

Research Article

“LIVING BEYOND LIMITS”: NEUROGENIC INFLUENCES OF OVEREXCITABILITIES ON THE MENTAL HEALTH OF THE HIGHLY GIFTED

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Abstract

This study introduced the concepts of the inability to deal with or channel overexcitabilities to expand the giftedness research. Giftedness refers to outstanding levels of competence and aptitude in one or several domains. Based on neurogenic theories of sensory modulation and integration, it was hypothesized that gifted individuals (1) exhibit stronger overexcitabilities and sensitivities than average-intelligent individuals, (2) that these deteriorate their mental health and induce mental illness, (3) and (4) the inability to deal/channel mediates the relation between overexcitabilities and mental health and illness. The design of the study was cross-sectional and descriptive (N=450). Highly gifted individuals (n=300) were recruited from Mensa and non-gifted college students (n=150) were recruited from the University of Groningen. The first and second hypotheses were tested using two and four independent T-tests, respectively. Four mediation analyses were conducted to test the mediational effects. The bootstrap sample was elevated to 5,000 to apply the analyses with more confidence. All hypotheses were supported. The mediational analyses were highly significant with medium to strong effect sizes. This study concludes that in the highly gifted the inability to deal with or channel overexcitabilities can explain varying levels of mental health and illness and is a major indicator in determining the influence of overexcitabilities on mental health and illness. Whether gifted individuals thrive in their lives may largely depend on their ability to channel overexcitabilities into success and innovation. As existing therapeutic practice more often than not fails the complexity of the gifted client, this thesis recommends interventions based on the Theory of Positive Disintegration to meet the needs of highly gifted individuals. *ASEAN Journal of Psychiatry, Vol. 25 (3) March, 2024; 1-23.*

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Introduction

“The creative instinct is, in its final analysis and in its simplest terms, an enormous extra vitality, a super-energy, born inexplicably in an individual, a vitality great beyond all the needs of his own living—an energy which no single life can consume. This energy consumes itself then in creating more life, in the form of music, painting, writing, or whatever its most natural medium of expression. Nor can the individuals keep himself from this process, because only in its full function is he relieved of the burden of his extra and peculiar energy—an energy at once physical and mental, so that all his senses are more alert and more profound

than another man’s, and all his brain more sensitive and quickened to that which his senses reveal to him in such abundance that actuality overflows into imagination. It is a process proceeding from within. It is the heightened activity of every cell of his being, which sweeps not only himself, but all human life about him, or in him, in his dreams, into the circle of its activity”.

Rationale

Although intellectual giftedness is no guarantee for success or happiness, it has been associated with the highest human achievements and has been, more so than any other measurable human

trait, established as the strongest predictor for occupational, educational, social and economic outcomes [1-4]. While this relation towards success is apparent, the relation between giftedness and mental health continues to be a task of intricate and complex matters and remains rather unclear [5-7]. Karpinski et al., point out that overexcitabilities, or sensitivities, often accompany intellectual giftedness and may cause mental illnesses such as severe depression [8]. Depression has been designated as the 'leading cause of disability around the world', signifying the relevance to investigate the role of overexcitabilities in giftedness [9]. The current thesis assumed that gifted individuals exhibiting strong overexcitabilities are prone towards mental illness rather than mental health compared to those with weak overexcitabilities. It was further presumed that the inability to process overexcitabilities acts as a mediator of this relation, which in this case would be decisive in identifying gifted persons at risk for mental illness and consequential negative life outcomes.

Cognitive-emotional characteristics of intellectually gifted individuals

The American Psychological Association (APA) defines intelligence as the extent to which "individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, and to engage in various forms of reasoning, to overcome obstacles by taking thought" [10]. Although there are currently no widely accepted definitions of giftedness, "outstanding potential in any area recognized by performance" or "outstanding ability to deal with complexity" appear to be the hallmarks of giftedness recurrent in different definitions. Prevalence estimates, as indicated by an Intelligence Quotient (IQ) of 130 or above, range from one to two percent, as proposed by Turkman, Henry and McCoach et al., respectively [11-13]. Research for more than 100 years provides conclusive evidence that a general factor of intelligence, *g*, exists, which strongly correlates with all domains of cognitive tests such as processing speed, reasoning, memory, executive functioning and spatial ability [14,15]. Factor *g* has been used to delineate structural and functional brain differences of individuals with varying levels of intelligence [16].

The Parieto-Frontal Integration Theory (P-FIT), promulgated by Jung and Haier, was deemed as the "best available answer to the question of where in

the brain intelligence resides" and is influential in that it (1) explains most of the current neuroimaging studies and in that it (2) highlights the critical role of rapid sensory processing and receptivity in giftedness, which were associated with sensory discomfort, strong emotional response and mental illness. Based on 37 neuroimaging studies, Haier proposed that the occipital and temporal lobe are the first regions to receive visual and auditory information, respectively [15-19]. The information travels then from visual and auditory cortices to parietal regions where it is elaborated and integrated [17]. Finally, the information is transferred to frontal cortices and used to analyze hypothetical action outcomes [19]. The anterior cingulate cortex is hereby critical for decision-making, error recognition and the responses [17]. More white matter tracks in this system result in rapid processing speed and high IQ, representing there by the critical convergence between parietal sensory association cortices and frontal lobes [16,17,19].

The Columbus Group (1991) promoted a new definition of giftedness to account for the different sensory processing and there are different perceptual experience of gifted individuals, stating that "the uniqueness of the gifted renders them particularly vulnerable and requires modifications in parenting, teaching and counselling in order for them to develop optimally". These needs seem to be pronounced in gifted children, as they are more aware of unspoken messages in interpersonal relationships and as they experience emotions such as joy, boredom and sadness to a heightened degree [20]. Non-promotion or neglect of the demands has been associated with a negative overall life trajectory [5]. Specifically, gifted individuals who have not been identified or nurtured and promoted at an early stage, suffer significantly more from low self-esteem, fear of failure, depression, and a variety of other negative mental health impacts [5]. These needs might be further pronounced as the brain maturation of the highly gifted differs compared to average-intelligent individuals, and may thus play a critical role in the asynchronous development frequently observed in gifted children and adolescents, which was negatively associated with mental health [6].

Mental health of the highly gifted

The relation between intellectual giftedness and mental health and illness occupies an ambivalent position in science. There has been some evidence that intellectually gifted individuals are physically

and mentally healthier than their peers. Two of the most renowned studies about the relation between intellectual giftedness and mental illness are the “Marburger Hochbegabtenprojekt” and the “Termites” study [21,22]. Both studies are longitudinal, and the latter, dating back to 1921, has been acknowledged as the longest study about the relation between intellectual giftedness and mental health and illness [23]. Both studies, continuing to measure gifted individuals at a whole life span, concluded that gifted individuals are healthier in psychological and physical terms. The results have been unchanged since then and the relation “ingenuity and madness” has been declared as a myth [23]. However, more recent evidence points to a more critical direction, as there are substantial conflicting studies in the literature regarding the association of IQ, especially high verbal ability, and mental disorders such as depression, anxiety disorders, bipolar disorder, ADHD, and autism spectrum disorders [7,15,24-27].

Overexcitabilities and high sensitivity

Overexcitabilities were defined in different ways, such as “enhanced and intensified mental activity distinguished by characteristic forms of expressions which are above common and average” or as “multifaceted lens through which to view the intensities of gifted” acting as a “mode of understanding and responding to the world” adds that “giftedness is not a matter of degree but a different quality of experiencing”. The terms overexcitabilities and sensitivity are commonly defined as equivalent to each other (Lind, 2000), in that both refer to (1) “the higher than average responsiveness to stimuli”, the (2) corresponding reactions that are “over and above average in intensity, duration, and frequency”, and (3) the resulting ease of overstimulation [28-34]. If there is a difference between the two, this seems to be rather in Dabrowski’s approach to divide the overexcitabilities into several dimensions, illustrated in the following, to understand its psychological and behavioral consequences, including coping strategies, on an individual’s life better. Incrementally, the essential role of overexcitabilities in the emergency of mental health disorders has become acknowledged [7,35,36].

