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New Insights of Impairments and Disorders Associated to Seasonal Affective Disorder.

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Abstract
SAD is a subtype of MDD, in which symptoms appear in autumn and winter, but disappear in spring and summer. It is thought that a shortage of light causes the symptoms of SAD. While SAD is a well-known disorder and some therapies inhibit the symptoms, no cure has been found yet due to its complexity. Apart from the common symptoms of SAD, other studies have found seasonal differences in their results. This means that SAD may potentially cause these differences and have more impairments than currently known. This review will be looking at what impairments and disorders are correlated with SAD. It is found, with 5 articles of the 3 past years (2017-2019) that cognitive impairments, self-perceived personality, SPS, alcohol abuse and OCD all have an association with SAD.

Cognitive impairments are not only found during winter, but are also present during summer in individuals with SAD. Furthermore, a correlation between cognitive impairments and the severity of depression is also found. A higher neuroticism in summer was found to be correlated with a more severe depression during winter. Neuroticism also increases from summer to winter, where extraversion decreases from summer to winter. SPS is higher in individuals with SAD and are more frequently high trait SPS. SPS increases from summer to winter in individuals with SAD and a higher SPS in the summer is correlated with a more severe depression in the winter. Alcohol abuse and SAD have a correlation with each other, as well as cognitive impairment and SAD. Individuals with SAD more often have a history with alcohol abuse and have a worse short-term memory. Individuals with AUD and ADD show some SAD-like symptoms. OCD is more frequently found in individuals with SAD. Individuals with OCD showed more compulsions and a more severe depression in winter.

Multiple impairments are found with SAD. While the most severe symptoms and impairments are found during winter, symptoms can also be found during summer. These summer impairments could be used to find potential individuals with SAD.

Keywords Seasonal affective disorder, review, impairments, comorbidity, cognitive impairment, sensory processing sensitivity, alcohol abuse, OCD

Glossary Seasonal affective disorder (SAD); Major depressive disorder (MDD); Sensory processing sensitivity (SPS); Obsessive-Compulsive Disorder (OCD); Yale-Brown Obsession and Compulsion Scale (Y-BOCS); Seasonal Pattern Affective Questionnaire (SPAQ); Global Seasonality Score (GSS); Structured Interview Guide for the Hamilton Rating Scale for Depression-Seasonal Affective Disorder (SIGH-SAD); Major Depressive Inventory (MDI); Highly Sensitive Person (HSP); Alcohol use disorder (AUD); The World Health Organization Composite International Diagnostic Interview (M-CIDI); alcohol dependence disorder (ADD); mini-mental state examination (MMSE); Rey Auditory Verbal Learning Test (RAVLT); Hamilton Depression Rating Scale-17 (HDRS-17); Beck Anxiety Inventory (BAI);

Introduction

Seasonal affective disorder (SAD) is a subtype of major depressive disorder (MDD). The most common type of SAD is winter SAD, beginning in autumn and continuing in the winter, with a full remission in the spring and summer. Symptoms that are known with SAD could be, but are not limited to, increased duration of sleep, increased appetite, bodyweight gain, carbohydrate craving and loss of energy

(Rosenthal, 1993). These symptoms may be influenced by low levels of light (Espiritu, 1994). Less daylight is available in winter, which could explain why SAD occurs in the winter. Currently there is no cure for SAD. However, there are ways to inhibit the symptoms of SAD. According to a study on hospital treatment of SAD, 84% of hospitals recommended treatment against SAD of any kind. Possible treatments that were recommended were lifestyle changes, psychotherapy, light therapy and antidepressants (Nussbaumer-Streit, 2017).

While the former named symptoms are quite common and known, there may be other impairments and disorders that show a connection with SAD, but are less frequent or harder to spot, yet may be critical to understanding SAD and curing it.

Studies have found that cognitive abilities are impaired by people with SAD (Jensen, 2015; Drake, 1996). These studies found that cognitive tasks such as pattern recognition and verbal memory tests are done significantly worse during autumn and winter compared to healthy individuals. What is currently unknown is whether these cognitive impairments are only observed in autumn and winter, or if they remain in spring and summer. It is important to know whether cognitive impairments can be found throughout the year to gain more insight of the disorder and find ways to cure it.

