TERM FOLLOW-UP

Personality is considered as an important aspect related to social functioning and symptoms in schizophrenia and other psychotic disorders (12). Previous studies have observed relationships between certain personality traits and the subsequent development of schizophrenia, psychosis, and psychotic symptoms (153-156). Associations between individual differences in personality traits among individuals with schizophrenia and occupational functioning, social isolation, substance use, suicidal ideation and symptom severity have been observed (157).

Personality traits among individuals affected by psychotic disorders have been investigated earlier. The mainly used questionnaires are the Five-Factor Model (FFM)-derived NEO personality inventories (PIs) NEO-FFI, NEO-PI and NEO-PI-R (124, 125), the Tridimensional Personality Questionnaire (TPQ) (109, 158), its successor Temperament and Character Inventory (TCI) and the revised Temperament and Character Inventory (TCI-R) (159). The most important findings in these studies are a higher degree of Neuroticism in NEO questionnaires and of Harm avoidance in the TPQ among patients with schizophrenia. Neuroticism and Harm avoidance are measuring tendencies to avoidance, emotional instability, fatigability, pessimism, shyness, vulnerability, vulnerability to self-consciousness, and worry.

There are only a few previous studies that have analysed long-term stability of personality traits in patients with psychotic disorders. Three different studies have used Five-Factor Model (FFM) questionnaires, i.e. NEO-Five Factor Inventory (NEO-FFI), NEO-Personality Inventory (NEO-PI), and NEO-Personality Inventory Revised (NEO-PI-R) and one the 168-item version of the Minnesota Multiphasic Personality Inventory (MMPI-168), to evaluate stability of personality traits in this group of individuals. The results of the studies support the view that personality traits among individuals with psychotic disorder remain relatively stable over the time periods investigated (three months, up to five years), although not as stable as among non-psychotic individuals (160-164).

2.5 SSP AMONG PATIENTS WITH LONG-TERM TREATED PSYCHOTIC DISORDERS

There is a lack of studies using SSP to investigate individuals with schizophrenia or other long-term treated psychotic disorders. SSP is a further development of the questionnaire Karolinska Scales of Personality (KSP). In KSP some of the scales were developed focused in studying vulnerability for schizoid and psychopathic traits instead of aiming at covering the whole human personality, this in contrast to the general Five-Factor Model. The development and background of SSP has earlier been described (5). Previous studies investigating personality traits in individuals with long-term treated psychotic disorders have usually not published data on internal consistency in the samples of patients with psychotic disorders. Investigation of psychometric properties is of great importance. It is not given that a sub-group of the population with partly deviant symptomatic experiences and cognitive abilities, and which are likely not to respond in a greater extent in population-based inventories, would display a similar understanding of questionnaires tested and developed in the general population. In addition, there are only a few previous studies that have analysed sub-traits of the major dimensions.

2.6 LONG-TERM FOLLOW-UP STUDIES USING KSP

Long-term follow-up studies re-testing KSP, the predecessor of SSP, were reviewed in this doctoral project measuring rank-order stability (Table 1) and mean-level change (Table 2). This was done because of the dearth of long-term follow-up studies using SSP. We found 14 long-term (at least 22 months) follow-up studies. Engman et al (2012) investigated 50 epilepsy patients (mean age 33 years) before and after resection surgery of the frontal or the temporal lobe to study how the surgical intervention influenced personality (165). Only one substantial mean-level KSP-scale change was found: patients with frontal lobe surgery scored lower on Psychic Anxiety ($z=-0.65$) after surgery. Gardner et al (2004) investigated 65 chronically depressed patients at mean age 47 years and at examination three years later noted stability estimates ranging from $r=0.64$ (Psychastenia) to $r=0.80$ (Socialization). When analyzing the five KSP-scales (Muscular Tension, Psychastenia, Psychic Anxiety, Socialization, Somatic Anxiety) they did not find any substantial mean-level differences (all $z<0.26$) (166). Gustavsson et al (1997) investigated 130 healthy twins with a mean-age at 42.5 years. The twins were reinvestigated nine years later. The twins were divided into two

groups, one group with twins separated at early age, and one group of twins who were reared together. Stability correlations varied between rho=0.36/0.52 (Guilt) and rho=0.75/0.86 (Socialization). Mean-level z-score deviation between baseline and follow-up never exceeded 0.23 for any of the 15 KSP scales in the two investigated groups (167). Kampe and collaborators investigated a cohort of adolescents at mean age 15 and ten years after the first examination (168, 169). Stability correlations varied between r=0.28 (Suspicion at ten-year follow-up) and r=0.73 (Somatic Anxiety at age interval 20-25 years). Correlations were generally higher at the last five-year interval. Data for mean-level change for the first five-year interval showed non-trivial estimates for KSP Suspicion (z=0.61) and Detachment (z=0.69), and higher estimates for Social Desirability (z=0.59). Mattsson et al (2005) investigated brain surgically treated patients (n=57) with epilepsy at mean ages between 33 and 39 years. The patients were divided with regard to treatment response between two and eight years after surgery (170). Noticeable mean-level changes were found in two of the five KSP scales administrated for patients who were free from seizures after surgery: Psychastenia (z=-0.55), and Somatic Anxiety (z=-0.52). No non-trivial changes occurred for the other scales (Inhibition of Aggression, Muscular Tension, and Psychic Anxiety), or in the group of patients with less good seizure control. Mindus et al (1999) investigated patients with severe obsessive compulsive disorder (OCD) (mean age 42 years) before and eight years after capsulotomy. They found substantially lower Guilt (z=-0.60), Indirect Aggression (z=-0.92), Psychic Anxiety (z=-0.66), and Somatic Anxiety (z=--0.57) at follow-up (171). Rück et al (2006) investigated individuals with a mean age of 42 years with anxiety disorders before and 13 years after capsulotomy and noted substantially lower Irritability (z=-0.65), Muscular Tension (z=-2.00), Psychastenia (z=-1.35), Psychic Anxiety (z=-0.65), and Somatic Anxiety (z=-1.70) as well as higher Impulsivity (z=0.50) at follow-up (172). Rydén and collaborators investigated 2619 patients (mean age 48 years) before and two years after conventional treatment vs. surgery for their overweight (173). No non-trivial mean-level changes were reported in any of the seven KSP scales administrated (Impulsivity, Irritability, Monotony Avoidance, Muscular Tension, Psychastenia, Psychic Anexiety, and Somatic Anxiety). Stålenheim and collaborators (174) investigated a cohort of 38 individuals in conjunction with a forensic investigation at age 34 years and during a two-year follow-up. They noted stability estimates from r=0.41 (Irritability) to 0.81 (Psychic Anxiety) and lower mean-level scorings on Muscular Tension (z=-0.56) and Somatic Anxiety (z=-0.65). Vinnars et al (2009) investigated individuals (n=111) with personality disorders (mean age 35 years) before and after two years of psychotherapy. They noted lower mean-level scorings on Neuroticism (z=-0.70) among individuals treated with non-manualized therapy. No non-trivial differences were found for the other KSP factors (Agreeableness, Impulsiveness), nor among the individuals treated with manualized therapy (175). Weinryb and collaborators (1992) investigated individuals (n=37) at mean age 39 years suffering from ulcerative colitis before and 22 months after surgery with stability estimates ranging from r=0.44 (Guilt) to r=0.86 (Psychic Anxiety). They did not find any non-trivial mean-level differences (all z<0.37) (176). Wilczek et al (2004) investigated individuals (n=36) at age 34 years before and after three years of psychoanalytic therapy. They reported substantial decrease in the scales

Table 1. Long-term rank-order stability evaluated by interpersonal correlations in studies using Karolinska Scales of Personality.

Study	N	W%	Age (y)	Group	Interval (y)	SA	PA	MT	Ps	InhA	Im	MA	De	So	SD	IndA	VA	Ir	Su	Gu
Kampe 1991	66	53	15	15-20 y	5	.62	.52	.59	.66	.51	.51	.47	.49	.57	.47	.46	.49	.46	.34	.38
Kampe 1996	66	53	20	20-25 y	5	.73	.62	.58	.53	.68	.68	.59	.57	.61	.63	.65	.68	.61	.58	.57
Kampe 1996	69	54	15	15-25 y	10	.57	.49	.40	.57	.49	.57	.42	.43	.59	.42	.43	.59	.46	.28	.33
Weinryb 1992	37	38	39		1.8	.76	.86	.72	.66	.75	.79	.84	.71	.78	.61	.74	.62	.46	.52	.44
Gustavsson 1997	65	41	42.5	A	9	.47	.63	.53	.48	.79	.60	.63	.75	.86	.64	.63	.66	.46	.53	.52
Gustavsson 1997	65	41	42.5	B	9	.65	.62	.64	.66	.59	.68	.76	.51	.75	.53	.49	.46	.47	.55	.36
Östlund 2007	539	100	34.5		5	.71	.72	.72	.71	.71	.71	.62	.68	.77	.47	.57	.61	.48	.56	.47
Stålenheim 1997	38	0	34		2	.53	.81	.56	.65	.73	.59	.62	.58	.67	.69	.64	.50	.41	.51	.62
Gardner 2004	65	71	47		3.5	.70	.75	.68	.64					.80						
Mean						.67	.70	.66	.67	.69	.68	.63	.65	.76	.50	.57	.60	.47	.53	.46

Abbreviations: N, number; %, percent; y, year; SA, Somatic anxiety; PA, Psychic anxiety; MT, Muscular tension; Ps, Psychastenia; InhA, Inhibition of aggression: Im, Impulsivity; MA, Monotony Avoidance; De, Detachment; So, Socialization; SD, Social desirability; IndA, Indirect Aggression; VA, Verbal aggression; Ir, Irritability; Su, Suspicion; Gu, Guilt.