Sensual overexcitabilities: A function of heightened experience of sensual pleasures that is expressed *via* increased desire for luxury, aesthetics, comfort, fashion and superficial relationships with peers, promiscuity etc. As in psychomotor

overexcitabilities, sensual overexcitabilities may act as catharsis of emotional tension that manifests themselves in sensual expressions. Heightened sensual overexcitabilities may result in overeating or excessive sexual stimulation.

Psychomotor overexcitabilities: A function of energy surplus that manifest itself in increased pace of speech, restlessness, aggressive behavior, delinquency, sports and the urge to act. Expressions of psychomotor overexcitabilities can be either pure manifestations of an energy surplus or may result from the inner emotional tensions.

Imaginational overexcitabilities: Increased ability to associate pictures, images and sensations, which is related to ingenuity, creativity and a richness of ideas that manifest it in usage of images and metaphors in linguistic expressions or in clear and distinct visualizations. Emotional tensions may herein translate into vivid dreams, nightmares and a blending of imagination and truth, and a fear of the unknown. In extreme forms individuals may live in a phantasy world and may exhibit a preference for poetry.

Intellectual overexcitabilities: Contrary to the first three overexcitabilities, there is no transfer of emotional tension on intellectual activities of any kind. This, however, does not mean that intellectual and emotional processes of high intensity do not accompany each other. Intellectual overexcitabilities manifest themselves in a strong thirst of knowledge and a deep curiosity about scientific thinking and matter. Individuals with intellectual overexcitabilities like it deal with and to solve theoretical problems.

Emotional overexcitabilities: A function of emotional experiences, especially with regard to relationships yielding a strong bond and deeper connection with persons, locations and living objects. Intense feelings and emotional expressions are only relevant for development insofar they relate to the experience of relationships. Different types of overexcitabilities, cited in Preckel et al., [37].

Role of overexcitabilities

Gere found that gifted individuals with strong sensitivities exhibit severe sensory processing problems and explained this by theories of sensory modulation and integration [35]. Karpinski et al., built upon this finding and framed the Hyper Brain-Hyper Body framework, suggesting that highly

gifted individuals with strong overexcitabilities are several times more likely to suffer from mood disorders, such as depression and bipolar disorder, ADHD, generalized and specific anxiety disorders, obsessive compulsive disorder, allergies, asthma, auto-immune diseases, neuro-inflammation and autism spectrum disorders compared to their peers [7]. This relation could be explained by the mediation of overexcitabilities. Overexcitabilities may act as a protective resource against the development of mental illness, which can, contrary, equally well predispose the gifted ones towards psychological disorders. Gere noted that heightened sensitivity might be seen as double-edged sword, which is a highly tuned measure of receiving information being a distractor when this ability to integrate information is not functioning optimally. Correspondingly, it has been noted that the same abilities and awareness that inspire gifted individuals to create potentially drives the same into deep depression and to withdraw [7,38-42].

Nevertheless, processing difficulties, as suggested by, were neither considered nor included in or other studies [7,35]. Therefore, the exact underlying mechanisms of overexcitabilities in the emergency of mental illness remain unclear. Sensory modulation provides a neurogenic account of overexcitabilities in the highly gifted, whereas sensory integration offers insights into the consequential impact on the mental health and illness. It has been found that processing problems (i.e., sensory modulation and integration, reduce resilience, which predisposes them towards mental illness and impairs their mental health [43-48]. Resilience, which was defined as "dynamic process encompassing positive adaption within the context of significant adversity", acts as protective resource that can "modify, ameliorate, or alter a person's response to some environmental hazard that predisposes a maladaptive outcome [47,49,50]. Although it is disputed whether gifted individuals are more resilient than their peers, it has been found that gifted individuals with strong sensitivities tend to be less resilient [46-48].

Neurogenic account of overexcitabilities

The neurogenic account of overexcitabilities provides insight into the underlying neurological mechanisms that contribute to heightened sensitivity and responsiveness in individuals who exhibit these traits.

Theories of Sensory Modulation: Sensory Modulation Theories suggest that highly

gifted individuals cannot respond to stimuli appropriately due to their inability to modulate sensory input [35]. Sensory modulation refers to the process of the brain to regulate itself, in that the Central Nervous System (CNS) changes the responsiveness and excitability of neuronal circuits to adjust to changing external conditions [51,52]. Sensory modulation relies on habituation and excitatory sensitization [35]. Habituation emerges when the CNS recognizes a stimulus as familiar or repetitive and leads to neural inhibition. Without habituation, an individual would be continually distracted by new stimuli, which is thus decisive in mediating incoming stimuli to focus on specific tasks while attending to the surrounding. Excitatory sensitization enhances attention and immediate response to a stimulus [35]. The process of sensory modulation transduces then energy from the environment into signals, making thus an appropriate response possible [35]. Modulation may refer to behavioral or physiological adjustments as response to sensory stimulation [53]. This process can be unstable in gifted individuals since their neurological threshold towards stimuli is very low [35].

Theories of Sensory Integration: Sensory Integration Theories refer to the interactive relationship between neurological threshold, and physiological, behavioral, and emotional response as a consequence of atypical modulation abilities [35,53]. Sensory modulation is necessary for the brain and body to maintain homeostasis by modulating to new and ongoing stimuli and modulation inability was associated with psychophysiological disruptions of parasympathetic and sympathetic reactions [35,53,54]. Even typical and benign sensory stimuli may thus be experienced as unpleasant, painful, irritating and stressful, resulting in an inability to respond appropriately to stimuli such as defensive behaviors and withdrawal [55-58]. Atypical modulation may hence lead to social and emotional maladjustment and psychological distress, thereby increasing the vulnerability towards mental illness by reducing resilience, which in turn disturbs the physiological homeostasis and further the ability of gifted individuals to deal with adversity [35,44-46].

Relevance and aim

All currently available therapies to combat mental illness are merely palliative and none is curative [58]. Furthermore, mental health is regularly but inconsistently conceptualized and measured in research [59]. Most measurements

focus on mental illness instead of mental health, running thereby the risk of missing to identify individuals with low or high levels on the other, and may thus account for the prevailing discrepant findings of giftedness, mental health and illness. Therefore, the current thesis includes both mental health, encompassing psychological, emotional, and social well-being, and mental illness [60]. This approach allows to categories individuals according to the Dual Continua Model, along the dimensions flourishing, struggling, floundering and languishing. An individual is flourishing in the absence of mental illness and high levels of positive functioning (i.e., mental health) in terms of social, emotional and psychological well-being [61]. The absence of mental illness but low levels of positive functioning is considered as languishing and struggling are those with high levels of positive functioning in presence of mental illness [61]. Floundering refers to a mental crisis with low positive functioning and high mental illness.

Research indicates that sensory integration as an intervention may help gifted individuals to process sensory input in an appropriate way [62]. Especially gifted children with an asynchronous development may benefit from resources gained from sensory integration, as the emotional and social consequences might be pervasive and debilitating [62]. The current research aims to help in this regard as the establishment of the inability to deal with/to channel overexcitabilities (thereby highlighting its role in mental health and illness) would prove its significance in determining the mental health status of the gifted. Contrary, the ability to channel overexcitabilities (i.e., absent processing problems), may be defined as “freeing of overexcitabilities from its negative consequences in that it allows an individual to use its capacities in the promotion of mental health in a manner that enables the individual to flourish and strive in his or her life.” This may allow future research to (1) delineate the exact nature of processing problems of highly gifted individuals, to (2) help

gifted individuals to fulfill their potential and (3) reduce or prevent mental illness. Particularly, it was shown that those who flourish are happier and live a more satisfied, fulfilled, and meaningful life in terms of self-actualization [60,63].

Current research

Based on the literature review, several assumptions can be made regarding the relationship between overexcitabilities, the inability to process or to channel overexcitabilities, and mental health and illness. The corresponding research question of this thesis is: Does the inability to deal with or to channel overexcitabilities (i.e., the presence of processing problems) mediate the relation between overexcitabilities, mental health, and illness in gifted individuals? Gifted individuals exhibit stronger overexcitabilities than their peers and processing problems of the same, which impairs resilience, which in turn disturbs the physiological homeostasis, and the ability of gifted individuals to deal with adversity, thereby predisposing them towards mental illness [7,35,45,46,48]. Mental health encompasses the dimensions of social, emotional, and psychological well-being, which are all detrimentally affected by sensory processing problems, especially since even neutral and benign cues might be interpreted as malign. Impaired mental health, in turn, increases mental illness [35,60,63]. Correspondingly, the following hypotheses have been deduced.