Currently, it is unknown what effect SAD has on the self-perceived personality characteristics. While many studies look for a cause for SAD in light levels and molecular expression, self-perceived personality characteristics may also play a part in the depression experienced by people with SAD. That is why it is of importance whether there is a difference to be found between individuals with SAD and healthy individuals. By doing knowing this, it may be possible to counteract the symptoms.

Sensory information may be processed differently by different individuals. The sensory processing sensitivity (SPS) is how sensitive an individual is to stimulation around them. It is hypothesized that high trait SPS may lead to a greater risk of SAD (Murray, 2002). This is due to individuals that are sensitive to stimulation, will be overwhelmed by their surroundings, causing stress. High trait SPS seems to share a link between symptoms like anxiety, depression and stress (Liss, 2008). However, it has not been studied whether and how individuals with SAD experience SPS. If SPS and SAD share a common link, it may explain why individuals with SAD experience certain symptoms.

It is found in a study on MDD that individuals suffering with MDD are more prone to developing substance abuse than healthy individuals (Melartin, 2002). On top of that, Sher (2002) found that there is seasonality found in alcohol abuse. One could imply that SAD may have an influence on alcohol abuse as well. Taking into consideration that carbohydrate craving may enhance alcohol abuse even further, it seems possible that SAD and alcohol abuse share a link.

OCD shares a high comorbidity with many mood disorders such as MDD and bipolar disorder (Ruscio, 2010). It was found in a study that the Yale-Brown Obsession and Compulsion Scale (Y-BOCS) showed seasonal variation in score (Brewerton and Ballenger 1992). Since SAD is a subtype of MDD, it has been suggested that OCD might also share a link with SAD.

Research question

This review will be looking at impairments and disorders that have been found in the last 3 years (2017-2019), which are thought to be associated with SAD. Apart from the known symptoms discussed in the introduction, other impairments were found that could have an association with SAD and may influence the health of individuals. The question that will be answered in this review is: “What are the new insights on symptoms and impairments associated with seasonal affective disorder?” The association of SAD and cognitive ability, self-perceived personality, SPS, alcoholism and OCD will be looked at in this review.

Literature research

Cognitive ability in remission

In the study of Hjordt (2017) in Denmark, they found that the cognitive ability of individuals with SAD is not only impaired in the autumn and winter months, but is also found in the spring and summer. For their study, they collected volunteers between age 18 and 45, through internet and newspaper advertisement. Two

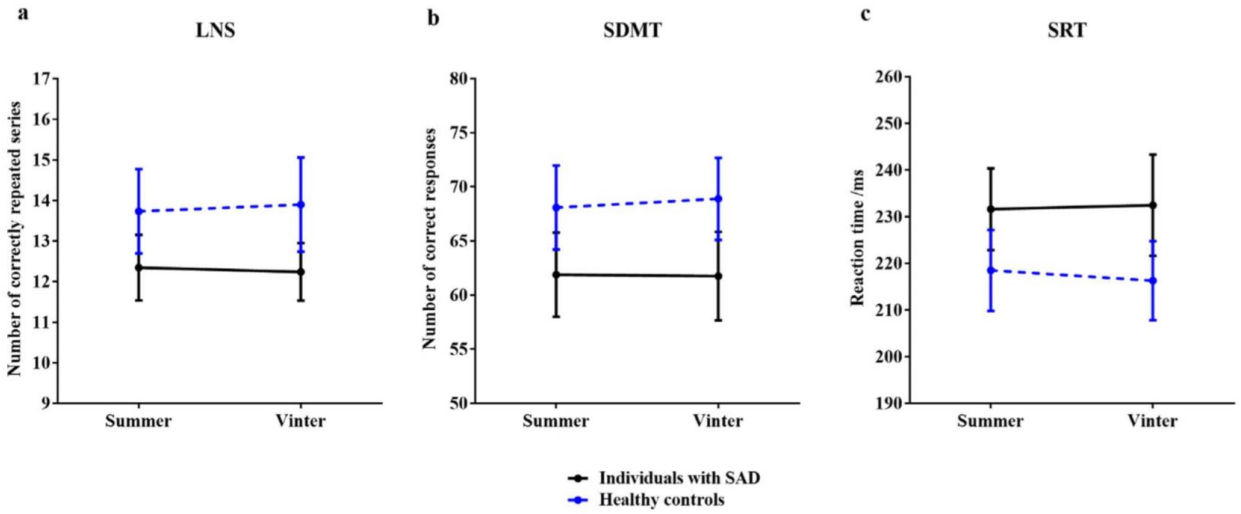

Fig. 1 The cognitive test scores of individuals with SAD and healthy controls in the summer and winter; (a) working memory test - sequencing of letters and numbers, (b) cognitive processing speed – translating symbols, (c) reaction time. (Hjordt, 2017).