Table 2. Long-term mean level change (z-scores) in studies using Karolinska Scales of Personality

Study	N	Women (%)	Age (y)	Group	Interval (y)	SA	PA	MT	Ps	InhA	Im	MA	De	So	SD	IndA	VA	Ir	Su	Gu
Kampe 1991	66	53	15	15-20 y	5	-0.06	-0.13	0.33	-0.03	-0.01	-0.13	-0.06	**-0.69**	0.05	**0.59**	-0.19	-0.42	-0.30	**-0.61**	-0.11
Weinryb 1992	37	38	39		1.8	-0.36	-0.17	-0.14	-0.14	-0.27	0.21	0.10	0.02	0.03	0.21	0.07	0.00	0.08	0.05	-0.12
Gustavsson 1997	65	41	42.5	B	9	-0.11	-0.02	0.00	0.18	-0.02	-0.07	-0.09	-0.05	-0.01	-0.12	0.20	-0.09	-0.19	-0.17	0.19
Gustavsson 1997	65	41	42.5	A	9	-0.14	-0.13	-0.11	-0.21	-0.26	-0.20	0.02	-0.18	0.00	0.00	-0.12	-0.22	-0.23	-0.17	0.19
Östlund 2007	539	100	34.5		5	-0.13	-0.12	0.06	0.03	0.08	-0.06	-0.06	-0.11	0.03	0.06	-0.05	-0.19	-0.11	-0.02	-0.21
Ryden 2004	2619	72	48		2	-0.29	-0.17	-0.16	-0.34		-0.01	0.16						-0.16		
Öjehagen 2003	26	81	36		5	**-0.93**	-0.34	**-0.61**	-0.26	0.08	-0.05	0.19	-0.36	0.20	-0.08	0.08	-0.14	-0.41	-0.34	-0.43
Stålenheim 1997	38	0	34		2	**-0.65**	-0.47	**-0.56**	-0.37	-0.43	-0.24	-0.12	-0.43	0.25	-0.17	-0.16	0.03	-0.28	-0.47	-0.20
Wilczek 2004	36	80	34		3	**-0.92**	**-0.70**	**-0.61**	-0.48	**-0.81**	-0.11	0.14	**-0.51**	0.26	-0.09	0.05	0.03	-0.49	-0.26	**-0.64**
Ruck 2006	16	NR	41.8		12.5	**-1.70**	**-0.65**	**-2.00**	**-1.35**	-0.40	**0.50**	0.10	-0.10	0.20	-0.05	-0.10	0.10	**-0.65**	0.15	0.20
Mindus 1999	19	53	41.8		8	**-0.56**	**-0.60**	-0.45	-0.25	-0.38	0.26	-0.08	0.10	-0.09	-0.10	**-0.92**	0.20	-0.47	-0.06	**-0.60**
Mattsson 2005	34	59	33.3	Engel I	2-8	**-0.52**	-0.46	-0.47	**-0.55**	-0.26										
Mattsson 2005	23	48	39	Engel II-IV	2-8	0.13	-0.02	0.15	0.07	0.15										
Engman 2012	39	NR	34	Temporal	2.7	0.05	0.00	0.10	0.20	0.30	0.30	-0.10	0.05	-0.15	-0.05	-0.20	-0.20	0.15	0.05	0.00
Engman 2012	11	NR	33	Frontal	3.1	-0.10	**-0.65**	-0.45	-0.30	-0.35	-0.10	-0.30	0.30	0.30	-0.15	0.15	-0.45	-0.15	0.00	-0.45
Gardner 2004	65	71	47		3.5	-0.17	-0.10	-0.25	-0.09					0.08						
Vinnars 2009	60	69	35	MT	2															
Vinnars 2009	51	69	35	NMT	2															
Mean						-0.28	-0.17	-0.14	-0.27	-0.04	-0.02	0.11	-0.16	0.05	0.06	-0.06	-0.17	-0.16	-0.11	-0.18

Abbreviations: N, number; %, percent; y, year; SA, Somatic anxiety; PA, Psychic anxiety; MT, Muscular tension; Ps, Psychastenia; InhA, Inhibition of aggression: Im, Impulsivity; MA, Monotony Avoidance; De, Detachment; So, Socialization; SD, Social desirability; IndA, Indirect Aggression; VA, Verbal aggression; Ir, Irritability. Su, Suspicion; Gu, Guilt; B, twin B; A, twin A; NR, not reported; Engel I, seizure free or no more than a few early, non-disabling seizures, or seizures upon drug withdrawal only; Engel II-IV, worse epilepsy outcome than Engel I; Temporal, Temporal resection; Frontal, Frontal resection; MT, Manualized Supportive-Expressive Psychotherapy; NMT, Non-manualized community delivered psychodynamic treatment.

Detachment (z=-0.51), Guilt (z=-0.64), Inhibition of Aggression (z=-0.81), Muscular Tension (z=-0.61), Psychic Anxiety (z=-0.70), and Somatic Anxiety (z=-0.92) (177). Öjehagen et al (2003) investigated individuals (n=26) in conjunction with suicide attempt (mean age 36 years) and five years later and reported substantial mean-level decrease in Muscular Tension (z=-0.61) and Somatic Anxiety (z=-0.93) (178). Finally, Östlund and collaborators (2007) investigated 539 women from a general population cohort (mean age 34.5 years) with regard to alcohol abuse and dependence. Östlund et al reported stability estimates ranging from r=0.47 (Guilt and Social Desirability) to r=0.77 for Socialization during the five-year follow-up. They did not find any non-trivial mean-level changes in any of the KSP scales (all z-score differences below 0.22) (179).

2.7 GENDER ASPECTS

Gender-related differences in outcome and clinical expression in long-term treated psychotic disorders have long been recognized (180). In first-episode psychosis men have an earlier age at first contact with psychiatry and a higher incidence (181, 182). Negative symptoms are more severe in men (183), whereas women exhibit more affective symptoms, have a longer duration of illness before treatment, are less socially isolated, less often abuse alcohol and drugs and are more heavily medicated (184). Several studies indicate that social function and response to treatment are better among women affected by schizophrenia and first-episode psychosis explained by a better adaption to requirements in community. Women also need more risk factors than men in order to develop long-term treated psychotic disorder (185).

Gender related to personality appear to differ in several respects and have been documented for a number of personality traits investigated in terms of the Five-Factor Model. Women have been found to score higher than men on Neuroticism, Agreeableness and some facets of Conscientiousness. On the overall domain Extraversion gender differences are small. Women tend to score higher than men on Gregariousness, Positive Emotions and Warmth, whereas men score higher than women on Excitement Seeking and Assertiveness. At the domain level, no significant gender differences are typically found in Openness (186, 187). Lynn et. al. investigated mean gender differences in 37 nations based on Eysenck´s three personality traits Extraversion, Psychoticism and Neuroticism. In 30 and 34 countries men obtained higher means on Extraversion and Psychoticism, respectively. For all countries, women obtained higher means on Neuroticism (188). There is a lack of studies investigating gender aspects related to personality in individuals with psychotic disorder.

3 AIMS OF THESIS

The first aim of the thesis has been to investigate if SSP is possible to use in a psychosis population. The second aim was if personality traits were stable over a long follow-up time-period in a sample of patients with schizophrenia spectrum disorder and non-psychotic individuals. A third aim was to evaluate the position of the SSP-measured traits in relation to traits in other personality instruments. A fourth aim was to investigate personality differences between patients with long-time treated psychotic disorder and non-psychotic controls. The specific objectives for the included studies are described below.

3.1 STUDY 1: PERSONALITY TRAITS IN ESTABLISHED SCHIZOPHRENIA: ASPECTS OF USABILITY AND DIFFERENCES BETWEEN PATIENTS AND CONTROLS USING THE SWEDISH UNIVERSITIES SCALES OF PERSONALITY

In this study, the aim was to investigate whether SSP, related to internal consistency and factor structure, can be used in patients with long-term treated psychotic disorder and whether patients with psychotic disorder differ, when measured with SSP, from individuals without psychotic disorder**.**

3.2 STUDY 2: STABILITY OF PERSONALITY TRAITS OVER A FIVE-YEAR PERIOD IN SWEDISH PATIENTS WITH SCHIZOPHRENIA SPECTRUM DISORDER AND NON-PSYCHOTIC INDIVIDUALS: A STUDY USING THE SWEDISH UNIVERSITIES SCALES OF PERSONALITY

The study aimed to investigate whether personality traits were stable over a five-year period in patients with schizophrenia and related disorders. In addition, a second aim of the study was to investigate whether patients with schizophrenia and related disorders differ from non-psychotic individuals with regard to personality traits.

3.3 STUDY 3: THIRTEEN-YEAR FOLLOW-UP OF LONG-TERM TREATED PSYCHOTIC DISORDER: PERSONALITY ASPECTS

In this study the aim was to investigate stability of personality traits by analysing rank-order stability and mean-level change in patients with schizophrenia spectrum disorders and a control group of non-psychotic individuals at three occasions during 13 years by using SSP. We also aimed to investigate if patients with psychotic disorder differ from non-psychotic individuals with regard to personality traits measured with SSP.

3.4 STUDY 4: SWEDISH UNIVERSITIES SCALES OF PERSONALITY: RELATION TO OTHER PERSONALITY INSTRUMENTS

The aim of the study was to investigate personality traits measured with SSP in relation to traits in other personality inventories. The study investigated SSP in relation to the other personality instruments, that is the revised Chapman scales, NEO-PI-R, SCID-II screen and STQ by using correlations between the factors and scales in SSP with domain and scales of the other different constructs.

4 MATERIALS AND METHODS

4.1 PARTICIPANTS

All participants were recruited as a part of the Human Brain Informatics (HUBIN) study at Karolinska Institutet and Hospital in Stockholm, Sweden. Patients with schizophrenia and other long-term psychotic disorder were recruited from outpatient clinics, specialized in psychiatric disorders, in the North-Western part of Stockholm County, between 1999 and 2003. The control subjects were recruited among hospital staff members, students or drawn from a population register. In addition, a group of non-psychotic parents and siblings of the individuals with schizophrenia or other long-term psychotic disorder was asked to participate in the study. No significant difference was found between siblings of patients with psychotic disorder and the group of healthy controls (162) and therefore siblings were pooled with controls.

Patients were diagnosed according to DSM-III-R and DSM-IV, as previously described (189, 190). Level of function was measured by the Global assessment of functioning (GAF) scale (191). The vocabulary part of Wechsler Adult Intelligence Scales (WAIS) was used as a proxy for verbal intelligent quotient (IQ) (192). Level of negative and positive psychotic symptoms were measured by using the Scale for the Assessment of Positive Symptoms (SAPS) and the Scale for the Assessment of Negative Symptoms (SANS) (193, 194). Chlorpromazine equivalents were used for an overview of the consumption of antipsychotic drugs (195).