- **H1:** Intellectually gifted individuals exhibit stronger (internal as well as external) overexcitabilities compared to average-intelligent individuals.
- **H2:** Intellectually gifted individuals with strong overexcitabilities exhibit a poorer mental health status than their peers.
- **H3:** The inability of intellectually gifted individuals to deal with overexcitabilities mediates the relation between strong overexcitabilities and mental health (Figure 1).

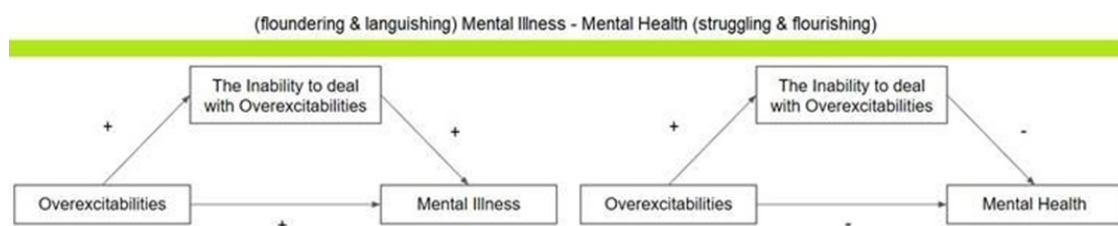


Figure 1. Conceptual relationship between overexcitabilities, the inability to deal with overexcitabilities, and mental illness and health.

H4: The inability of intellectually gifted individuals to deal with overexcitabilities mediates the relation between strong overexcitabilities and mental illness (Figure 1).

Materials and Methods

Participants

This study was approved by the Ethics Committee of the University of Groningen and incorporated a control sample of $n=150$ psychology students from the University of Groningen and an international sample of $n=300$ intellectually gifted individuals from Mensa Germany. This was accomplished for both groups *via* Qualtrics, where individuals could register for participation. The research head of Mensa sent an e-mail to its members who were directed to Qualtrics. The control sample was recruited *via* Subject Online Need Access (SONA) first-year practicum. Non-completion of the questionnaire resulted in exclusion from the analyses ($n=49$). As indicated in Appendix A, students who indicated to suffer substantially from study-induced symptoms of mental illness due to stress ($n=49$) were excluded from the analysis. A screening for giftedness showed that roughly one-third of the students believed to be gifted, which is, given the low prevalence of giftedness, statistically impossible and seems thus to be exemplarily of the Dunning-Kruger effect-the tendency of psychology students to inaccurately assess their intellectual capacities [64]. As illustrated in Appendix B, the final dataset included a sample of $n=352$, of whom were $n=255$ gifted individuals and $n=98$ students from the University of Groningen, the latter being young, less educated, and more likely to be female.

Mental health and illness

MHC-SF: The Mental Health Continuum-Short Form (MHC-SF) is a 14-item self-administered questionnaire used to measure social, psychological, and emotional well-being exhibiting a high internal consistency and moderate test-retest reliability [65]. The three-factorial structure of the MHC-SF has been confirmed as the three subscales correlated well with the respective aspects of well-being and functioning, establishing convergent validity. Mental health could be differentiated from mental illness, showing discriminant validity. Participants could rate how much they agree with statements such as "That our society is becoming a better place for people" on a 6-point Likert scale (1=never to

6=every day).

BSI: The Brief Symptom Inventory (BSI) is a self-reported questionnaire used to identify clinically relevant psychological symptoms in adolescents and adults [66]. Five scales, each containing 5-7 items, were included in this study: The Somatization, Depression, Anxiety, Hostility and Interpersonal Sensitivity scale. A General Severity Index (GSI), illustrating mental illness, was computed based on these scales. Alpha coefficients for the used BSI symptom scales exhibit satisfying degrees of internal consistency [67]. Convergent validity was established by inter correlations with clinical rating scales. Participants could rate the extent to which they agree to statements such as "Feeling that you are watched or talked about by others" on a 5-point Likert scale (1=not at all to 5=extremely).

Dual continua model

The BSI and the MHC-SF were used to determine the mental health status of individuals, which is composed of a combination of mental health and illness. The mental health status encompasses the four categories of flourishing, languishing, floundering, or struggling [60]. High scores on the GSI of the BSI indicate high levels of mental illness (Figure 2). High scores on the MHC-SF are based on the scores on the three subscales emotional, psychological, and social well-being, thereby displaying mental health. Emotional well-being indicates overall happiness, interest in life and general satisfaction with life. Psychological functioning indicates high levels of self-acceptance, positive relations with others, personal growth, autonomy, and purpose in life, and finally, an individual exhibits high social well-being if he or she scores high on social contribution, social integration, social actualization, social acceptance, and social coherence.

Overexcitabilities, sensitivity, and its processing problems

OEQ-II: The Over Excitability Questionnaire-Two (OEQ-II) is a 32-item self-administered questionnaire measuring the nature and degree of over-excitability [68,69]. Preckel, Schneider, and Holling indicated a Cronbach's Alpha of 0.86 (psychomotor), 0.89 (sensual), 0.85 (imaginational), 0.89 (intellectual), and 0.84 (emotional) for the five different sub-dimensions [37]. The validity of the OEQ-II was established [2,70]. Participants could rate how much they

agree to statements such as “I have strong feelings of joy, anger, excitement, and despair” on a 5-point Likert-scale (1=not at all like me to 5=very much like me). The following example items illustrate the different types of overexcitabilities:

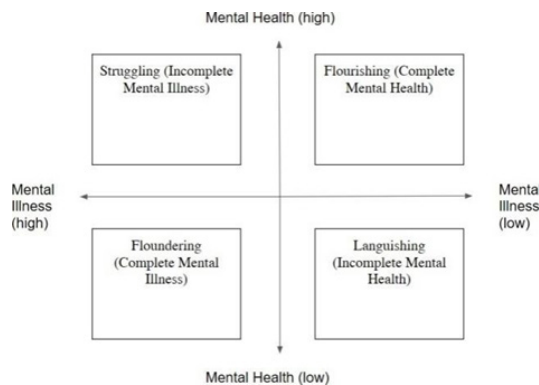


Figure 2. Schematic representation of the dual continua model. Flourishing refers to a state of complete mental health, struggling to high functioning despite the presence of mental illness and languishing to a state of incomplete mental health. In the last category, floundering describes a condition of both mental illness and impaired mental health.

- Sensual: “The varieties of sound and colour are delightful.”
- Psychomotor: “I love to be in motion.”
- Imaginational: “I like today dream.”
- Intellectual: “I like to play with ideas and try to think about how to put them to use.”
- Emotional: “I have strong feelings of joy, anger, excitement, and despair.”

SV-12: The Clinical Inventory for the Assessment of Sensitivity and Corresponding Processing Problem (SV-12) is a 30-item self-administered German questionnaire measuring sensitivity and its processing problems [71]. Cronbach’s Alpha range from 0.84 to 0.77 for the Sensitivity and Processing problems scales, respectively. Convergent validity was established by a two-factorial solution of both constructs. The SV-12 was translated, as illustrated in Appendix C, in English for the purpose of the current study. An example of the Sensitivity scale would be “I notice many subtleties in my environment” and an example of the Processing problems scale would be “I often feel that I need more time to process certain impressions or experiences”. Participants

could rate the extent of their agreement on a 5-point Likert-scale (1=does not apply to 5=applies completely. Furthermore, the SV-12 measures the sensitivity towards outer perception, the sensitivity towards inner perception, empathic sensitivity, emotional sensitivity, and openness. In the following, an example for each of the translated sensitivity subscales was illustrated

- Sensitivity towards outer perception: “I notice many subtleties in my environment.”
- Sensitivity towards inner perception: “I have a rich, complex inner life.”
- Empathic sensitivity: “I feel the mood quickly when I come into a room with people.”
- Emotional sensitivity: “Feelings play an important role in my decisions.” Openness: “I am curious and always want to try new things.” Processing problems: “I am often overwhelmed by my feelings”.