groups were formed: an SAD group, existing of 29 individuals diagnosed with SAD and a control group, existing of 30 healthy individuals. The groups were checked for substance abuse and the SAD group was not allowed to have used any drug or light treatment in the past year.
The participants were asked to do a Seasonal Pattern Affective Questionnaire (SPAQ) in which the healthy group was required a Global Seasonality Score (GSS) of <10 and the SAD group a GSS of >11. For symptom severity, the Structured Interview Guide for the Hamilton Rating Scale for Depression-Seasonal Affective Disorder (SIGH-SAD) was done by participants. A SIGH-SAD score of <8 defines remission of depression.
The participants were given cognitive tests twice: In summer, from May to July, and in winter, from November to February with an interval of 4,5 to 6,0 months.
Three separate tests were used. The first test is a working memory test, in which participants heard a mixture of numbers and letters and had to order them. The second test is a cognitive processing speed test, in which participants had to translate a list of unfamiliar symbols into numbers. The third test is a motor speed test, in which the participant had to press a button as quickly as possible once a que displayed on screen.

For their results, they found that every individual of the SAD group showed increased SIGH-SAD scores in the winter, and also showed full remission of depression in the summer. No difference was found between SIGH-SAD scores of the control group between summer and winter.
The results of the cognitive tests (Fig. 1) showed that the SAD group recited fewer series of items in the working memory test, translated fewer correct symbols in the cognitive processing speed test and had a higher latency response in the motor speed test compared to the controls in summer and winter.
Furthermore, it was found that the cognitive processing speed test score was negatively correlated with change in depressive symptoms. No correlation was found between depressive symptoms and the working memory test.

To conclude the results of this study, they found that, independent of the season, the SAD group showed worse scores on the working memory test, cognitive processing speed test and motor speed test compared to the control group. The authors claim that these impairments are trait-like characteristics of SAD, which separates individuals prone to winter depression to individuals with SAD.
On top of that, they also found an association between the impairments of cognitive processing speed with the seasonal change in depressive symptom severity. The authors claim that the cognitive processing speed may not be affected by the degree of depression, but rather the other way around. It may be possible that the degree of impaired cognitive processing influences the seasonal change of depressive symptoms in the winter.

Self-perceived personality characteristics
In another study of Hjordt (2018) in Denmark, they found a difference in neuroticism and extraversion in individuals with SAD in winter compared to healthy individuals. They also found that neuroticism in summer of individuals with SAD is correlated with depression in winter. In the study, they collected volunteers between age 18 and 45, through internet and newspaper advertisement. Two groups were formed: an SAD group, existing of 29 individuals diagnosed with SAD and a control group, existing of 30 healthy individuals. Any participant with other significant illnesses or addiction were excluded from the study. The SAD group was not allowed to have used any drug or light treatment in the past year. The participants were asked to do a SPAQ in which the healthy group was required a GSS of <10 and the SAD group a GSS of >11.
To test the self-perceived personality, the participants did the NEO PI-R questionnaire in both summer and winter. The NEO PI-R exists out of five major personality traits: neuroticism, extraversion, openness, agreeableness, and conscientiousness. Each of these traits exist out of 6 sub-traits.
To test recent depressive symptoms of the last two weeks, a Major Depression Inventory (MDI) was done both in summer and winter.