All participants were given complete description of the study before participating. All participants gave written informed consent to participate in the respective study.

4.2 QUESTIONNAIRES

One of the main purposes of this research project was to investigate whether SSP, regarding to internal consistency and factor structure, can be used to measure personality traits in patients with schizophrenia and other long-term treated psychotic disorders. SSP is constructed to evaluate different personality traits known to correlate with psychopathology rather than evaluate personality as a whole (5). SSP is applicable in different cultural and social contexts (196, 197).

The SSP questionnaire is developed to measure individual differences in some specific personality traits. The defined and selected traits have relevance to the study of psychopathology from an individual difference perspective (5). The questionnaire SSP is constructed for self-reporting and has a relatively short format. It consists of 91 items divided into 13 different scales. It is possible to choose between four different answer options: not true at all, does not match particularly well, agree somewhat and exactly right. The participating individual need to select only one of the answers for each item. The 13 different scales are as follow: Somatic Trait Anxiety (STA; My body often feel stiff and tense), Psychic Trait Anxiety (PsTA; I am the kind of person who is excessively sensitive and easily

hurt), Stress Susceptibility (SS; I get tired and hurried too easily), Lack of Assertiveness (LA; Even though I know I am right I often have great difficulty getting my point across), Detachment (D; I feel best when I keep people at a certain distance), Embitterment (E; I have often got into trouble even when it was not my fault), Mistrust (M; I tend to be on my guard with people who are somewhat more friendly than I expected), Physical Trait Aggression (PhTA; If someone hits me, I hit back), Verbal Trait Aggression (VTA; When I get angry, I often express myself ironically or sarcastically), Adventure Seeking (AS; I have an unusually great need of change), Impulsiveness (I; I have a tendency to act on the spur of the moment without really thinking ahead), Social Desirability (SD; No matter whom I am talking to, I am always polite and courteous), and Trait Irritability (TI; I do not have so much patience). The 13 scales have been factor analysed and grouped into three different factors, Neuroticism, Aggressiveness and Extraversion (5). The Neuroticism factor is comprised of six scales (STA, PsTA, SS, LA, E, M), the Aggressiveness factor includes PhTA, VTA, SD (negative loading) and TI and the Extraversion factor includes AS, I and D (negative loading) (Figure 3).

Figure 3. Swedish universities Scale of Personality (SSP).

Factor	Scale
Neuroticism	Somatic Trait Anxiety
	Psychic Trait Anxiety
	Stress Susceptibility
	Lack of Assertiveness
	Embitterment
	Mistrust
Aggressiveness	Physical Trait Aggression
	Verbal Trait Aggression
	Social Desirability (-)
	Trait Irritability
Extraversion	Adventure Seeking
	Impulsiveness
	Detachment (-)

The Karolinska Scales of Personality (KSP-196) is an extended version of Karolinska Scales of Personality (KSP) and a precursor to SSP. KSP-196 includes all the 91 items used in SSP.

The Structured Clinical Interview for DSM III-R, Axis II (SCID-II-screen) is a screening questionnaire investigating personality disorders listed in DSM-III-R (114). This screening questionnaire gives the option to apply or deny presence of the proposed item. Personality

disorders regarding to DSM-III-R are arranged into three clusters. Cluster A include Paranoid, Schizoid and Schizotypal personality disorders. Cluster B include Antisocial, Borderline and Narcissistic personality disorders. Cluster C consist of Avoidant, Dependent, Obsessive-compulsive and Passive-aggressive personality disorders. A separate scale, Self-defeating, is also included in SCID-II-screen questionnaire.

The NEO-PI-R (125) is based on the five-factor model. It is a 240 items self-report personality questionnaire and provides scores on the five personality dimensions Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism, and each of the personality domains is composed of six facet scales. NEO-PI-R use a 5-point Likert-type scale with possible answers from strongly disagree to strongly agree.

Revised Chapman scales is a personality questionnaire assessing schizotypal symptoms and are elaborated to find symptoms predicting schizophrenia. Revised Chapman scales is a short version of several other scales (198-200). It consists of 50 item and use a 4-point Likert-type scale.

The psychotic traits questionnaire STQ measure schizotypal and borderline symptoms (201). This questionnaire is used in several countries (202) and consist of two scales, Schizotypal personality (STA) and Borderline personality (STB) and correspond to the distinction between schizotypal personality disorder and borderline personality disorder made in DSM-III. STQ is a 55-item assessment tool using a true-false scale.

4.3 STATISTICAL ANALYSES

4.3.1 Study 1: Personality traits in established schizophrenia: aspects of usability and differences between patients and controls using the Swedish universities Scales of Personality

When analyzing personality traits in established schizophrenia and investigating differences between patients and controls both the questionnaires KSP-196 and SSP was used. For the individuals who completed KSP-196 the 13 different SSP scales was calculated according to the SSP manual, based on the 91 items that are common in SSP and KSP-196. This is for all articles included in this thesis.

Internal consistency was measured using Cronbach´s alfa. Factor analyses was evaluated using varimax rotation identifying eigenvalues >1. As extraction method principal axis factoring was used and the limit for factor loading was set at >0.45.

In the case-control analyses, as a first step multiple analysis of covariance (MANCOVA) was performed, to control for interaction effects taking diagnosis and gender and multiple testing into account. MANCOVA was performed with diagnosis (controls vs patients) and gender as between-subjects factors and age as a covariate. Post hoc analysis of covariance (ANCOVA) was calculated for each SSP scale using diagnosis and gender as between-subject factors and age as a covariate.

4.3.2 Study 2: Stability of personality traits over a five-year period in Swedish patients with schizophrenia spectrum disorder and non-psychotic individuals: a study using the Swedish universities Scales of Personality

Internal consistency was measured using Cronbach´s alfa. Statistical power was measured for a paired samples t-test for individuals with long-term psychotic disorder and healthy control subjects, respectively. The mean difference was expressed as a non-trivial z-value ($z_{critical}$=0.5) (203, 204) and α=0.05, given that an approximate estimate suffices (205).

To control for multiple testing, the statistical analysis of the 13 SSP-scales was performed using MANCOVA with diagnosis (psychotic disorder vs siblings vs controls) and gender (women vs men) as between-subject factors, time (baseline vs follow-up) as within-subject factor, and age as a covariate. The analysis did not show any significant differences between siblings and controls and therefore they were pooled into one group. MANCOVA was then redone with diagnosis (psychotic disorder vs healthy individuals) and gender (women vs men) as between subject factors, time (baseline vs follow-up) as within-subject factor and age as a covariate. For each SSP-scale ANCOVA were performed.

To investigate the effect of time rank-order and linear correlations according to Pearson (r), Spearman (rho), and intraclass correlations (ICC) were calculated between baseline and follow-up for the 13 SSP scales both for individuals with psychotic disorder and healthy individuals. ICC coefficients for single measures were calculated both for agreement and consistency. To calculate the test-retest correlations in the same way as the mean of the 13 SSP-scales, the correlations were jackknifed. This was done by recomputing the correlations excluding one individual at time. All correlations (Pearson) were transformed to an approximate normal distribution, using the Z-transformation, before performing the final J-summaries. This to produce a better statistical estimate. The z-transformed and normalized correlations were analysed in the same way as for the means, first MANCOVA with diagnosis (Psychotic disorder vs healthy individuals) and gender (women vs men) as between subject factors, and age as a covariate. After doing this ANCOVAs were performed for each of the SSP-scales.

4.3.3 Study 3: Thirteen-year follow-up of long-term treated psychotic disorder: personality aspects

Statistical analyses of SSP's three factors and 13 scales were performed using ANCOVA to assess mean-level change between individuals with psychotic disorder and healthy control subjects. ANCOVA was done with diagnosis (psychotic disorder vs healthy individuals) and gender (women vs men) as between subject factors, time (baseline vs 5-year follow-up vs 13-year follow up) as within-subject factor and age as a covariate. Test of within-subject effects, which explain the time aspect and tests of between-subject effects, which compare the diagnostic groups were calculated.

To investigate rank-order stability the effect of time was calculated using linear correlations according to Pearson (r). Calculations were made between scores of the different time-points

for each of the three SSP factors and the 13 SSP scales for individuals with psychotic disorder and healthy control subjects.

Literature search and inclusion of studies using SSP or KSP analyzing long-term mean-level change or rank-order stability were done. For evaluation of mean-level change z-scores were calculated for each of the scales (or factors if data for scales were not given). A z-score equivalent to the lower limit of a medium effect size d=0.5 according to Cohen (1988) (205), was deemed as a lower limit for a non-trivial difference (203, 204) and indicated with bold numbers in Table 1 and Table 2.

4.3.4 Study 4: Swedish universities Scales of Personality: relation to other personality instruments

The scales in the different personality questionnaires used in this study were quality tested by measuring the ability to discriminate between individuals, this by using intra-class correlation (ICC). ICC was used to compare the total variance with the variance within the test situation. ICC analyses were calculated using the two-way mixed method, average measures, and absolute agreement.

Correlations were calculated between the 13 scales and three factors in SSP and all the different scales, factors and clusters in the other personality questionnaires in this article. The strength of the association was divided into five groups: very weak (r=0.00-0.19), weak (r=0.20-0.39), moderate (r=0.40-0.59), strong (r=0.60-0.79), and very strong (r=0.80-1.00) (206).

Between SSP factors, Chapman scales, NEO factors, SCID-II clusters, and STQ scales exploratory factor analyses were calculated using the principal factor method, with a stepwise increase in the numbers of factors until the solution reproduces the correlation matrix. Additionally, to facilitate interpretation varimax rotation was calculated.

Furthermore, a complementary principal component analysis (PCA) was calculated between SSP factors, Chapman scales, NEO factors, SCID-II clusters, and STQ scales using the SPSS procedure Factor analysis, using the option Listwise deletion. Three components were extracted.