Procedure

The data collection period encompassed ten days. It started on the 15th of October and was closed on the 25th of October. To collect the necessary data the four questionnaires as illustrated above were transformed into online questionnaires by using the survey website Qualtrics. To contact participants of the control group, the link to the survey was published on Sona-Systems, a platform where researchers can gather a convenience-based sample consisting mainly of first-year students in need of European Credit Transfer System (ECTS) points. To contact intellectually gifted individuals, the link was sent to members of Mensa Germany, the German branch of the worldwide leading association for intellectual giftedness. Participants were transferred to the website of the questionnaire by clicking on the provided link. During the first part of the questionnaire, participants were informed about the topic of the study and were asked for their informed consent. Afterwards, the participants completed the four questionnaires. After completion of all questionnaires, participants have been asked if their want to be informed about the results of this study and were offered an option to fill in their e-mail address. Finally, they were thanked for participation and informed about the opportunity to contact the researcher in case of any questions or in case of any remarks about the study.

The dimensions and subscales of the final survey created for the purposes of the current study were based on the literature review and a pilot study. The final survey, including in this study included variables and subscales, is depicted in Table 1.

In order to warrant a high data quality, trick questions have been incorporated into the survey to identify non-credible responses. Three of such questions were spread throughout the multiple scales of the survey. The three trick questions

were formulated as follows:

- **Trick question 1:** “In order to ensure that you are reading the content of this study carefully, we ask you to answer this statement with “applies most often”.
- **Trick question 2:** “To ensure the data quality of this study, please enter a numeric one”.
- **Trick question 3:** “Please select the choice “Not at all like me”.

Table 1. An overview of all in the current study included variables and different sub scales.

Questionnaires	Number of items	Variable	Subscales and measures
MHC-SF	12	Mental health	Emotional WB
			Psychological WB
			Social WB
BSI	28	Mental illness	Somatisation
			Depression
			Anxiety
			Hostility
			Interpersonal
			Sensitivity
OEQ-II	32	Overexcitabilities	Sensual
			Psychomotor
			Imaginational
			Intellectual
			Emotional
SV-12-1	16	Sensitivity	Outer/Inner
			Empathetic
			Emotional
			Openness
SV-12-2	14	The inability to deal with/ channel overexcitabilities	Processing
			Problems

Note: WB refers to well-being; SV-12-1 refers to the sensitivity a subscale of the SV-12; SV-12-2 refers to the processing problems subscale of the SV-12.

Design and analysis

This study had a descriptive and cross-sectional design. SPSS 24.0 has been used to analyze the data. First, a screening for study-related stress was used to filter stress-induced influences on mental health and a screening for intellectual giftedness for the control group was used to eliminate potential biases that might have impacted the results of the current study. Secondly, the trick questions were correlated with the variables of the study to evaluate non-reliable responses. Third, descriptive statistics were computed including the means, standard deviations, kurtosis, skewness and Cronbach's Alpha of all variables. Fourth, a Kolmogorov-Smirnov test was used to test for normal distribution. Depending on the normal distribution of the data, Spearman or Pearson correlations were employed. Effect sizes of R^2 have been set at 0.01 (small), 0.09 (medium) and 0.25 (large) according to the recommendation of the Cambridge University (n.d.) and Cohen (1988) in determining the magnitude of the observed effects.

The first hypothesis if gifted individual's exhibit stronger overexcitabilities has been tested by conducting a T-test between the scores for the scales of Overexcitabilities and (OEQ-II) sensitivity (SV-12-1) between gifted individuals and average-intelligent individuals in the control group. The second hypothesis whether gifted individuals with strong overexcitabilities exhibit a poorer mental health status than their peers was tested by conducting two independent T-tests comparing strong *versus* weak overexcitabilities for each group. High *versus* low Overexcitabilities (OEQ-II) were divided by a median split of the overall sample. The means were subsequently applied to the Dual Continua Model to evaluate whether gifted individuals with strong overexcitabilities exhibit a poorer mental health status than their peers.

In order to categorize the participants in the Dual Continua Model, cut-off scores for values of mental health and illness were used (Appendix D). Westerhof and Keyes prescribe mean values of 0.7 (corresponding to a 1.7 on a 1-5 Likert-Scale) and above on the BSI as a possible mental illness, precluding categorization of flourishing and languishing [60]. Those who scored 4 (6-point Likert-Scale) on average or above on the

MHC-SF were considered as mentally healthy and categorized on the right part (flourishing or struggling) of the model.

The third and fourth hypothesis whether the inability to channel overexcitabilities (SV-12-2) mediates the relation between strong overexcitabilities and mental health and illness has been evaluated by conducting four mediation analyses. Both hypotheses were tested by analyzing the indirect effect of the inability to deal with overexcitabilities on this relation by using The MEDIANTE file developed by Hayes and Preacher (2014). Bootstrapping was chosen to test the mediation hypotheses because it is more effective than the Baron and Kenny approach and as it works with comparably low sample sizes by selecting randomly a large sample from the original sample, which increases the statistical power [72,73]. The MEDIANTE file does not assume the traditional assumptions of the Baron and Kenny causal steps approach, such as a significant relation between x and y.

In order to check for reverse causal effects, x was interchanged with m, and effect sizes between these and the initial models were compared. It was assumed that effect sizes for the proposed models are substantially larger compared to the reverse causal effect models, although the reverse causal effect models might be significant likewise because as noted, processing problems. The indirect effects have been computed in the sample of highly gifted individuals to identify mediation effects. Overexcitabilities and Sensitivity have been used for both analyses as separate independent variables, thereby yielding in total four different mediation analyses, as Figure 3 illustrates. The indirect effect of the inability to channel overexcitabilities between overexcitabilities and sensitivity as the independent variables and mental health as the dependent variable was analyzed by calculating the non-standardized indirect effects for each of 5,000 bootstrapped samples. A corresponding 95% Confidence Interval (CI) was computed by determining the indirect effects at the 2.5th and the 95.5th percentile. An indirect effect of the inability to deal with/channel overexcitabilities could be confirmed if the CI did not include the number zero [74]. With a bootstrap sampling of 5,000, it is possible to circumvent power problems and to apply the mediational analyses with more confidence.

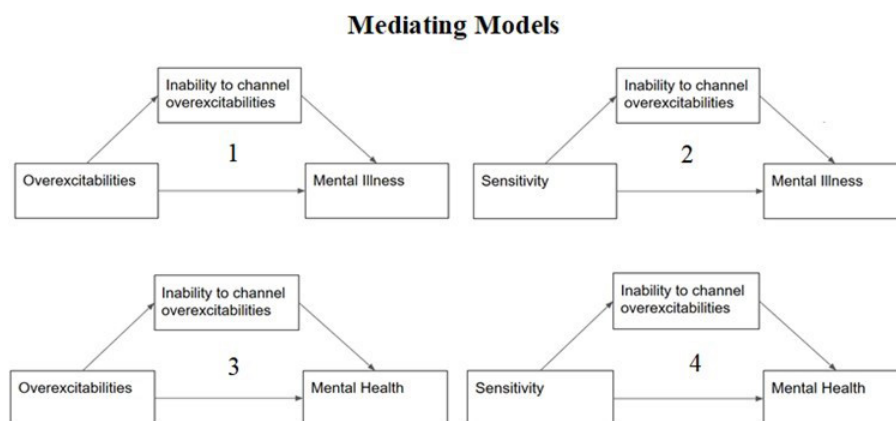


Figure 3. The four mediation models were tested in this thesis.

Results

Descriptive analyses

The descriptive analyses as well as the zero-order correlations for all in the study included variables are illustrated in Appendix E, for the overall sample, the Mensa group and the student group from the University of Groningen group, respectively.

Table 1 illustrates the difference between the giftedness group and the student group. Mental health scores were non-normally distributed, with a left skewness of -0.39 (SE=0.13) and kurtosis of -0.16 (SE=0.26). Mental illness scores were non-normally distributed, with a right skewness of 1.13 (SE=0.13) and kurtosis of 1.12 (SE=0.26). Participant scores on overexcitabilities were normally distributed, with skewness of 0.00 (SE=0.13) and kurtosis of -0.51 (SE=0.26). Consistently, sensitivity scores were normally distributed, with a skewness of 0.83 (SE=0.13) and kurtosis of -0.22 (SE=0.26). Finally, the inability to deal with overexcitabilities was normally distributed, with scores exhibiting a skewness of -0.02 (SE=0.13) and kurtosis of -0.41 (SE=0.26). Cronbach's Alpha for the overall survey and the questionnaires used indicated a good to excellent internal consistency, as shown Appendix F. A composite score of the items, as measured by the Kolmogorov-Smirnov test, showed no significant deviation from a normal distribution ($D(350) = 0.038, p=0.20$) and usage of Pearson correlation seemed thus warranted. In order to identify non-credible responses as a potential confounder, trick questions were correlated with all the variables included in this study. The correlations were insignificant.