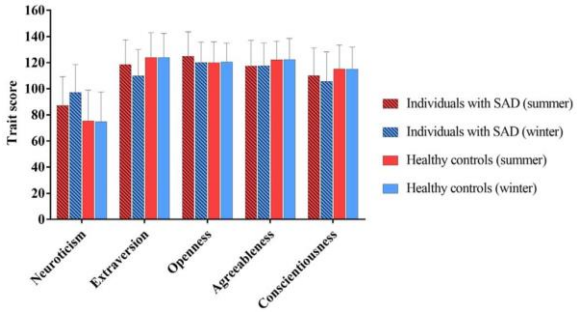

Fig. 2 Personality characteristic scores of individuals with SAD and healthy controls in summer and winter (Hjordt, 2018).

Their results show that the MDI score of the individuals with SAD was significantly higher in winter compared with summer. MDI of the controls showed no difference between seasons. Significance was found for a higher neuroticism for individuals with SAD in the winter compared to the control group (Fig. 2). For the sub-traits, anxiety, anger, hostility, depression and vulnerability were higher. No significance was found in summer between the SAD group and controls.

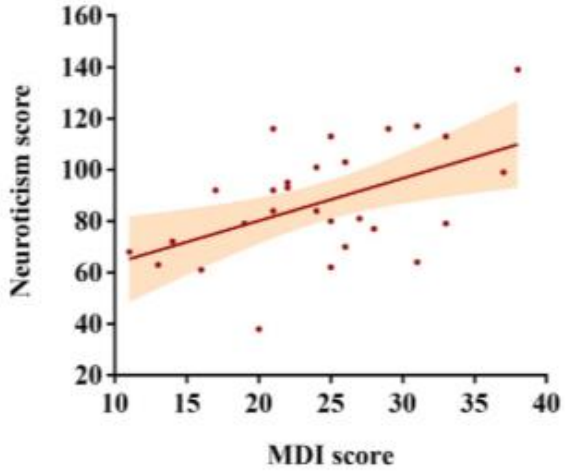

Fig. 3 The correlation between neuroticism score and MDI score (Hjordt, 2018)

It was also found that the seasonal change for neuroticism was significantly different for individuals with SAD compared to controls. The neuroticism was significantly increased from summer to winter for individuals with SAD while the control group remained stable.
Significance was also found for a lower extraversion for individuals with SAD in winter compared to the control group (Fig 2.). For the sub-traits, positive emotions and warmth were lower. There was no significance found in summer between the SAD group and controls. They also found that the seasonal change for extraversion was significantly different for individuals with SAD compared to controls. The extraversion was significantly decreased summer to winter for individuals with SAD while the control group remained stable.
No other significance was found for openness, agreeableness and conscientiousness.
Finally, a correlation was found between individuals with higher scores on neuroticism in the summer and a higher MDI score in the winter (Fig. 3). This correlation was not found in the control group.

Concluding the results, Individuals with SAD showed a significant increase in neuroticism from summer to winter. The authors claim that the increasing negative attitudes towards winter could lead to the increase of depressive episodes in individuals with SAD.
It was also found that individuals with SAD showed a significant decrease in extraversion from summer to winter. This decrease in extraversion may lead to an increase of depressive episodes in SAD, due to less positive

feelings.
It was also found that individuals with SAD appear to have a more severe depression during the winter when there is a higher neuroticism found in the summer. The authors claim that it could be an option to target neuroticism in psychotherapy. A reduction in neuroticism may lead to a less severe depression during winter.

Sensory Processing Sensitivity
It was found in the study of Hjordt (2019) in Denmark that individuals with SAD have a higher risk of high trait SPS than a healthy individual. In their study, they looked at the association between SPS and SAD and the differences between summer and winter.
They collected volunteers between age 18 and 45, through internet and newspaper advertisement. Two groups were formed: an SAD group, existing of 31 individuals diagnosed with SAD and a control group, existing of 30 healthy individuals. Any participant with other significant illnesses or addiction were excluded from the study. The SAD group was not allowed to have used any drug or light treatment in the past year.
Both groups did a Highly Sensitive Person (HSP) test and a MDI test both in winter and summer.
The HSP test is a questionnaire in which 27 questions can be answered on a scale from 1- strongly disagree to 7 - strongly agree on questions regarding sensitivity.
In the HSP test, not only gave it a scale of the sensitivity of an individual, but also the ease of excitation feeling mentally overwhelmed), low sensory threshold (experience unpleasant arousal) and aesthetic sensitivity (being aware of subtle aesthetics).
In the MDI test the participants had to fill in a questionnaire to find whether they had depressive symptoms in the last two weeks.