4.4 LITERATURE SEARCH OF LONG-TERM STUDIES USING SSP OR KSP

When investigating personality aspects with regard to mean-level change or rank-order stability in the 13-year follow-up study of long-term treated psychotic disorder a literature search was done. As a first step PubMed was searched with the following terms: ((*SSP* AND *personality*) OR (*KSP* AND *personality*) OR *Swedish universities Scales of Personality* OR *Karolinska scales of* personality) AND (*change* OR *follow-up* OR *longitudinal* OR *stability*). As a second step reference lists of articles of previous meta-analyses of personality stability were scrutinized (7, 10, 112, 152). Studies with follow-up periods of 18 months or longer were included. Sixteen studies were found that fulfilled these criteria.

4.5 ETHICAL CONSIDERATIONS

The studies included in this PhD project all involved human participants, which required several ethical considerations. All received a complete oral and written description of the study and participated only after giving written consent. The interviewers had extensive experience of communicating and working with individuals with mental disorders. Participation in all studies within the project was voluntary and participants could choose to withdraw their participation at any time.

Research data has been processed with care for the participants' integrity in matters such as storage, handling, and reporting. The presentation of results has also taken place in a well-balanced way.

Laws regarding confidentiality have been followed. All included studies were approved by the Stockholm Regional Ethics Committee and the Swedish Data Inspection Board (Datainspektionen). All research was conducted in accordance with the Declaration of Helsinki.

5 RESULTS

Each study included a series of main and sub-analyses. This section briefly describes the results for each study (Figure 4).

Figure 4. Overview of study results.

Study I	Internal consistencies among individuals with psychotic disorder were overall similar to that of non-psychotic individuals. The patients scored significantly higher in seven scales and lower in the three scales Adventure Seeking, Physical Trait Aggression and Verbal Trait Aggression of the 13 scales of the inventory. In the three scales Impulsiveness, Social Desirability and Trait Irritability there was no significant difference between the scoring of individuals with psychotic disorder and non-psychotic controls.
Study II	MANCOVA within-subjects analysis did not show any effect of time. SSP mean scale scores did not significantly vary during the five-year interval. Within subject correlations (Spearman) ranged 0.30 - 0.68 and 0.54 - 0.75 for the different SSP scales in patients with psychotic disorder and non-psychotic individuals, respectively. Patients scored higher than controls in SSP scales Detachment, Embitterment, Lack of Assertiveness, Mistrust, Psychic Trait Anxiety, Somatic Trait Anxiety and Stress Susceptibility.
Study III	Tests of within-subject correlations showed differences in the two scales Lack of Assertiveness, which were influenced by age, and Physical Trait Aggression, where patients' ratings were stable, whereas controls rated themselves less aggressive at higher age. Between-subjects correlations showed differences regarding any of the parameters diagnosis, time, age, gender or age x gender in factor Neuroticism as well as in nine of the 13 scales of SSP.
Study IV	SSP Neuroticism factor correlated with Chapman Social anhedonia, NEO Neuroticism and SCID-II cluster C. SSP Aggressiveness factor correlated with NEO Agreeableness and SSP Extraversion factor with NEO Extraversion. Weaker correlations were common between SSP factors and scales and scales of the other instruments. Strong correlations were sparse.

5.1 STUDY 1

5.1.1 Characterization of participants

Data from 226 participants were used in this study. There were 107 patients (35 (33%) women). The control group consisted of 48 (40%) women. Mean age at baseline (SD; range) is for female patients 41.1 years (8.81; 24-61 years), male patients 42.4 years (8.98; 24-66 years), female control subjects 43.2 years (7.74; 20-56 years) and male control subjects 43.0 years (8.19; 19-55 years). There were no significant case-control differences regarding age or gender. Patients had lower verbal IQ, lover level of functioning and were less educated. Patients were diagnosed with psychosis not otherwise specified (n= 10), schizoaffective disorder (n=15) and schizophrenia (n=82). Mean age at onset of illness was 24.3 years (Table 3).

Table 3. Study 1 - Characteristics of patients and controls.

	Patients (n=107)	Controls (n=119)	P-value
Gender (n, women/men)	35/72	48/71	NS[a]
Age (year)	41.9 (8.9)	43.1 (8.0)	NS[b]
Education (year)	12.7 (3.0)	14.2 (2.8)	P<0.001[b]
WAIS verbal IQ	87.9 (20.8)	102.4 (15.9)	P<0.001[b]
GAF	48.8 (9.4)	85.8 (7.3)	P<0.001[b]
Diagnosis - schizophrenia (n)	82	—	
Diagnosis - schizoaffective disorder (n)	15	—	
Diagnosis - psychosis NOS (n)	10	—	
Medication - no antipsychtics (n)	7	—	
Medication - 1st gen antipsychtics (n)	46	—	
Medication - 2nd gen antipsychtics (n)	47	—	
Medication - 1st and 2nd gen antipsychtics (n)	7	—	

Notes: NS: not significant; WAIS: Wechsler Adult Intelligence Scales; IQ: Intelligent quotient; GAF: Global Assessment of Functioning. All values in mean (standard deviation) except for distribution of gender, diagnosis and medication.

Missing data (patients/controls): Education (2/2), WAIS (30/38), GAF (1/0).

[a] X^2-test, [b] Unpaired two-sided t-test.

5.1.2 Internal consistency

Internal consistency measured with Cronbach's alpha revealed coefficients between 0.67-0.81 among patients and 0.69-0.86 among controls, with three exceptions: Somatic Trait Anxiety (0.59) and Social Desirability (0.55) among patients, and Social Desirability (0.52) among controls. The scale with the lowest internal consistency was Social Desirability, which is in accordance with the Swedish normative study (5) (Table 4).

Table 4. Study 1 - Swedish universities Scales of Personality (SSP) internal consistency.

SSP factors and scales	Patients	Controls	Normative study
Neuroticism	0.82	0.89	—
Somatic Trait Anxiety	0.59	0.80	0.75
Psychic Trait Anxiety	0.79	0.86	0.82
Stress Susceptibility	0.67	0.80	0.74
Lack of Assertiveness	0.75	0.77	0.78
Embitterment	0.67	0.77	0.75
Mistrust	0.78	0.84	0.78
Aggressiveness	0.62	0.71	—
Physical Trait Aggression	0.75	0.85	0.84
Verbal Trait Aggression	0.78	0.71	0.74
Social Desirability (-)	0.55	0.52	0.59
Trait Irritability	0.73	0.78	0.78
Extraversion	0.54	0.46	—
Adventure Seeking	0.81	0.84	0.84
Impulsiveness	0.70	0.69	0.73
Detachment (-)	0.71	0.80	0.77

Notes: Data given as Cronbach´s alpha for psychotic patients (n=107) and control subjects (n=119). Data from the Swedish normative study (n=741) is shown for comparison.

5.1.3 Factor analyses

To get a picture of how patients with psychotic disorders answer the SSP questionnaire a pilot study by using factor analyses was performed. The numbers of individuals were however a bit too small to get robust evaluations. The investigation showed a three-factor model, as anticipated. Among patients the first factor, Neuroticism, was similar to the Swedish normative study (5). The second factor Aggressiveness included high loadings from the scales Physical Trait Aggression, Verbal Trait Aggression, Social Desirability and Trait Irritability, but in addition also Adventure Seeking, Impulsiveness and Mistrust, scales which in the Swedish normative study mainly loaded in third factor Extraversion (Adventure Seeking and Impulsiveness) and factor Neuroticism (Mistrust) (5). In patients factor three, Extraversion, consisted of the scales Detachment and Social Desirability. For Detachment that is as in the Swedish normative study (5). Social Desirability loaded on the Aggressiveness factor in the Swedish normative study (5). Among controls the loadings was all as in the Swedish normative study (5) except for the scale Detachment which loaded on the Neuroticism factor. These results are similar to results in a recent study (207).

5.1.4 Multiple analyses of covariance and post-hoc analyses

Analyses using MANCOVA showed effects of age, diagnosis, and gender. No interaction effect was found between diagnosis and gender. After using MANCOVA post-hoc analyses

using ANCOVA was performed for each of the SSP scales. For ten of the 13 scales patients and controls scored significantly different. For the scales Impulsiveness, Social Desirability and Trait Irritability there were no significant differences. Gender effects were found for the scales Detachment, Impulsiveness, and Physical Trait Aggression. Gender effects was mainly explained by differences in the control group for Detachment (men > women), Impulsiveness (women > men), Physical Trait Aggression and Somatic Trait Anxiety (women > men). In Physical Trait Aggression there was a tendency for gender difference also among patients (men > women).

Analyses were also performed for the higher-order factors Aggressiveness, Extraversion and Neuroticism, as they appeared in the Swedish normative sample. Analyses using MANCOVA showed effects of age and diagnosis. There were no effects with regard to gender or diagnosis x gender. Post-hoc analyses using ANCOVA showed that patients scored higher in Neuroticism and lower in Aggressiveness whereas no significant case-control differences were found in Extraversion.

5.1.5 Correlations investigating the influence of symptom load and antipsychotic medication among patients

To investigate if symptom load or antipsychotic medication influenced the results, correlations between SANS and SAPS instruments, and the SSP-scales and factors were performed among patients only. After Bonferroni-correction for multiple testing there were associations between SANS composite scores and one of the 13 scales, i.e. Impulsiveness, as well as factor Aggressiveness, and factor Extraversion. No significant associations were found between SAPS scores and any of the SSP-scales or factors. There was a correlation between antipsychotic equivalents and the SSP scale Verbal Trait Aggression and factor Aggressiveness. The results suggest that antipsychotic medication or symptom load do not to a major extent influence the results.

5.2 STUDY 2

5.2.1 Characterization of participants

There were 36 patients (8 (22%) women) and 76 controls (29 (38%) women) included in this study. The mean age (SD; range) was at baseline among female patients 37.5 (8.2; 25-50), male patients 36.9 (7.5; 24-50), female control subjects 40.8 (7.4; 24-50), and male control subjects 41.2 (8.1; 23-53) years, respectively. There were no significant age or gender differences between patients and controls. Patients had significantly lower level of functioning, were less educated, and had lower verbal IQ than controls. Mean age at onset of illness was 24.2 years. Patients were diagnosed with schizophrenia (n=26), schizoaffective disorder (n=7), and psychotic disorder not otherwise specified (n=3) (Table 5).