Hypothesis testing

Hypothesis 1: The first hypothesis if intellectually gifted individual's exhibit stronger overexcitabilities has been tested by conducting a T-test between the scores for the scales of overexcitabilities and sensitivity between gifted and the student group. Gifted individuals exhibited stronger overexcitabilities ($M=3.56, SD=0.48$) than students ($M=3.28, SD=0.56$), ($t(350) = 0.851, p<0.001, R^2=0.063$) and scored marginally significantly higher on the sensitivity questionnaire ($M=3.60, SD=0.53$) than students ($M=3.48, SD=0.56$), ($t(348) = 0.922, p=0.053, R^2=0.011$).

Finally, intellectually gifted individuals exhibited stronger outer overexcitabilities ($M=3.99, SD=3.64$), compared to the control group ($M=3.64, SD=3.64$), ($t(249) = 3.782, p<0.001, R^2=0.039$), as well as inner overexcitabilities ($M=3.01, SD=.74$), than the control group ($M=2.83$), ($t(350) = 2.005, p=0.046, R^2=0.012$). The hypothesis was thus supported. Means for the individual subscales, corrected for multiple testing, are depicted in Table 2. Appendix G shows a comparison of the over excitability subscales with the norm population.

Hypothesis 2: The second hypothesis if gifted individuals with strong overexcitabilities exhibit a poorer mental health status than their peers was evaluated by conducting four independent T-comparing strong *versus* weak overexcitabilities and sensitivities, divided according to a median split of the overall sample. Table 3 displays the frequencies for both groups regarding strong *versus* weak overexcitabilities and strong *versus* weak sensitivities. Strong overexcitabilities and strong sensitivities were primarily found in the

giftedness group, whereas the average intelligent individuals scored lower on both overexcitabilities and sensitivities.

Table 4 illustrates the results of the four independent T-tests. Highly gifted individuals with strong overexcitabilities and sensitivities tended to exhibit more symptoms of mental illness, but there was no such difference regarding mental health. No differences were found for strong *versus* weak overexcitabilities and sensitivities regarding mental health and illness in average intelligent individuals. As Figure 4 illustrates, the hypothesis that overexcitabilities are primarily associated with a low mental health status of gifted individuals was thus confirmed.

Gifted individuals with strong overexcitabilities were most likely to be categorized as floundering (complete mental illness), whereas those with weak ones were most likely to be categorized as being languishing (incomplete mental health). Students were, irrespective of strength of overexcitabilities, most likely to be categorized as struggling (incomplete mental illness). The frequencies are depicted in Figure 5. Almost every second gifted individual (42.6%) who was unable to channel overexcitabilities was categorized as floundering (complete mental illness) compared to one quarter (28.0%) of the overall giftedness sample.

Hypothesis 3 and Hypothesis 4: Overexcitabilities and Sensitivity were used for the proposed models and were thus deemed as an unlikely solution. The results, including the confidence interval and effect size for each of the four models, are depicted in Table 5. All four mediation models were highly significant with effect sizes ranging from medium

to large. Both mediational hypotheses, as shown in the following, were supported.

Four mediation analyses have been conducted with the Mensa sample. Reversed causal effect models displayed much lower effect sizes than the proposed models and were thus deemed as an unlikely solution.

The four mediation models

Model 1 and 2: The relationship between overexcitabilities, sensitivity and mental illness was mediated by the inability to channel overexcitabilities. As Figure 6 illustrates, the standardized regression coefficients between overexcitabilities, sensitivity and mental illness were significant, as was the coefficient between the inability to channel overexcitabilities and mental illness. The bootstrapped standardized indirect effects did not include zero in either models (Model 1: $\beta=0.62$; (0.12; 0.29)) (Model 2: $\beta=0.65$ (0.16; 0.33)) and was thus significant.

Model 3 and 4: The relation between overexcitabilities, sensitivity and mental health was mediated by the inability to channel overexcitabilities. As Figure 6 illustrates, the standardized regression coefficient between overexcitabilities and mental health was significant, but not the coefficient between sensitivity and mental health. The coefficient between the inability to channel overexcitabilities and mental health was significant. The bootstrapped standardized indirect effects did not include zero (Model 3: $\beta=0.43$; (-0.38, -0.15)) (Model 4: $\beta=0.44$; (-0.44, -0.18)). The indirect effect was thus significant in both models.

Table 2. Differences between gifted individuals and average-intelligent individuals.

Characteristic	Total	Highly gifted	Average intelligent	P-value
Mental health (M, SD)	3.91 (0.86)	3.84 (0.92)	4.10 (0.64)	0.011a*
Emotional well-being	4.43 (1.03)	4.36 (1.09)	4.60 (0.82)	0.053b*
Psychological well-being	4.04 (1.05)	4.15 (1.05)	3.74 (1.0)	0.001b*
Social well-being	3.45 (1.15)	3.14 (1.12)	4.22 (0.81)	<0.001b**
Mental illness (M, SD)	1.70 (0.59)	1.66 (0.49)	1.80 (0.52)	0.017a*
Somatisation	1.24 (0.25)	1.21 (0.40)	1.35 (0.47)	0.008b*
Depression	1.77 (0.76)	1.71 (0.73)	1.93 (0.79)	0.017b*
Anxiety	1.72 (0.61)	1.66 (0.58)	1.86(0.65)	0.006b*

Hostility	1.67 (0.63)	1.68 (0.61)	1.64 (0.68)	0.498b
Interpersonal Sensitivity	2.02 (0.83)	1.96 (0.83)	2.18 (0.81)	0.027b*
Overexcitabilities (M, SD)	3.48 (0.50)	3.56 (0.48)	3.28 (0.50)	<0.001a**
Sensual OEs	3.54 (0.77)	3.62 (0.73)	3.32 (0.84)	0.001b*
Psychomotor OEs	3.21 (0.79)	3.22 (0.77)	3.17 (0.83)	0.537b
Imaginational OEs	2.97 (.87)	3.06 (0.84)	2.72 (0.90)	0.001b*
Intellectual OEs	4.16 (0.63)	4.38 (0.48)	3.60 (0.63)	<0.001b**
Emotional OEs	3.44 (0.79)	3.41 (0.84)	3.51 (0.63)	0.262b
Sensitivity(M,SD)	3.50 (0.54)	3.35 (0.50)	3.26 (0.52)	0.053a
Outer Sensitivity	3.89 (0.78)	3.99 (0.77)	3.64 (0.75)	<0.001b**
Inner Sensitivity	2.96 (0.76)	3.01 (0.74)	2.83 (0.80)	0.046b*
Empathetic Sensitivity	3.67 (0.77)	3.69 (0.77)	3.62 (0.76)	0.582b
Emotional Sensitivity	3.18 (0.93)	3.04 (0.92)	3.56 (0.85)	<0.001b**
Openness	4.04 (0.72)	4.15 (0.67)	3.75 (0.77)	<0.001b**
Inability to channel/deal with Overexcitabilities (M, SD)	3.03 (0.75)	3.10 (0.78)	2.87 (0.65)	0.012a*

Note: a= Independent samples t-test; b= ANOVA; OEs= overexcitabilities; Mean values are indicated in the corresponding range to enhance interpretability; ANOVA tests were added to correct for multiple testing; *P<0.05; **p<0.001.

Table 3. Comparison of strong and weak overexcitabilities and sensitivity between the two groups.

	Highly gifted individuals		Average intelligent individuals	
	Overexcitabilities	Sensitivity	Overexcitabilities	Sensitivity
Strong (%)	148 (58.3%)	138 (53.5%)	32 (32.7%)	57 (39.8%)
Weak (%)	106 (41.7%)	118 (46.4%)	66 (67.3%)	39 (58.2%)

Note: Frequencies were computed by a median split of the overall sample.