In their results, they found a significant group difference for SPS in both summer and winter. They found that SPS was higher in individuals with SAD, both in summer and winter, compared to the healthy individuals. They also found that the ease of excitation, low sensory threshold and aesthetic sensitivity was higher in individuals with SAD, both in summer and winter, compared to healthy individuals.
SPS also seemed to increase from summer to winter in individuals with SAD, while healthy individuals did not differ between seasons.
Using three different intensity groups of SPS,

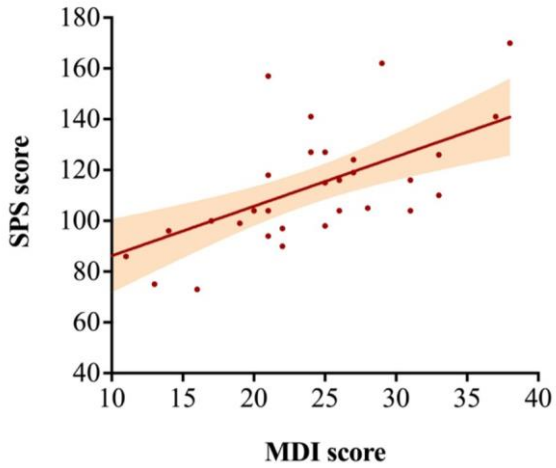

Fig. 4 The correlation between sensory processing sensitivity in summer and MDI in winter (Hjordt, 2019).

low sensitivity (SPS score < 3,71), medium (SPS score 3,71 – 4,66) sensitivity and high sensitivity (SPS score > 4,66), they found that 25% of the individuals

with SAD showed a high sensitivity while only 5% of the healthy individuals showed a high sensitivity.
Furthermore, a correlation was found between MDI and SPS (Fig. 4). They found that for individuals with SAD, a higher score of SPS in the summer resulted in a higher MDI score in the winter. This correlation was not found in healthy individuals.

To conclude the study, it is found that SPS is higher in individuals with SAD, and that high trait SPS is more frequent in individuals with SAD than healthy controls.
An association was found with high trait SPS in the summer and more severe SAD in the winter. The authors claim that high trait SPS causes vulnerability for SAD, which leads to a more severe depression in the winter. This could be explained by individuals with high SPS being more overwhelmed, which leads to more stress, thus leading to more severe SAD.
The authors claim that we could use high trait SPS as a marker to find individuals with SAD during the summer through high sensitivity. It may also be possible to reduce SAD in winter by reducing the stress and feeling of being overwhelmed for individuals with SAD and SPS.
Finally, an increase in SPS is found from summer to winter. The authors claim that due to the seasonal change, such as darker days and leaves turning brown, the brain triggers a

mechanism. This shift in the brain causes more attention to their environment, thus causing more feelings of being overwhelmed, which leads to feeling more stressed and thus causing depression.

Alcohol use disorder

In a study on SAD and alcohol use disorder (AUD) in Finland, Morales-Muñoz (2017) found a strong correlation between SAD and AUD in a large sample population test, as well as a correlation between SAD and short-term memory problems.

For their study, they collected 5903 participants of which 4554 participants, age 18 to 97, did a diagnose interview for mental disorders and were included to the study.

The World Health Organization Composite International Diagnostic Interview (M-CIDI) is used for measuring mental disorders. In this study, the M-CIDI was only focused on the part on alcohol abuse. Topics such as alcohol abuse during lifetime, alcohol dependence disorder (ADD) during lifetime and past 12 months, AUD during lifetime and past 12 months and alcohol abuse of the past 12 months were taken into consideration.

SPAQ was used to test SAD in participants. A GSS score of >11 indicated SAD to a degree in an individual, while <10 indicated a healthy individual. In the SPAQ test, the topics seasonal changes in sleep duration, social activity, energy level, mood, appetite and weight were tested.

The mini-mental state examination (MMSE) is a questionnaire that measures cognitive impairment. This test has 30 questions that was used to cover functions such as registration, attention, calculation, recall, language, ability to follow commands and orientation.

Participants also had to do a category verbal fluency test. In this test, participants had to name as many animals as possible in one minute.