Table 5. Study 2 - Characteristics of patients and controls.

	Patients (n=36)		Controls (n=76)	
	Baseline	Follow-up	Baseline	Follow-up
Gender (n, women/men)	8/28	8/28	29/47	29/47
Age (year)	39.4	44.4	41.1	47.5[a]
Education (year)	12.6	—	14.0[a]	—
WAIS verbal IQ	87.3	—	103.0[b]	—
GAF	49.2	48.3	87.3[b]	83.9[b]
Medication - no antipsychtics (n)	4	5	—	—
Medication - 1st gen antipsychtics (n)	16	9	—	—
Medication - 2nd gen antipsychtics (n)	14	15	—	—
Medication - 1st and 2nd gen antipsychtics (n)	2	7	—	—

Notes: WAIS: Wechsler Adult Intelligence Scales; IQ: Intelligent Quotient; GAF: Global Assessment of Functioning. All values in mean (standard deviation) except for distribution of gender, diagnosis and medication.

Missing data (patients/controls): Education (0/1), WAIS (7/12), GAF baseline (0/2), GAF follow-up (0/7).

[a] $p<0.1$, [b] $p<0.001$.

5.2.2 Internal consistency

The attrition rate was among female patients 0.77, male patients 0.72, non-psychotic women 0.54, and non-psychotic men 0.53. For patients, reasons for not participating at follow-up were as follow: changed residence to a region far away or emigrated (n=2), dead (n=15), declined to participate or no contact (n=54). Reasons for not participating at follow-up among the controls were: changed residence to a region far away or emigrated (n=7), declined to participate or no contact (n=54), no available time (n=5). Individuals participating and not participating at follow-up did not significantly differ at baseline with regard to age, chlorpromazine equivalent dose of antipsychotic medication, GAF, gender, negative or positive psychotic symptomatology, verbal IQ or any of the SSP personality traits. For all the 13 SSP-scales internal consistency was calculated both at baseline and follow-up for patients and non-psychotic individuals separately. For 54% of the patients and 82% of the non-psychotic individuals' consistencies were above 0.70. For 81% of the patients and 96% of the non-psychotic individuals' consistencies were above 0.60.

5.2.3 Effect by time on mean differences

When using nominal data differences occurred between baseline and follow-up both for patients and controls. However, after taking covariates in account and correction for multiple testing, within-subjects analysis of the means using MANCOVA did not show any significant effect of time, interaction time and age, interaction time and diagnosis, interaction time and gender, or interaction time and diagnosis and gender.

5.2.4 Effect by time on interpersonal correlations

Among patients, within-subject correlations using rank-order correlations (rho) between baseline and follow-up varied between 0.30 and 0.68. The highest correlation was for Mistrust (0.68) and lowest for Social Desirability (0.38) and Somatic Trait Anxiety (0.30). For non-psychotic individuals correlations varied between 0.54 (Stress Susceptibility) and 0.75 (Adventure Seeking). Linear correlations and ICCs showed similar results. When using MANCOVA calculating test-retest correlations, significant differences were found for diagnosis. There were no significant differences regarding to gender, age, or interaction between diagnosis and gender. Post-hoc analyses using ANCOVA were also calculated for each of the SSP scales. In the 13 post-hoc ANCOVAs of the test-retest correlations some nominal differences were found.

5.2.5 Between-subject analyses

Between-subject analyses of mean differences between individuals with psychotic disorders and non-psychotic individuals using MANCOVA was significant regarding diagnosis and gender but not to age or interaction between diagnosis and gender. Post-hoc ANOVAs were performed for each of the 13 SSP scales. For seven of the scales (STA, PsTA, SS, LA, E, M and D) patients scored significantly higher than controls. For six of the scales (PhTA, VTA, SD, TI, AS and I) no significant differences were found. Gender effects were found for Detachment and Impulsiveness, and the interaction diagnosis x gender affected Somatic Trait Anxiety. Age effects were found for Psychic Trait Anxiety.

5.2.6 Power

The statistical power was analysed for a paired samples t-test for the patient and control samples separately. Given α=0.05 and a mean difference of z=0.5, the sample of patients had a power of 83% to detect a difference. The sample of non-psychotic individuals had a power of 99%.

5.3 STUDY 3

This study expands on study 2, in that the patients with long-term treated psychotic disorder and the healthy controls were investigated for personality aspects after both five and 13 years of follow-up.

5.3.1 Characterization of participants

There were 7 (25%) female and 21 male patients, in total 28 individuals, mean age at baseline 39.0 years, mean age at onset of illness 21.7 years, with psychotic disorder and 23 (40.4%) woman and 34 men, in total 57 individuals, mean age at baseline 41.7 years, among the non-psychotic individuals. Patients had a lower level of functioning compared to controls. Patients were diagnosed with psychotic disorder not otherwise specified (n=3), schizoaffective disorder (n=6) and schizophrenia (n=19) (Table 6).

Among the 85 patients who did not participate at 13-year follow-up the reasons for drop-out were: changed residence to a region far away or emigrated (n=3), dead (n=13), declined to participate or no contact (n=26), not asked about participation (n=39) and not completed SSP at 5-year follow-up (n=4). Reasons for drop-out among the 86 controls were: changed residence to a region far away or emigrated (n=6), declined to participate or no contact (n=24), not asked about participation (n=29) and not completed SSP at 5-year follow-up (n=27).

Table 6. Study 3 - Characteristics of patients and controls.

	Patients (n=28)			Controls (n=57)		
	Baseline	5-year follow-up	13-year follow-up	Baseline	5-year follow-up	13-year follow-up
Gender (n, women/men)	7/21	—	—	23/34	—	—
Age (year)	21.7	—	—	—	—	—
Education (year)	13.6	—	—	13.9	—	—
WAIS verbal IQ	92.4 (n=24)	—	94.0 (n=4)	103.6 (n=50)	—	104.0 (n=15)
GAF	50.7	50.4	46.3	86.9[b] (n=55)	82.5[a] (n=51)	80.8[a] (n=56)
Medication - no antipsychtics (n)	4	5	4	—	—	—
Medication - 1st gen antipsychtics (n)	11	7	8	—	—	—
Medication - 2nd gen antipsychtics (n)	12	12	11	—	—	—
Medication - 1st and 2nd gen antipsychtics (n)	1	4	5	—	—	—

Notes: WAIS: Wechsler Adult Intelligence Scales; IQ: Intelligent quotient; GAF: Global Assessment of Functioning. All values in mean (standard deviation) except for distribution of gender, and medication.

[a] $p<0.05$, [b] $p<0.01$.

5.3.2 Stability estimates during a 13-year time period

Within-subject analyses were done between the 13 SSP scales, the three SSP factors and age at baseline, diagnosis, gender, and both diagnosis and gender together were calculated to investigate mean level changes during 13-year follow-up (Table 7). Overall, stability over time did not vary. Some smaller exceptions were found. Time influenced Lack of Assertiveness ($p=0.004$), time x age influenced Lack of Assertiveness ($p=0.005$) and time x diagnosis influenced Physical Trait Aggression ($p=0.036$).

Also, rank-order stability was investigated by using simple correlations for all the SSP scales and the SSP factors between baseline, five-year follow-up and 13-year follow-up in individuals with psychotic disorders and healthy control subjects.

Table 7. Study 3 - Tests of within-subjects effects using listwise deletion.

SSP factors and scales	Intercept	Scale	Scale x Age at baseline	Scale x Diagnosis	Scale x Gender
Neuroticism	0.000	0.757	0.654	0.643	0.721
Somatic Trait Anxiety	0.000	0.570	0.607	0.890	0.492
Psychic Trait Anxiety	0.000	0.808	0.364	0.680	0.890
Stress Susceptibility	0.000	0.779	0.656	0.943	0.182
Lack of Assertiveness	0.000	0.004[b]	0.005[b]	0.805	0.585
Embitterment	0.000	0.997	0.867	0.468	0.375
Mistrust	0.000	0.475	0.537	0.139	0.469
Aggressiveness	0.000	0.693	0.972	0.149	0.784
Physical Trait Aggression	0.000	0.410	0.625	0.036[a]	0.201
Verbal Trait Aggression	0.000	0.146	0.317	0.506	0.654
Social Desirability (-)	0.000	0.925	0.889	0.965	0.704
Trait Irritability	0.000	0.700	0.582	0.532	0.124
Extraversion	0.000	0.742	0.858	0.555	0.964
Adventure Seeking	0.000	0.638	0.576	0.266	0.262
Impulsiveness	0.000	0.236	0.375	0.289	0.457
Detachment (-)	0.000	0.209	0.295	0.396	0.621

Notes: ANOVA showing p-values for the effect of time within individuals for personality traits (factors and scales) taking age, diagnosis (patient or control), and gender into account.

[a] <0.05, [b] <0.01

5.3.3 Case-control differences

Mean-level differences were calculated to investigate changes between patients with psychotic disorders and non-psychotic individuals. Between-subject analyses over the period showed that individuals with psychotic disorders differed compared to non-psychotic individuals for the SSP factor Neuroticism and its scales Embitterment, Lack of Assertiveness, Mistrust, Psychic Trait Anxiety, Somatic Trait Anxiety and Stress Susceptibility (all p=0.003 or less) as well as for Detachment (p=0.005). Age influenced factor Neuroticism (p=0.019), its scales Lack of Assertiveness, Mistrust and Psychic Trait Anxiety (all p<0.05), and Trait Irritability (p=0.023). Gender influenced Detachment (p=0.021) and Physical Trait Aggression (p=0.042). Diagnosis x gender influenced Somatic Trait Anxiety (p=0.006) (Table 8).

Table 8. Study 3 - Tests of between-subjects effects using listwise deletion.