Table 4. Differences between weak and strong overexcitabilities and sensitivities on mental health and illness.

		Highly gifted individuals		Average intelligent individuals	
		Mental illness (M, SD)	Mental health (M, SD)	Mental illness (M, SD)	Mental health (M, SD)
Overexcitabilities	strong	1.77 (0.53)	3.91 (0.92)	1.77 (0.45)	4.23 (0.75)
	weak	1.50(0.38)	3.73 (0.91)	1.86 (0.64)	4.03 (0.58)
P-value		<.001	0.132	0.504	0.147
Sensitivities	strong	1.76 (0.52)	3.91 (0.90)	1.88 (0.56)	4.16 (0.72)
	weak	1.54 (0.43)	3.75 (0.94)	1.76 (0.49)	4.05 (0.60)
P-value		<0.001	0.159	0.259	0.397

Note: Mental health and illness scores based on strong and weak overexcitabilities, displayed for both groups.

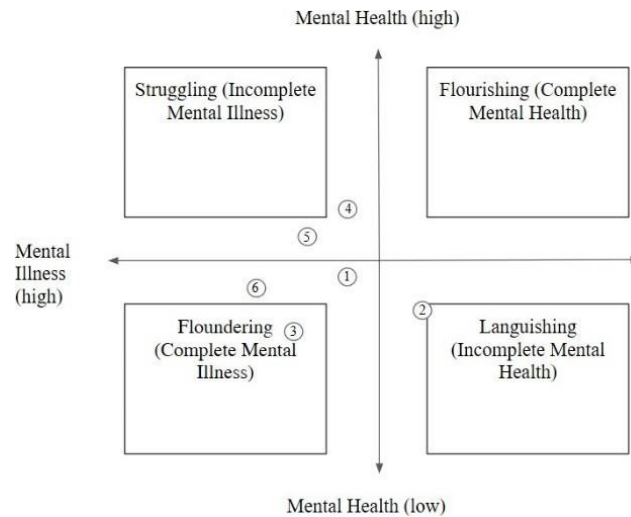


Figure 4. Gifted individuals and students with strong *versus* weak overexcitabilities and an inability to deal with/channel overexcitabilities as categorized in the dual continua model. Cut-off scores are depicted in Appendix D. Note: 1=Highly gifted individuals with strong overexcitabilities; 2=Highly gifted individuals with weak overexcitabilities; 3=Highly gifted individuals who are unable to channel/deal with overexcitabilities; 4=Students with strong overexcitabilities; 5=Students with strong overexcitabilities; 6=Students who are unable to channel/deal with overexcitabilities.



Figure 5. Frequency of flourishing, struggling, languishing and floundering based on (1) overexcitabilities (left side), (2) group (upper right side) and (3) the Inability to channel overexcitabilities (lower right side). Note: () Flourishing; (■) Languishing; (▨) Floundering; (▩) Struggling.

Table 5. Confidence intervals and effect sizes for the four mediational models.

Model	Independent variable	Mediator variable	Dependent variable	Confidence Intervals (CI)	R ²
1	Overexcitabilities	Inability to channel overexcitabilities	Mental Illness	($\beta=0.62^{**}$; (0.12, 29))	0.42
2	Sensitivity	Inability to channel overexcitabilities	Mental Illness	($\beta=0.65^{**}$; (0.16,0.33))	0.41
3	Overexcitabilities	Inability to channel overexcitabilities	Mental Health	($\beta=0.43^{**}$;(-0.38,-0.15))	0.18

4	Sensitivity	Inability to channel overexcitabilities	Mental Health	($\beta=0.44^{**}$; (-0.44,-0.18))	0.17
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Note: * $p<0.05$; ** $p<0.001$; Appendix H shows testing with normal instead of strong overexcitabilities.

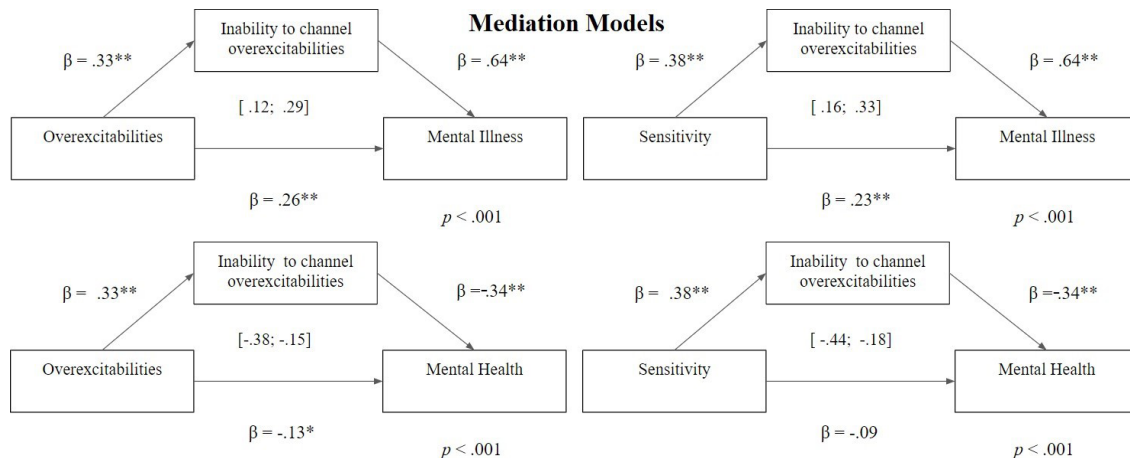


Figure 6. Results of the four Preacher and Hayes mediational analyses.

Discussion

The primary purpose of the current research was to obtain a better understanding of sensitivity and overexcitabilities and its influence on the mental health and illness of highly gifted individuals. Intellectual giftedness is praised as being the strongest predictor for positive outcomes, such as income levels and educational success. However, little is known regarding the difficulties encountered by this group. Specifically, those who are highly gifted demonstrate overexcitabilities in various domains that predispose them to psychological disorders and elevated sensory responses [7,35]. Based on the Parieto-Frontal Integration Theory (P-FIT) by Jung and Haier, Karpinski et al., Hyper Brain-Hyper Body framework and Gere's Theory of Sensory Modulation and Integration, four hypotheses were proposed: (1) Gifted individuals exhibit stronger overexcitabilities than average-intelligent individuals, (2) gifted individuals with strong overexcitabilities exhibit a poorer mental health status than their peers and (3) as well as (4) that the inability to deal with overexcitabilities mediates the relation between strong overexcitabilities, mental illness and mental health [7,16]. All hypotheses were supported. All mediation models reached medium to large effect sizes and suggest that sensitivity and overexcitabilities are highly similar constructs. Finally, factor analyses yielded support for one underlying factor as the most likely solution.

Hypothesis 1

In line with the first hypothesis, highly gifted individuals exhibited, on average, stronger overexcitabilities and (inner and outer) sensitivities compared to average-intelligent individuals. When looking at the frequencies of overall overexcitabilities and sensitivities, the majority of gifted individuals were primarily found to be highly over excitable (58.3%) and sensitive (53.5%), while highly over excitable (32.7%) and sensitive (39.8%) individuals constituted only the minority in the control group. Except for psychomotor and emotional overexcitabilities, gifted individuals were more likely to display sensual, imagination and intellectual overexcitabilities. This is congruent with the meta-analysis conducted by Winkler and Voight who found that highly gifted individuals were likely to display stronger overall overexcitabilities and to reach higher mean values for the subscales of intellectual, imaginal, and sensual overexcitabilities [75]. However, the study reported also higher mean values of emotional overexcitabilities, which was not supported by the current research.

A potential explanation for the difference between the findings of the current research and the meta-analysis by Winkler and Voight regarding emotional overexcitabilities is that the control group consisted of a selective sample of psychology students [75]. E.g., it was found that psychology

students possess unique emotional characteristics which may decrease the comparability with highly gifted individuals regarding emotional overexcitabilities [76,77].