The Rey Auditory Verbal Learning Test (RAVLT) is a test in which participants are given a list of 15 unrelated words. These words have to be repeated over five different trials. After that, the participants get a new list of 15 unrelated words and then again must repeat the 15 words of the original list and after 30 minutes the original list again. In this test only the short-term verbal recall part was taken into consideration.

For the results, a correlation was found between the SPAQ test and M-CIDI. Seasonal changes in sleep duration, social activity, energy level and mood were found to all have at least 3 correlations in every single topic of M-CIDI. No correlations were found in seasonal change in appetite or weight.

Regarding the other tests, correlations were found between MMSE and seasonal change in sleep duration and social activity. The category verbal fluency test was correlated with seasonal change in sleep duration. The RAVLT correlated with all the topics in the SPAQ test.

SAD and controls and AUD, ADD and controls were also compared to each other. Participants diagnosed with SAD showed worse result on the short-term verbal recall and covered all M-CIDI topics significantly higher than the control group. The individuals with SAD were younger than controls and showed more men than women compared to the controls.

Participants with AUD (lifetime and past 12 months combined) scored higher on seasonal changes in sleep duration, mood social activity and energy level, compared to the control group. The individuals with AUD were younger than controls and showed more men than women compared to the controls.

Participants with ADD (lifetime and past 12 months combined) scored higher on seasonal change in sleep duration, social activity, mood and energy level. The individuals with ADD were younger than controls and showed more men than women compared to the controls.

The subjects that were diagnosed with SAD and alcohol abuse were compared to healthy controls without these diagnoses. The SAD and alcohol abuse group were found to have higher scores on all the SPAQ topics compared to the control group. A higher alcohol abuse during lifetime was found, and scored lower on the MMSE and short-term verbal recall, compared to the control group. The individuals with SAD and alcohol abuse were younger than controls and showed more men than women compared to the control group.

To conclude this study, the results show that there is a correlation between SAD and alcohol disorder, as well as a correlation between SAD and cognitive impairment.

It has been shown that there are significant differences between SAD and the control group. They seem to have a worse short-term memory and more often have a history with ADD and AUD.

Individuals with AUD and ADD showed more seasonal change in sleep duration, energy level, mood and social activity.

Individuals with SAD and alcohol abuse showed more seasonal variation, more often a history with alcohol abuse, worse cognitive functioning and a worse short-term memory.

Obsessive-Compulsive Disorder

In a study in Turkey on seasonal mood changes and OCD, Tan (2017) found individuals with SAD have a higher change of OCD than healthy individuals. In their study, they collected 104 individuals with OCD and 125 healthy controls. Individuals with OCD were diagnosed, and those with severe disorders were excluded. The control group was not diagnosed, but were checked for neurological disorders and major psychiatric disorders only, to avoid using a too healthy control group.
Approximately, half of both groups participated in the winter, and the other half participated in the summer.
SPAQ was used to measure SAD in participants. A GSS score of >11 indicated SAD to a degree in an individual, while <10 indicated a healthy individual. In the SPAQ test, the topics seasonal changes in sleep duration, social activity, energy level, mood, appetite and weight were tested.
Y-BOCS was used to measure the severity of OCD in patients. The test exist out of 19 question, of which 10 are used to measure OCD severity. The authors claim the remaining 9 questions do not have sufficient reliability to include in the measuring of OCD.
The Hamilton Depression Rating Scale-17 (HDRS-17) was used to measure severity of depressive symptoms.
Participants with OCD were also asked to fill in the Beck Anxiety Inventory (BAI).

In the results, it was found that SAD was significantly more frequent in individuals with OCD compared to healthy controls. More women suffered from SAD than men did, and the age distribution was the same.
It was also found that Y-BOCS scores was significantly correlated with HDRS-17 scores. Furthermore, individuals with SAD that were measured in the winter scored significantly higher on compulsion and HDRS-17 scores.

In conclusion, it was found that individuals with OCD had a higher frequency of SAD than healthy individuals. The authors claim that this could mean that OCD and SAD may share the same neurobiological impairments, thus causing both disorders.
It was found that Y-BOCS score, severity of obsessions and anxiety showed no difference in winter and summer. However, compulsions and depression were higher in the winter than summer. The authors claim that this could partially be explained by SAD, since SAD causes individuals to be more depressed during winter. However, compulsions are currently not known in SAD. Why compulsions are correlated with winter is currently unknown and requires more research.