SSP factors and scales	Intercept	Age at baseline	Diagnosis	Gender	Diagnosis x Gender
Neuroticism	0.000	0.019[a]	0.000[c]	0.741	0.108
Somatic Trait Anxiety	0.000	0.069	0.002[b]	0.982	0.006[b]
Psychic Trait Anxiety	0.000	0.035[a]	0.000[c]	0.975	0.178
Stress Susceptibility	0.000	0.152	0.000[c]	0.881	0.091
Lack of Assertiveness	0.000	0.046[a]	0.003[b]	0.655	0.148
Embitterment	0.000	0.158	0.000[c]	0.677	0.389
Mistrust	0.000	0.032[a]	0.000[c]	0.421	0.681
Aggressiveness	0.000	0.090	0.728	0.530	0.987
Physical Trait Aggression	0.000	0.353	0.756	0.042[a]	0.912
Verbal Trait Aggression	0.000	0.088	0.866	0.325	0.815
Social Desirability (-)	0.000	0.894	0.685	0.437	0.711
Trait Irritability	0.000	0.023[a]	0.236	0.515	0.930
Extraversion	0.000	0.220	0.813	0.226	0.404
Adventure Seeking	0.000	0.244	0.174	0.487	0.125
Impulsiveness	0.000	0.088	0.342	0.314	0.977
Detachment (-)	0.000	0.727	0.005[b]	0.021[a]	0.992

Notes: ANOVA showing p-values for the differences of personality traits (factors and scales) over time between individuals taking age, diagnosis (patient or control), and gender into account.

[a] <0.05, [b] <0.01, [c] <0.001.

5.3.4 Long-term follow-up studies using SSP

Two previous studies have used SSP for long-term follow-up. Spangenberg et al. (2019) divided the patients regarding depressive and anxiety symptoms using median split of Comprehensive psychopathological rating scale – self rating for affective disorder (CPRS-S-A). By using mean-level change they found changes in eight SSP scales among patients with lower degree of depression and changes in two SSP scales among patients who were more severely depressed and anxious (208). Our previous study is the second one and is earlier described (162).

5.3.5 Long-term follow-up studies using KSP

Long-term investigations using SSP are sparse, therefore literature search was done for studies re-testing KSP, the predecessor of SSP, at long time intervals. Fourteen studies had investigated long-term follow-up (22 month or longer) using KSP (165-168, 170-175, 177-179, 209). Seven of the studies investigated rank-order stability (166-169, 174, 179, 209). The present study showed overall similar stability estimates as the comparable KSP scales in the seven studies above, with some exceptions. Mean-level change measured with KSP in long-term follow-up studies gave various results.

5.4 STUDY 4

5.4.1 Characterization of subjects

The study included 186 women (mean age 51.7, SD 14.1, age range 23-91 years) and 220 men (mean age 48.1, SD 13.3, age range 19-88 years), in total 406 participants (mean age 49.7, SD 13.8, age range 19-91 years). All of them had previously participated as non-psychotic controls in clinical studies at the Karolinska Institutet (197, 210-212).

5.4.2 Factor analyses

Factor analyses did not give informative relationships between the investigated instruments Therefore a complementary principal component analysis (PCA) was calculated between SSP factors, Chapman scales, NEO factors, SCID-II clusters and STQ scales. PCA. Three factors explained 62.5% of the variance. Factor 1 had substantial loadings from SSP Neuroticism (0.82), Chapman Social anhedonia (0.73), SCID-II cluster A (0.72), SCID-II cluster C (0.82), SCID-II Self-defeating (0.65), STQ Borderline personality (0.65) and STQ Schizotypal personality (0.62). For factor 2 SSP Extraversion (0.75), Chapman Physical anhedonia (-0.65), NEO Extraversion (0.68), NEO Openness (0.74) and SCID-II cluster B (0.74) had their highest loadings. The highest loadings on factor 3 came from SSP Aggressiveness (-0.72) and NEO Agreeableness (0.83). PCA was calculated in addition to simple correlations.

Varimax rotated factor analysis between SSP, revised Chapman scales, NEO-PI-R, SCID-II screen and STQ revealed four factors explaining 55.3% of the variance. Generally, loadings were very weak to moderate.

For factor 1 the highest loadings came from SSP Neuroticism (-0.25), SCID-II screen cluster B (-0.29), SCID II screen cluster C (-0.37), SCID II screen Self-defeating ((-0.33), STQ Borderline (-0.37), STQ Schizotypal (-0.39) and NEO-PI-R Neuroticism (-0.37). The highest loadings on factor 2 came from SSP Extraversion (-0.46), revised Chapman scales Physical anhedonia (0.47) and NEO Extraversion (-0.49). For factor 3 the strongest loadings were obtained from SSP Aggressiveness (0.61), revised Chapman scales Social anhedonia (0.25) and NEO-PI-R Agreeableness (-0.68). The highest loadings on factor 4 were obtained from revised Chapman scales Physical anhedonia (0.63), NEO-PI-R Conscientiousness (-0.43), NEO-PI-R Openness to experience (-0.45) and STQ Schizotypal personality (-0.34).

Overall, the factor analyses did not provide satisfactory information. Therefore, simple correlations between each of the three SSP factors and each of the major scales or factors of the other personality instruments included in this study, one at a time, were calculated.

5.4.3 Intraclass correlations

By using intraclass correlations discriminative ability of the different factors and scales were investigated. ICC for the 13 SSP scales varied between 0.54 and 0.85. The three SSP factors displayed ICC values between 0.74 and 0.91. ICC for revised Chapman scales Physical anhedonia, Perceptual anhedonia and Social anhedonia were 0.68, 0.72 and 0.78,

respectively. The NEO-PI-R facets showed ICCs between 0.44 and 0.78. ICC varied between 0.44 and 0.65 for SCID-II screen scales. STQ scales Borderline personality and Schizotypal personality revealed ICCs of 0.80 and 0.70, respectively.

5.4.4 Simple correlations

Simple correlations with one variable at time between SSP factors vs clusters/factors/major scales of revised Chapman scales, NEO-PI-R, SCID-II screen and STQ were calculated, as well as the degree of the variance explained of the total SSP questionnaire using squared multiple correlations. The SSP factor Aggressiveness correlated negatively to NEO Agreeableness (-0.62). The SSP factor Extraversion was strongly correlated with NEO-PI- R Extraversion (0.63). SSP factor Neuroticism was strongly correlated with revised Chapman scales Social anhedonia (0.62), SCID-II cluster C (0.71) and NEO-PI- R Neuroticism (0.80). Also, substantial squared multiple correlations were found for NEO-PI- R Extraversion (0.61) and NEO-PI-R Neuroticism (0.67) (Table 9).

Table 9. Study 4 - Correlations between Swedish universities Scales of Personality (SSP) and Chapman, NEO-PI-R, SCID-II screen and STQ.

Clusters/factors/major scales	N (women/men)	SSP Neuroticism	SSP Extraversion	SSP Aggressiveness	R^2
Chapman Physical anhedonia	220 (104/116)	0.25	-0.33	0.05	0.14
Chapman Social anhedonia	220 (104/116)	0.62	-0.45	0.30	0.56
Chapman Perceptual aberration	220 (104/116)	0.42	-0.02	0.16	0.18
NEO Neuroticism	298 (141/157)	0.80	-0.04	0.39	0.67
NEO Extraversion	298 (141/157)	-0.54	0.63	-0.08	0.61
NEO Openness	298 (141/157)	-0.24	0.53	0.01	0.31
NEO Agreeableness	298 (141/157)	-0.12	-0.14	-0.62	0.38
NEO Conscientiousness	298 (141/157)	-0.47	-0.06	-0.20	0.24
SCID-II Cluster A	323 (145/178)	0.55	-0.11	0.27	0.31
SCID-II Cluster B	323 (145/178)	0.35	0.43	0.46	0.42
SCID-II Cluster C	323 (145/178)	0.71	-0.05	0.27	0.50
SCID-II Self-defeating	323 (145/178)	0.56	0.03	0.24	0.32
STQ Schizotypal personality	218 (99/119)	0.47	0.15	0.19	0.27
STQ Borderline personality	218 (99/119)	0.46	0.17	0.33	0.30

Notes: Correlations between Swedish universities Scales of Personality (SSP) factors, and clusters, factors and major scales for the personality inventories Chapman, NEO-PI-R, SCID-II screen and STQ. Squared multiple correlations were calculated to assess the variance of the total SSP questionnaire shared with each of the other clusters, factors, and major scales.

SSP vs. SCID-II screen: When measuring simple correlations between SSP vs SCID-II screen only the SSP scales Embitterment and Psychic Trait Anxiety correlated with SCID-II screen clusters or personality disorders at level r>0.6. SSP Embitterment correlated with SCID-II

cluster C and SSP Psychic Trait Anxiety correlated with SCID-II screen cluster C and the two personality disorders Avoidant and Dependent. SSP Embitterment had moderate to strong correlations with all SCID-II screen personality disorders with exceptions for Antisocial, Histrionic, Narcissistic and Schizoid personality disorders. SSP Neuroticism factor was strongly correlated with SCID-II screen cluster C as well as Avoidant and Dependent personality disorders. Several very weak to moderate correlations between SSP and SCID-II screen occurred (Table 10).

Table 10. Study 4 - Correlations between Swedish universities Scales of Personality (SSP) and SCID-II-screen clusters.

SSP factors and scales/SCID-II-screen	Cluster A	Cluster B	Cluster C
Neuroticism	0.547	0.345	0.709
Somatic Trait Anxiety	0.440	0.434	0.521
Psychic Trait Anxiety	0.454	0.295	0.665
Stress Susceptibility	0.356	0.233	0.579
Lack of Assertiveness	0.304	0.043	0.508
Embitterment	0.497	0.443	0.602
Mistrust	0.547	0.198	0.483
Aggressiveness	0.267	0.457	0.269
Physical Trait Aggression	0.166	0.230	0.082
Verbal Trait Aggression	0.218	0.434	0.164
Social Desirability (-)	-0.043	-0.237	-0.132
Trait Irritability	0.339	0.459	0.430
Extraversion	-0.106	0.428	-0.048
Adventure Seeking	0.006	0.335	0.018
Impulsiveness	0.113	0.445	0.216
Detachment (-)	0.347	-0.123	0.333

Notes: N=323, women=145, men=178.