In order to increase the external validity of this thesis, mean values of the normal population of the individual over excitability subscales by Rost et al., were used to compare gifted individuals and students with respect to the normal population (Appendix G) [21]. Piechowski promulgated that at least one domain of over excitability must be prevalent to support Dabrowski's notion that overexcitabilities are prevalent in highly gifted individuals [78]. In the current thesis, 87.8% and 61.8% of the giftedness sample scored more than one standard deviation higher on the intellectual and sensual over excitability subscale compared to the normal population, respectively, whereas this was the case for none of the subscales for the student population. The results are in line with Alias, Rahman, Majid and Yassin who reported that 88% of gifted children of their study had at least one type of overexcitabilities [79].

The heightened scores of gifted individuals on the sensual over-excitability subscale, the outer sensitivity subscale and on the inability to channel/deal with overexcitabilities are consistent with previous research. That is, the P-FIT [16,17]. Tetreault predicted, based on the convergence and increased white matter tracks between parietal association cortices and frontal lobes, that gifted individuals exhibit a rapid sensory [18]. Processing, this may lead to sensory discomfort and emotional response [18]. Sensual overexcitabilities allow an individual to have a far more expansive experience, to perceive reality in greater depth [80] as manifested in heightened awareness of all senses of sight, touch, taste and hearing [80,81]. This may lead to ease of overstimulation and sensory discomfort and thus aligns with the overall theme of this thesis and the enhanced outer perception of gifted individuals [80].

The heightened scores of highly gifted individuals on the inner sensitivity and intellectual and imaginal over excitability subscales are presumed to result from the enhanced brain connectivity, as predicted by the P-FIT [18]. Further, high scores on these scales were associated with typical characteristics of the highly gifted, such as an increased activity of the mind, an increased capacities for sustained intellectual effort, detailed visual recall, detailed

planning, concentration, avid reading, thirst for knowledge, curiosity, keen observation, search for understanding and truth, the forming of new concepts, passion for precision, tenacity in problem-solving and reflective thought, such as love of theory and analyses, thinking about thought, preoccupation with logic, introspection without judgement, critical thinking and intuitive and conceptual integration [28,80].

Hypothesis 2

Mental health: Heightened sensitivity is assumed to influence the sensory experience to such an extent that typical and benign sensory inputs are experienced as unpleasant, subsequently resulting in defensive responses and Withdrawal. Gere argued that this amplified reaction towards incoming stimuli leads to sensory discomfort and subsequent peculiarity in emotional and behavioral response, increasing thereby psychosocial and emotional problems and reducing the mental health [35]. Contrary to Gere and Bar-Shality et al., this thesis found no overall discernable effect of varying levels of overexcitabilities on mental health in average intelligent and highly gifted individuals [35,44].

However, it was found that highly gifted individuals scored lower on mental health than average intelligent individuals. Although highly gifted individuals scored lower on mental health, it could be discarded that this difference resulted from diverging levels of overexcitabilities because highly gifted individuals with strong *versus* weak overexcitabilities scored equally low on mental health, which was supported by the insignificant correlation between overexcitabilities in gifted individuals and their mental health. Another more likely explanation accounting for the reduced mental health of gifted individuals was proposed by Glaw et al., who argued that highly gifted individuals exhibit low levels of positive mental health because they find it hard to find meaning in life, which is critical for successful human functioning, happiness, well-being, psychosocial health and a positive development [82-87].

Mental illness: Average intelligent individuals exhibited more symptoms of mental illness compared to highly gifted individuals. However, after closer inspection, it was revealed that the Likert scale of the official German version of the BSI differs from the English version [66]. The differences are displayed in Appendix I. Although

not noticed directly by the author, the same bias can be found in the validation of the German version. From the gifted individuals, 96.8% completed the German version of the survey, which was only the case for 22.4% of the average intelligent individuals. The differences in mental illness between both groups might thus be attributable to the differences between the two language scales.

Highly gifted individuals with strong overexcitabilities scored higher on mental illness than those with weak overexcitabilities. This finding is important to note because it indicates, as a priori hypothesized, that strong overexcitabilities and sensitivities predispose especially gifted individuals towards mental illness. The Columbus Group (1991) noted that the intensities of gifted individuals interact with the heightened cognitive capacity, making them thus especially vulnerable. Roedell asserted that this vulnerability will increase with intellectual advancement [88]. The Hyper Brain-Hyper Body framework promulgated further that there is a nonlinear relationship between intelligence and mental illness that is caused by overexcitabilities [7]. While the difference between gifted individuals and average intelligent individuals regarding mental illness thus likely stems from the differing Likert-scales of the BSI and the lower scale response of gifted individuals, this thesis can support the notion, in line with and the Columbus Group (1991), that overexcitabilities specific to gifted individuals put these particularly at risk for mental illness [7].

Dual continua model: In line with the second hypothesis, highly gifted individuals with strong overexcitabilities exhibited thus the poorest mental health status (floundering: high mental illness, low mental health), followed by those with weak ones (languishing: low mental illness, low mental health) and average intelligent individuals with strong and weak overexcitabilities (Struggling: High mental illness, high mental health). When considering the frequencies of those who are flourishing or floundering when categorized in the Dual Continua Model, it was found that gifted individuals with strong overexcitabilities were less likely to flourish (37.84%) compared to average intelligent individuals with strong overexcitabilities (46.88%). Reversely, gifted individuals with strong overexcitabilities were more likely to be categorized as floundering (33.11%) compared to average intelligent individuals with strong overexcitabilities (21.88%). Strong overexcitabilities in average intelligent individuals were thus associated with higher levels of well-

being, quality of life, relationships, meaningful purpose and engagement (University of Alabama, 2013). Contrary, strong overexcitabilities in gifted individuals were associated with low positive functioning and emotional well-being [68]. In conclusion, the mental health of gifted individuals was lower than that of average-intelligent individuals and was not associated with their level of over excitability. Mental illness, however, is more prominent in gifted individuals with higher levels of overexcitabilities. While stronger levels of overexcitabilities appeared to have a detrimental outcome in gifted individuals, this trend was reversed in average intelligent individuals. That is, stronger overexcitabilities were (1) not related to mental illness symptoms in average intelligent individuals but were (2) positively related to mental health levels of average intelligent individuals, indicating thus an incremental growth of mental health for them for stronger levels of over excitability. Correspondingly, stronger overexcitabilities were associated with a better mental health status in average intelligent individuals and with a worse in gifted individuals.

Hypothesis 3 and 4

The current research hypothesized-other than the Hyper Body-Hyper Brain framework-that the mental health and illness of gifted individuals is more the result of extent of processing problems (i.e., sensory modulation and integration), in combination with overexcitabilities, than of overexcitabilities alone [7]. Indeed, it was found that the inability to deal with/channel overexcitabilities-or equivalently processing problems-mediated the relation between strong overexcitabilities, mental health and illness. All regression coefficients were in the hypothesized direction. As expected, both strong overexcitabilities and stronger inability to channel/deal with overexcitabilities were thus associated with higher levels of mental illness and lower levels of mental health in gifted individuals, respectively.

The results are consistent with previous literature. That is, the heightened sensitivity towards light, sound, smell or texture (or in Dabrowski's terms, strong overexcitabilities) can be either associated with Sensory Integration Dysfunction as a source of mental illness such as ADHD, depression, bipolar disorder, anxiety disorder and ASD or may act as a capacity and predictor for a life full of passion, success, engagement, self-fulfillment and innovation [31,89,90]. In

the first case, Hinterberger et al., suggested that processing problems may result in mental illness and impairments, such as mental overload, stress, anxiety disorders [71]. This finding aligns well with Gere's conception of processing problem as a predictor for emotional disturbances in gifted individuals and the positive correlation between processing problems and mental illness found in the current research [35]. In the second case, strong overexcitabilities may be even conducive to the mental health.

That is, the ability of a highly gifted individual to channel overexcitabilities in such a way that he or she is not becoming overstimulated, may be conducive to his or her mental health because overexcitabilities are not inherently a defect and can even feed, empower, enrich and amplify an individual's potential towards success and innovation [89,90]. E.g., Konrad found recently that highly sensitive individuals were only vulnerable to develop a mental illness when they exhibited concurrently processing problems [91]. A tentative support for this theory can be provided the current research-at least for the average intelligent individuals-as they scored lower on problems and seemed to even benefit from strong overexcitabilities.