Discussion

In this review, it has been shown that SAD brings more impairments and disorders than just the common symptoms, such as a longer duration of sleep and energy loss. Impaired cognitive ability, worse self-perceived personality, high trait SPS, alcohol abuse and OCD all seem to have an association with SAD.

It becomes clear that individuals with SAD do not only experience an impaired cognitive ability during winter, but also during summer. It is also shown that greater cognitive impairments are correlated with a greater severity of depression. What these results show is that light influences have an effect on the severity of SAD, but are likely not the main cause. Due to cognitive impairments during summer, it is likely that there is an impairment in the neurobiology of the brain, and that light influences only play a part in the bigger picture of SAD.

It also has been shown that a high score of neuroticism in summer correlated to a more severe depression during winter. It is already known that neuroticism is associated with depression (Christensen, 2006; Jourdy, 2017). It was also found that that neuroticism increases from summer to winter. Taking the previous findings, it is possible that because individuals start with a high neuroticism in the summer, they will end up with an even higher neuroticism in the winter, thus causing a more severe depression.
We do however not know whether seasonal change is different in individuals with SAD with a high neuroticism compared to individuals with SAD with a lower neuroticism. If the seasonal change is equal or even greater in individuals with SAD with a high neuroticism, it could explain why neuroticism in the summer is correlated with severity of depression in the winter.

Again, in the study on SPS, it was shown that a

high SPS in the summer is associated with a greater severity of SAD in the winter and that SPS increases from summer to winter. Like the previous hypothesis, it could be that individuals that start with a high SPS in the summer, will have an even higher SPS in the winter in, resulting in more stress and thus more depression. It is also shown that individuals with SAD have a higher SPS and have a higher frequency of high trait SPS.

Markers like these which we can find in summer, could be used to find potential individuals with SAD. Not only that, but it might even be possible to reduce the severity of SAD in winter, by limiting neuroticism or SPS by therapy. Whether therapy of neuroticism or SPS will help against the severity of SAD it currently unknown and needs to be investigated.

A connection was shown between SAD and alcohol abuse. Individuals with SAD more often show a history with ADD or AUD. Because carbohydrate craving is found in SAD, this may explain one of the reasons why we find this result. We also know that MDD and substance abuse are associated, which is why it isn't surprising to find SAD and substance abuse associated as well.
It was also shown that individuals with SAD show cognitive impairments, with reinforce former findings.
Furthermore, it is found that AUD and ADD show seasonal change in sleep duration, energy level, mood and social activity. We find these same symptoms in SAD. Interestingly, no difference is found in cognitive ability. These results could mean that AUD and ADD may share some of the pathways in the brain that lead to seasonal change, but not to cognitive impairment.

It was shown that individuals with OCD have a higher frequency. Like the authors said, it could be possible that OCD and SAD share some pathways in the brain, causing both disorders. Using their comorbidity, we can also use OCD as a marker to find individuals with SAD during summer.
It is also shown that there are more compulsions and a more severe depression in winter. While depression can possibly be explained by SAD itself, compulsions are currently not explainable. The pathways of SAD and OCD have to be understood better, before we can explain why compulsions are more frequent in winter.
In this review, three of the five main articles were written by Hjordt. In his articles, the same methods were used to collect his participants by collecting them via advertising. While advertising is often used for recruitment of participants, it may not be representative to the average population. In his article on self-perceived personality, he did not find significance in openness, which previous studies did (Bagby, 1996; Enns, 2006). Because the other two studies haven't been done before, and therefore no reference point is available, we must keep an open mind for potential abnormalities.

The SPAQ test was used in every article to measure the severity of SAD in individuals. While SPAQ isn't a diagnostic test, due to it not being sensitive enough, it can still be used to screen SAD in individuals (Mersch, 2004).

A large part of tests were done with questionnaires in most studies. While it is hard to measure emotions and behavior on humans, using questionnaires are not as objective as observations and could be differently conceived by individuals with SAD, due to psychological and other factors.