SSP vs. NEO-PI-R: Several strong correlations were found when measuring simple correlations between SSP and NEO-PI-R. The SSP Aggressiveness factor had only weak to moderate correlations with NEO-PI-R. The SSP Extraversion factor correlated strongly with NEO-PI-R Extraversion factor (r=0.628) and its facet NEO-PI-R Excitement seeking (r=0.624). SSP Adventure Seeking strongly correlated with NEO-PI-R Excitement seeking (r=0.624). SSP Detachment correlated inversely to NEO-PI-R factor Extraversion (r=0.625) and its facet NEO-PI-R Warmth (r=0.637). SSP Impulsiveness correlated negatively to NEO-PI-R Deliberation (r=0.625). SSP factor Neuroticism was strongly correlated with NEO-PI-R Neuroticism and four of its scales (Anxiety (r=0.683), Depression (r=0.762), Self-consciousness (r=0.693) and Vulnerability to stress (r=0.737). The SSP scale Embitterment strongly correlated with NEO-PI-R Depression (r=0.686), NEO-PI-R Neuroticism (r=0.733),

and NEO-PI-R Vulnerability to stress (r=0.626). SSP Mistrust showed strong negative correlation with NEO-PI-R Trust (r=0.670. SSP Psychic trait anxiety was strongly correlated with NEO-PI-R Neuroticism factor (r=0.778) and its facet Depression (r=0.716), NEO-PI-R Neuroticism facets NEO-PI-R Anxiety (r=0.709), NEO-PI-R Self-Consciousness (r=0.687) and NEO-PI-R Vulnerability to stress (r=0.708). SSP Somatic Trait Anxiety was strongly correlated with the NEO-PI-R factor Neuroticism (r=0.656) as well as its facet NEO-PI-R Depression (r=0.622). SSP Stress susceptibility was strongly correlated with NEO-PI-R factor Neuroticism (r=0.671) and its facets NEO-PI-R Depression (r=0.626) and NEO-PI-R Vulnerability to stress (r=0.697) (Table 11).

Table 11. Study 4 - Correlations between Swedish universities Scales of Personality (SSP) and revised NEO personality inventory (NEO-PI-R).

SSP factors and scales/NEO-PI-R factors	N	E	O	A	C
Neuroticism	0.801	-0.535	-0.238	-0.123	-0.474
Somatic Trait Anxiety	0.656	-0.263	-0.058	-0.141	-0.376
Psychic Trait Anxiety	0.778	-0.507	-0.205	0.001	-0.390
Stress Susceptibility	0.671	-0.482	-0.263	-0.059	-0.471
Lack of Assertiveness	0.515	-0.501	-0.268	0.138	-0.443
Embitterment	0.733	-0.359	-0.121	-0.195	-0.450
Mistrust	0.469	-0.443	-0.226	-0.299	-0.158
Aggressiveness	0.388	-0.078	0.010	-0.623	-0.195
Physical Trait Aggression	0.142	-0.008	-0.000	-0.430	-0.006
Verbal Trait Aggression	0.282	0.046	0.098	-0.570	-0.127
Social Desirability (-)	-0.289	0.166	0.043	-0.447	0.274
Trait Irritability	0.479	-0.141	-0.036	-0.353	-0.234
Extraversion	-0.039	0.628	0.534	-0.138	-0.060
Adventure Seeking	-0.083	0.519	0.430	0.432	0.038
Impulsiveness	0.323	0.140	0.189	-0.235	-0.382
Detachment (-)	0.299	-0.625	-0.478	-0.186	-0.193

Notes: Correlations between Swedish universities Scales of Personality (SSP) factors and scales and factors in revised NEO personality inventory (NEO-PI-R). N=287, women=141, men=157. N= Neuroticism, E=Extraversion, O=Openness, A=Agreeableness, C=Conscientiousness.

SSP vs. revised Chapman scales: The SSP factor Neuroticism were strongly correlated with the revised Chapman scales Social anhedonia (r=0.622). Also, SSP scale Detachment was strongly correlated with revised Chapman scales Social anhedonia (r=0.649). Several weak to moderate correlations were found between SSP and revised Chapman scales (Table 12).

Table 12. Study 4 - Correlations between Swedish universities Scales of Personality (SSP) and revised Chapman scales.

SSP factors and scales/Chapman scales	Physical anhedonia	Social anhedonia	Perceptual aberration
Neuroticism	0.246	0.622	0.423
Somatic Trait Anxiety	0.096	0.407	0.426
Psychic Trait Anxiety	0.210	0.568	0.381
Stress Susceptibility	0.256	0.548	0.355
Lack of Assertiveness	0.191	0.423	0.170
Embitterment	0.167	0.487	0.385
Mistrust	0.261	0.539	0.304
Aggressiveness	0.054	0.304	0.165
Physical Trait Aggression	0.044	0.148	0.099
Verbal Trait Aggression	-0.032	0.190	0.081
Social Desirability (-)	-0.019	-0.191	-0.080
Trait Irritability	0.126	0.389	0.227
Extraversion	-0.325	-0.448	-0.017
Adventure Seeking	-0.255	-0.281	0.033
Impulsiveness	-0.029	0.015	0.099
Detachment (-)	0.372	0.649	0.171

Notes: N=220, women=104, men=116.

SSP vs. STQ: No strong correlations were found between SSP and STQ. There were moderate correlations between SSP factor Neuroticism and the STQ scales Borderline personality (r=0.456) and Schizotypal personality (r=0.474). Moderate correlations were also found between SSP scale Embitterment, Psychic Trait Anxiety and Somatic Trait Anxiety STQ Borderline personality scales (r=0.48, r=0.40 and r=0.52, respectively) and STQ Schizotypal personality (r=0.44, r=0.44 and r=0.54, respectively) (Table 13).

P-value for all correlations above were at or below p=0.0001.

Table 13. Study 4 - Correlations between Swedish universities Scales of Personality (SSP) and STQ.

SSP factors and scales/STQ	Schizotypal personality	Borderline personality
Neuroticism	0.474	0.456
Somatic Trait Anxiety	0.536	0.523
Psychic Trait Anxiety	0.442	0.400
Stress Susceptibility	0.306	0.310
Lack of Assertiveness	0.205	0.137
Embitterment	0.435	0.477
Mistrust	0.256	0.262
Aggressiveness	0.190	0.326
Physical Trait Aggression	0.086	0.169
Verbal Trait Aggression	0.181	0.293
Social Desirability (-)	-0.094	-0.180
Trait Irritability	0.228	0.365
Extraversion	0.146	0.174
Adventure Seeking	0.059	0.113
Impulsiveness	0.288	0.329
Detachment (-)	0.024	0.064

Notes: N=218, women=99, men=119.

6 DISCUSSION

In this project we investigated personality traits over time in patients with schizophrenia and related disorders using SSP, an inventory focused on psychopathology rather than on human personality as a whole. One of the aims was to investigate the factor structure and internal consistency when using SSP in a cohort of patients with schizophrenia and related disorders and among healthy individuals. As a second aim we investigated stability over time of the personality traits in the investigated cases and controls. We also investigated associations between SSP and scales from the personality instrument revised Chapman scales, NEO-PI-R, SCID-II screen and STQ. In addition, we investigated personality differences between patients with schizophrenia and related disorders, and healthy control subjects. The main findings, methodological considerations, directions for future research, and clinical implications are discussed.

6.1 ASPECTS OF USABILITY OF PERSONALITY QUESTIONNAIRES IN PATIENTS WITH PSYCHOTIC DISORDER

The main findings of the first study were that SSP seemed to be a psychometrically reasonably correct instrument when investigating personality traits among patients with psychotic disorder in a stable phase. Internal consistency data showed similar patterns in the sample of patients with psychotic disorder compared to non-psychotic individuals, although mostly with lower values. The number of patients included in this study was too small to make firm conclusions. The pilot investigation showed an overall factor structure among patients in line with the Swedish normative sample. The conclusion of this is that patients with psychotic disorder have a general understanding of the questions included in the SSP questionnaire which is similar to non-psychotic individuals. Two previous studies have investigated the internal consistency of personality among individuals with psychotic disorder using other personality questionnaires (161, 213). The use of SSP rating individual differences in personality among individuals with psychotic disorder has similar psychometric properties as the investigated instruments TCI and NEO. To assess if individuals with psychotic disorder during a relapse of their disorder can give reliable answers new investigations under those conditions has to be performed.

Several studies have investigated personality traits in patients with schizophrenia spectrum disorders. In the first study of this PhD-project the results have been compared with results in other studies using KSP, TPQ, TCI and NEO-FFI, NEO-PI and NEO-PI-R.

The results of the study showed that patients with psychotic disorder differ in their estimates compared with non-psychotic individuals. Reasons for this could be that they differ in several aspects. The patients with psychotic disorder included in this study almost always used antipsychotic drugs, in contrast to the non-psychotic controls. Extrapyramidal side effects could affect the results for some of the items like parts of those covering anxiety and detachment. There were no stable correlations except for VTA when analyzing relationships between antipsychotic drug equivalents and SSP scales. In VTA higher doses of

antipsychotic drugs were associated with lover scores of verbal aggression. Overall, these results suggest that antipsychotic medication does not in a significant way influence the scoring results of the personality traits in SSP. The result of this study is also in agreement with results from previous studies of individuals with other mental disorders where antipsychotic drugs are not the main treatment, and where the affected individuals still score higher on neuroticism-related scales. This is a further argument speaking against antipsychotic drug treatment being major cause of the differences between the two groups in the current study. It rather suggests that neuroticism is a common marker for a wide range of psychopathology.

6.2 STABILITY OF PERSONALITY TRAITS AND PERSONALITY ASPECTS OVER A FIVE- AND THIRTEEN-YEAR PERIOD

The main findings in the article *Stability of personality traits over a five-year period in patients with schizophrenia spectrum disorder and non-psychotic individuals: a study using Swedish universities Scales of Personality* was that SSP mean scale scores did not vary significantly during the observed time-period. Especially among individuals with psychotic disorder within-subject correlations showed less stability for the rank order between the individuals for some of the scales. The results are in accordance with previous studies investigating patients with psychotic disorders using FFM and MMPI-168 (160, 161, 163, 164). In three previous studies (214-216) three different samples were investigated with the SSP questionnaire at two different time-points. Despite different and much shorter time spans investigated, different ages of the investigated individuals, and varying patient categories, stability over time were overall similar to the present study in that only seldom z-score deviated above 0.5, a lower limit for a non-trivial difference (203, 204). In the present study the most deviant z-scores were Physical Trait Aggression (-0.47), Psychic Trait Anxiety (-0.40) and Verbal Trait Aggression (-0.41) where non-psychotic individuals scored lower at five-year follow-up compared with baseline. In the group with psychotic disorder the most deviant measures were that of Trait Irritability (-0.39).