Overexcitabilities, sensitivity, processing problems

During the literature review, it became not clear how overexcitabilities and sensitivity are related to each other. Dabrowski and Piechoswki uses both terms frequently interchangeably for each other, making it thus hard to differentiate both concepts from each other [32,33,81,92]. Usually, overexcitabilities are described as a "lens through which to view the gifted" and this trend continues in contemporary giftedness research (e.g., see Wageningen University, n.d.). Sensitivity-or the highly sensitivity person, is not reserved for highly gifted individuals and has been introduced to a broader audience by Aron and Aron [27,34]. The validation of all four mediation models for both overexcitabilities and sensitivities, and the factor analyses that yielded one underlying factor as the most likely solution, indicate that both constructs are highly similar. This would suggest that the terms sensitivity and overexcitabilities may be used interchangeable-at least in the future, but for now, more research is required to either demarcate both constructs or to conclude that both constructs have essentially the same underlying factor or overlap to a large extent. What has been shown

in the recent past is, however, that sensitivities and processing problems are strongly related, but clearly distinct constructs [71]. For now, it is too early and beyond the scope of this thesis to make further statements regarding the relationship between overexcitabilities, sensitivity, and processing problems other than stating that all three constructs often accompany each other at least in the current study for gifted individuals.

Strengths

This thesis enjoyed several strengths, such as reliable confirmation that participants fell in highly giftedness range (to be admitted at Mensa, participants must score two standard deviations above the mean on an IQ test and the tests are administered by a psychologist). Karpinski et al., argued that Mensa participants from any country are representative of those with high cognitive abilities [7]. The findings of this study can be thus assumed to be a reasonable proxy for those who are highly gifted. Furthermore, Karpinski et al., argue that most studies examining the relation between IQ and mental disorders include only standard deviation above or below the mean, falling short of incorporating individuals with a very superior intelligence (130 and above or at or above the 98th percentile) [7]. Most studies report an increased risk for negative mental health outcomes in lower IQ and a reduced risk for each increase in standard deviation, assuming thus a linear trend continuing upwards [7]. This is relevant to note since without including individuals scoring in uppermost intelligence percentiles (at least two standard deviations above the mean or higher) as this study did results with respect to mental health cannot be generalized to gifted individuals as most researchers fall short in discovering curvilinear relationships. A further major strength of the current study is that a mental health and illness were separated, which allowed employing a multidimensional measurement of the mental health status. This approach is innovative because the traditional approach of scientific studies to focus exclusively on mental health or illness has become obsolete as there is increasingly more evidence that mental health and illness are two related, but distinct dimensions [60]. Specifically, it was found that both groups exhibited similar frequencies with respect to those who are flourishing and floundering (the other two categories cannot be effectively compared as there is no consensus whether struggling or languishing is worse: which drastically changed when strong overexcitabilities was taken into consideration [60]. In this way, this

thesis provided a (1) valuable explanation under which circumstances highly gifted individuals may be flourishing or floundering and (2) a viable mechanism (i.e., the inability to channel or to deal with overexcitabilities) which can reconcile the dispute in science over the contribution of giftedness on an individual's mental health status. Further strengths include the usage of validated questionnaires, the large sample size employed and finally the statistical power, which was even enhanced by the bootstrapping procedure.

Limitations

Several limitations should be beard in mind before strong conclusions may be drawn. Some limitations regard the external validity of the findings. Firstly, hypothesis 2 was evaluated by considering results of the gifted and student sample separately because participants who took the German version of the BSI, irrespective of the group, scored significantly lower compared to the English version (Appendix I). Correspondingly, the results must be replicated in the future with a corrected BSI scale. Although it was later shown, in line with the hypothesis, that giftedness with strong overexcitabilities was associated with the poorest outcome (floundering), it can be assumed that the difference between this group and the others would be even larger. Secondly, the control group encompassed a homogenous group of psychology students, which did not match the Mensa sample regarding age, sex, education and language, limiting thus the comparability between both groups. Similarly, it has become increasingly acknowledged that college students suffer from high levels of anxiety and depression [93,94]. For this reason, students with study-induced mental illnesses were excluded from the analyses, which may limit comparability with the Mensa sample as they were not screened for stress-induced disorders. Future studies may match characteristics of both groups more carefully. Thirdly, nine participants failed one or more of the trick questions whose responses were not deleted as the advantages (greater effect size, greater number of participants, otherwise consistent responses, confirmation of honest responding of all participants and insignificant correlation between trick questions and the other variables) of retaining them were, after careful weighting and inspection of each case, estimated to be greater than the disadvantages. Thus, it cannot be assured that all responses were completely credible.

Finally, another limitation seems to apply to positive psychological approaches (of which the Dual Continua Model is part of) in general as that there seems to be no standard in calculating the four categories of flourishing, languishing, struggling and floundering. E.g., while Teng et al., relied on principles of exclusion, others rely on cut-off scores [59,63]. This study followed the approach by Westerhof and Keyes to preclude individuals with a BSI score of 1.7 (in the paper 0.7 because of their Likert scale) from flourishing and languishing [60]. Finally, there are currently no existing measures of the ability to deal with/channel overexcitabilities. Correspondingly, any indirect inferences in this regard are drawn based on low levels of the inability to deal with/channel overexcitabilities and replications with the direct measure are needed to establish its significance in gifted individuals. Despite these limitations, this thesis provides a valuable extension for giftedness research.

Clinical implications

Since as many as 35% of highly gifted individuals experience symptoms of sensory processing disorder, the most extreme form of processing problems, this thesis highlights the paramount role interventions can potentially provide to improve the mental health status of highly gifted individuals [95]. The low effect sizes of therapies based on sensory processing problems may be owed to the fact that they do not acknowledge the universal and prevailing impact that sensitivity and overexcitabilities have on all life domains of many highly gifted individuals, as “Effective counseling for the gifted requires a therapeutic orientation that strives to help a client integrate all aspects of his being”. Although sensory desensitization or a sensory diet may prove to be effective and may streamline the self-education process of gifted individuals, a combination with therapeutic approaches based on the needs of highly gifted individuals, such as those emphasizing the prevailing and ubiquitous role of overexcitabilities in the developmental path of gifted individuals, seem to be most promising in helping them to deal with/channel overexcitabilities [62].

Future intervention-based research may show whether approaches based on the Theory of Positive Disintegration (TOPD) (although not explicitly discussed in the text: Prove to be effective in applied contexts [96]. Some single case studies (for an excerpt: Shavinina), already

showed promising results for all life domains of gifted individuals [97]. Therapeutic approaches based on the TOPD treat overexcitabilities indirectly. That is, overexcitabilities are not regarded as maladaptive, but as elementally to the higher development and personal growth of highly gifted individuals. One strategy is to teach gifted individuals to embrace the profound emotional intensity, the depth and imaginal qualities resulting from sensory sensitivity as a necessary part of deeper understanding and to regard overexcitabilities not as a weakness, but as a strength that needs to be fostered [98]. Gifted individuals are encouraged to activate and express inner impulses, insights and drives in their most natural form of expression, such as art. In this way, gifted individuals learn to channel-rather than to suppress-overexcitabilities in an adaptive form that fosters personal growth and mental health. Therapeutic approaches based on the TOPD can be thus regarded as curative, contrasting with the traditional palliative approach in mental health care. The TOPD is currently the only existing approach that explains the psychological development and the emotional and affective response based on overexcitabilities. Jackson et al., argued that current therapeutic work is unsatisfactory and that while perhaps effective for the typical client, it-more often than not-fails the complexity of the highly gifted client.

Conclusion

The current research strongly supports the notion that overexcitabilities and sensitivities are more the rule than exception in gifted individuals. Strong overexcitabilities and sensitivities increased mental illness symptoms in highly gifted individuals decreased their mental health and thus their mental health status when categorized in the Dual Continua Model. This trend was reversed in average intelligent individuals. Furthermore, the current research established a mediational effect of the inability to deal with/channel overexcitabilities in gifted individuals in the form of processing problems on the relation between strong overexcitabilities and mental health and illness. Whether strong overexcitabilities result in higher levels of mental illness or lower levels of mental health depends thus largely on a gifted individual's inability to deal with/channel overexcitabilities. The inability to deal with/channel overexcitabilities can thus explain varying levels of mental health and illness and is a major indicator in determining the influence of

strong overexcitabilities on the mental health and illness of highly gifted individuals.

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