In conclusion, we see that there are many impairments and disorders to be found with SAD. Most of these impairments and disorders seem to become worse or increase the severity of SAD in the winter. Interestingly however is that we can find potential individuals with SAD through markers, which perhaps can be used to counteract symptoms in the winter.
Furthermore, multiple comorbidities were found between SAD and disorders. These comorbidities might be explained by the brain using the same impaired pathway, and leading to both disorders. It may be possible to study certain pathways of more known disorders, to learn more on the pathways of SAD.
SAD is a complex neurobiological disorder, which requires more research before a treatment will be found. For now we can try whether therapy against the found disorders can help reduce the severity of SAD and make it more bearable for individuals with this disorder.

References

Bagby, R.M., et al. (1996). Seasonal and non-seasonal depression and the five-factor model of personality. *J. Affect. Disord.* 38 (2–3), 89–95.

Brewerton, T., Ballenger, J., (1992). Seasonal variation of obsessive-compulsive disorder. *Biol. Psychiatry* 31 (Suppl. 173).

Christensen, M.V., Kessing, L.V., (2006). Do personality traits predict first onset in depressive and bipolar disorder? *Nord. J. Psychiatry* 60 (2), 79–88.

Drake, C.L., et al. (1996). Cognitive performance in seasonal affective disorder: pattern recognition and the Stroop task. *J. Nerv. Ment. Dis*. 184 (1), 56–59.

Enns, M.W., et al. (2006). Personality and seasonal affective disorder: results from the CAN-SAD study. *J. Affect. Disord*. 93 (1–3), 35–42

Espiritu R.C., et al. (1994). Low illumination experienced by San Diego adults: association with atypical depressive symptoms. *Biol Psychiatry* 35: 403-7

Hjordt, L.V., et al. (2017). Season-independent cognitive deficits in seasonal affective disorder and their relation to depressive symptoms. *Psychiatry research* 257: 219-226

Hjordt, L.V., et al (2018). Self-perceived personality characteristics in seasonal affective disorder and their implications for severity of depression. *Psychiatry Research* 262: 108-114

Hjordt, L.V., et al (2019). Sensory processing sensitivity and its association with seasonal affective disorder. *Psychiatry Research* 272: 359-364

Jensen, C.G., et al. (2015). Development and psychometric validation of the verbal affective memory test. *Memory* 1–16.

Jourdy, R., & Petot, J. (2017). Relationships between personality traits and depression in the light of the "big five" and their different facets. *L'évolution Psychiatrique,* 82(4), 37.

Liss, M., et al. (2008). The relationships between sensory processing sensitivity, alexithymia, autism, depression, and anxiety. *Personality and Individual Differences*, Volume 45, Issue 3, Pages 255-259

Melartin, T., et al (2002). Current comorbidity of psychiatric disorders among dsm-iv major depressive disorder patients in psychiatric care in the vantaa depression study. *The Journal of Clinical Psychiatry, 63*(2), 126-134.

Mersch, P.P.A., et al. (2004). The reliability and validity of the Seasonal Pattern Assessment Questionnaire: a comparison between patient groups. *Journal of Affective Disorders* 80; 209–219

Morales-Muñoz, I., Koskinen, S., Partonen, T. (2017). Seasonal affective disorder and alcohol abuse disorder in a population based study. *Psychiatry Research*

Murray, G., et al. (2002). Seasonality and personality: A prospective investigation of Five Factor Model correlates of mood seasonality. *Eur. J. Pers.* 16 (6), 457–468.

Nussbaumer-Streit, B., et al. (2017). Prevention of seasonal affective disorder: Results of a survey in german-speaking countries. *European Journal of Public Health, 27*

Rosenthal, N. E. (1993). Diagnosis and treatment of seasonal affective disorder. J. Am. Med. Assoc.270(22):2717 – 2720.

Ruscio, A., et al. (2010). The epidemiology of obsessive-compulsive disorder in the national comorbidity survey replication. *Molecular Psychiatry*, 15(1), 53-63.

Sher, L. (2002). Relationships between seasonality and alcohol use: a genetic hypothesis. *Medical Hypotheses*. Volume 59, Issue 1, Pages 85-88

Tan, O., et al. (2017). Seasonal mood changes in patients with obsessive–compulsive disorder. *Psychiatry Reseach*