In the scales Detachment and Social Desirability there were differences between individuals with psychotic disorder and non-psychotic individuals. Calculations using correlations to find out the impact of verbal IQ, GAF, SANS, and SAPS did not show any significant association and could not explain the reasons for the differences.

When investigating case-control differences over the five years patients scored higher than controls in six neuroticism-related scales, in consistence with Study 1 in this PhD-thesis. The results are also in line with the majority of previous studies using other personality questionnaires that indicate that patients with psychotic disorders score higher in neuroticism, and facets of neuroticism (12, 13, 15, 16, 217).

In Study 3, we investigated patients with schizophrenia spectrum disorder and non-psychotic individuals during a 13-year interval. The main findings were an overall low mean-level change and high rank-order stability. As in the 5-year follow-up study there were generally

lower mean-level change and rank-order stability among patients with psychotic disorder compared to non-psychotic individuals, with some exceptions. Case-control analyses in this study showed that patients with psychotic disorder differed compared to non-psychotic individuals with higher scores in the scale Detachment as well as the SSP factor Neuroticism and its scales. This is in agreement with our previous studies using SSP (162, 197) as well as studies using other personality questionnaires (15, 16, 160).

6.3 RANK-ORDER STABILITY IN STUDIES USING SSP OR KSP

In Study 3 we reviewed personality changes in other long-term studies using SSP or its predecessor KSP. Seven of the investigated long-term KSP studies provided stability estimates (166-169, 174, 179, 209). Mean correlations varied between 0.63 and 0.76 for nine of the 15 scales in KSP. For three of the scales, correlations were at or below 0.50. The results of the present study showed as hypothesized overall similar stability estimates as the results in the comparable KSP investigations in the studies mentioned above, with a few exceptions.

6.4 MEAN-LEVEL CHANGE IN STUDIES USING SSP OR KSP

Mean-level change measured with KSP in long-term follow-up studies gave various results. One study of individuals with chronic depressive disorder (166) and four different studies investigating non-psychiatric samples (167, 173, 179, 209) did not show any substantial mean-level change. Other studies, including psychological difficulties and including different kinds of significant interventions, found substantial changes in mean-level change (165, 170-172, 174, 177, 178). One aspect of the results is that this may point to the difficulties in separating trait from state, especially in neuroticism-related aspects. The results noted in the studies of Kampe et al (168, 169) included adolescents in the age interval 15-20 years, find reduced Detachment and Suspicion and increased Social Desirability and is likely to mirror a maturation phase (168). Mean-level personality changes in this age is expected (7).

When investigating long-term mean-level change of personality traits using SSP among individuals with psychiatric disorders results showed that individuals affected by more severe symptoms showed higher stability in personality related to individuals with milder symptoms (208). Provided the assumption that patients with psychotic disorders often show a more severe disease state the results in Study 3 are in accordance with the two previous studies on long-term outcomes measured with SSP (162, 208).

Taken together, studies using SSP and KSP indicate that the adult personality in ages 23-55 years usually shows both rank-order and mean-level stability among individuals with severe chronical illness and among healthy individuals. Therapeutic interventions of severe life events could result in a change in neuroticism-related personality aspects (171, 172). The results of the investigated studies should be treated with caution because of the few subjects included.

6.5 SSP QUESTIONNAIRE IN RELATION TO OTHER PERSONALITY INSTRUMENTS

The main findings in the study *Swedish universities Scales of Personality: relation to other personality instruments* is that SSP is a valuable personality questionnaire when mapping personality traits. SSP also correlate reasonably well, especially regarding its neuroticism-related scales, to the personality instruments revised Chapman scales, NEO-PI-R, SCID-II screen and STQ included in this study.

By performing factor analyses of higher order constructs of the clusters, factors and major scales questionnaires included in the study and SSP factors the relation between the different questionnaires initially were investigated. However, the results were difficult to interpret. These findings were unexpected and a reason for these results could be that not all of the personality higher construct used was developed using classical psychometric properties. This became especially clear for SCID-II screen where 76 items ended up in 23 factors explaining 63% of the variance. Statistical analyses using face validity was used to build three major clusters from the different factors (218). Simple correlations were performed between each of the SSP factors and the clusters, factors, and major scales of the other personality questionnaires. The result of this was that SSP shared 56%, 61%, 67% and 50% of the variance with the revised Chapman scales anhedonia, NEO-PI-R Extraversion, NEO-PI-R Neuroticism and SCID-II screen cluster C, respectively.

Correlations between SSP and NEO-PI-R have previously been investigated in an Estonian sample (196) and the results from the present study and results from the study of Aluoja et al (2009) were overall concordant. This makes it plausible that SSP capture aspects of the broader personality constructs of the Five-Factor Model, because of the similarities in the two different ethnic samples.

To our knowledge no previous study has investigated correlations between SSP and the revised Chapman scales. Correlations were found between the constructs suggesting that SSP covers aspects of the revised Chapman scales Social anhedonia scale. There were no strong correlations between SSP factors and scales and the other scales included in revised Chapman scales.

As far as we know no other previous study has investigated correlations between SSP and SCID-II screen. In the present study, the SSP Neuroticism factor was moderately to strongly correlated with two of three cluster B personality disorders (Paranoid PD, Schizotypal PD), one cluster B personality disorder (Borderline PD), all cluster C PDs (Avoidant PD, Dependent PD, Obsessive-compulsive PD, Passive aggressive PD), and with Self-defeating PD. Neuroticism can be considered as an almost common marker for psychopathology, therefore the correlations with the majority of personality disorder were anticipated (219). However, there was a lack of substantial correlation between the SSP Neuroticism factor and antisocial and histrionic PDs, which instead were associated with SSP Extraversion and SSP Aggressiveness factors. This may indicate an exception to the almost general association between Neuroticism and personality disorder.

Results of correlations between SSP and STQ shows that the two STQ scales not clearly could be separated in terms of SSP factors and scales. We could not find any previous study investigating relationships between SSP and STQ.

6.6 GENDER ASPECTS

In the present studies there was an overall smaller number of participating women than men, both among controls and patients (in Study 1 40% and 33%, respectively). This difference was even more pronounced in the follow-up investigations, where the proportion of women was stable among controls (38 – 40%), but was further reduced among patients (22 – 25%). A smaller proportion of women than men with psychotic disorders is in line with the distribution in population-based studies, with an incidence of about 40% women in schizophrenia (220). Our inability to recruit women patients to the study must however be seen as a limitation of our studies, even if gender was taken into account in several of the statistical calculations.

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7 CONCLUSIONS

Statistical correlations using reliability show that patients with schizophrenia spectrum disorder in a stable clinical phase can adequately complete SSP. Patients scored higher in neuroticism-related scales and lower in aggression-related scales than healthy controls. This is in accordance with previous studies where other personality instruments have been used.

Using SSP to assess stability of personality traits over a five-year period in a Swedish cohort of individuals with schizophrenia spectrum disorder and non-psychotic individuals shows that the stability of personality traits assessed with SSP was reasonably high both among non-psychotic individuals and among patients with psychotic disorders, however, non-psychotic individuals show higher stability than non-psychotic individuals. During a five-year interval SSP mean scale scores did not significantly vary. The results are in accordance with other studies using different personality instruments.

Measure stability of personality traits during a 13-year period indicate same results as in five-year follow-up with relatively stable results over time, especially in the upper young and middle adulthood. This is also in agreement with results from studies using KSP, the precursor to SSP. Case-control analyses showed that individuals with schizophrenia spectrum disorder differed compared to non-psychotic individuals for the SSP factor Neuroticism as well as the scale Detachment. These results are in agreement with previous studies.

When SSP was investigated in relation to other personality instruments there were substantial correlations between the neuroticism-related scales in SSP and the Chapman, NEO-PI-R and SCID-II screen inventories. Extraversion-related and aggressiveness-related scales in SSP are correlated with similar scales in NEO-PI-R. However, the included different personality inventories are not completely comparable to each other. They measure personality aspects in partly different ways, SSP are developed for measure personality traits known to correlate with psychopathology.

8 POINTS OF PERSPECTIVE

In Study 1 where we investigated if patients with psychotic disorder differ from healthy individuals in their responses to the SSP we also briefly investigated if symptom load or antipsychotic medication influence the results of the study. SANS and SAPS were used to measure psychotic symptoms and none of the controls used antipsychotic medication. Additional long-term follow-up studies to investigate the effect of the medication on personality traits are needed.

It is also interesting to delve further into how the severity of the disease affects the individual's personality traits over time.

In the studied group of individuals, the stability of personality traits was relatively high. Healthy individuals showed a higher degree of stability in personality traits than patients with psychotic disorders. Previous research shows similar results. Further research on differences in stability between individuals with psychotic disorders and healthy individuals related to personality traits is necessary to be able to explain the cause of these differences.

The follow-up studies in this project showed a higher degree of neuroticism-related personality traits in patients with psychotic disorders compared with healthy individuals. This is also in agreement with other studies. Further research is needed to understand why this difference exists.

The findings related to correlations between personality traits and psychopathological conditions underline the importance of being able to measure personality among individuals with schizophrenia and related disorders, also during long-time follow up, in order to optimize caretaking, treatment and other important needs in this group of patients.

It is also of interest to further investigate the relation between brain structure and function, cognition, neurological soft signs and clinical characteristics related to personality in long-term follow-up investigations of patients with psychotic disorders. There is still a lack of long-term investigations related to personality among individuals with psychotic disorders.

The results of this work are useful and have clinical implications since they show that personality traits can be measured with SSP in patients with schizophrenia and related disorders. It is likely that the knowledge of personality traits in this group of individuals can contribute to better treatment options and clinical interventions.

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