Preface

From literature search and planning, through pilot testing, data gathering and data analyses to the final process of writing the thesis I have had the opportunity to get an insight into the great world that is psychological science. Experiencing first hand how much work it takes, but also how much pleasure it yields when a project comes together. I would like to thank my supervisor Robert Biegler and co-supervisor Gerit Pfuhl for all of their help throughout all stages of this project, answering all my questions, large as well as small. Robert Biegler has been especially helpful with regard to theory, always having an overview of the literature on this field and sharing his knowledge and opinions with me, as well as developing the computerized tasks. Gerit has helped immensely with the preparations of the design of the study and also with the statistics, I have learnt a lot from you both. I would also like to thank Solveig Reitan Klæbo, Chief physician and specialist in psychiatry at St. Olav's Hospital in Trondheim, for opening the doors of Østmarka, and introducing me to staff and patients and allowing me to test the schizophrenic participants in this study. Autismeforeningen in Trondheim have been of much help, spreading information about this study to their members, setting me in contact with people with Asperger willing to participate. I would also like to thank Kyrre Svarva who helped me translate the surveys to Norwegian in the best possible way without losing its original meaning. Without participants, this study would not have happened, I would like to thank everyone who has spent an hour of their time playing computer games and filling out questionnaires for me. Finally, I would like to thank Knut!

Abstract

Schizophrenia patients are seen as inferior to healthy controls with regard to statistical inference. In this study I aim to investigate this further, using two novel tasks, the shape precision task measuring perceived and actual precision of visual short-term memory, and a modified version of the beads task measuring probability estimates and perception of change. Participants are also compared with regards to results from the Cognitive Biases Questionnaire (CBQ), Short Need For Closure Scale (SNFC) and a Theory of Mind survey (ToM). 20 patients on the schizophrenia spectrum and 19 healthy controls participated in this study. The results support the main hypothesis that schizophrenics are thought to perceive their predictions as more precise than they really are.

Innholdsfortegnelse

Decision Making in Schizophrenia

In this research I aim to investigate cognitive expectations and limitations in the processing of sensory data. Most of our knowledge about the world is derived from statistical inferences, the majority of which are done unconsciously. Even though the theory behind such inferences is quite simple, in reality some people will deviate from this. I want to investigate distortions and biases in patients with a diagnosis along the schizophrenia spectrum, people with autism spectrum disorder and in a healthy control group. In simpler terms we are looking at differences in thinking.

In all situations in life it is important to be able to separate what events are caused by our own actions and what events are caused by extraneous variables. The solution to this seems quite simple; we attribute any large enough deviations from our own predictions through forward modelling to extraneous variables. Forward modelling enables commands from the motor system to be perceived by the perceptual system, where the commands are subtracted from what is just perceived (Frith, 2005). For example, seeing a picture move across the retina may have two causes, either the picture is moving, or you are moving your eyes. If you know that you are turning your head, you will not be surprised that a picture of the car you just parked will move on the retina. If you on the other hand stand completely still and you see the picture of the car moving, such a deviation between your actions and expected outcome will cause you to suspect that the outcome has been caused by an outside event, namely the car is moving. If the deviation between expected and actual outcome is too big, you will probably believe something to be caused by an outside event. If, however, you are used to having a rather large difference between expected and actual outcome and you expect such a deviation, they will not surprise you, thus you will not think any more of it. In other words, the statistical effect size of prediction errors depends largely on how precisely you believe you can predict outcomes. The effect size determines whether or not you are surprised by a deviating outcome. If you expect actual outcome to differ ± x standard deviations from your predictions, you may infer an external cause for any deviation larger than x standard deviations from your prediction. Such a difference in actual outcome that is large enough from your perceived precision requires you to make a choice between recalibrating your perceived precision and suspecting that an outside variable causes such a difference.

In this study I look at the differences in decision making in patients with schizophrenia, an autism control group and a healthy control group using two novel tasks; shape precision task and a modified version of the beads task. I will describe these tests in detail and compare those results to that of three surveys; Cognitive Biases Questionnaire (CBQ), Theory of Mind (ToM) and Short Need for Closure Scale (SNFC).

Schizophrenia

According to Barlow and Durand (2011) Schizophrenia affects about 1% of the population and this statistic seem to be universal. Even if 1% of the population is affected by this disorder at some point in their life, the disorder presents itself differently from case to case. It may differ in symptoms as well as in severity.

Eugen Bleuler, a Swiss psychiatrist, first used the term schizophrenia in 1908. Schizophrenia means split mind (Schizein-split and Phren-mind). Bleulers intention behind the term was, however, something quite different; an associative splitting of the functions of personality, not of the personality itself. The term´s translation to "split mind" has led to the common misperception that schizophrenia is a disorder characterized by multiple personalities.

Schizophrenia is a complex mental disorder, characterized by several cognitive dysfunctions. A diagnosis of the disorder is given after observing two or more symptoms of schizophrenia being present for more than one month. These symptoms include delusions, hallucinations, disorganized speech, grossly disorganized or catatonic behaviour and negative symptoms, for example lack of affect. The disorder is also characterized by inappropriate emotions (Barlow & Durand, 2011). The diagnosis is only made if the patients´ lives have been significantly affected in their work life and social relations, respectively. No one knows exactly why some develop schizophrenia whilst others do not. Even though researchers have established that there is no one gene responsible for schizophrenia, evidence strongly suggests that genes are responsible for making some individuals more vulnerable for developing schizophrenia together with social factors and life events (Barlow & Durand, 2011).

50-70% of all schizophrenic patients experience delusions, hallucinations or both (Lindenmayer & Kahn, 2006). Delusions and hallucinations may give these patients a sense that they are not in control of their own movements, in some cases the patients also feel as if their thoughts are not their own thoughts. When a person's beliefs are inconsistent with reality we call that delusions. Among schizophrenia patients common delusions include delusions of grandeur; a belief of oneself as being more powerful or famous than is actually true and delusions of persecution; the belief that someone/something is out to get you. Several theories attempt to explain why such beliefs are held by some people, but not by most of the population. Barlow and Durand (2011) divide these theories in two groups. The first group, the motivational view looks at delusions as a way of coping and sees the beliefs as attempts to relieve stress and anxiety. The other group, the deficit view sees the beliefs as caused by a brain dysfunction, rather than a coping mechanism. A hallucination is as defined in Barlow and Durand (2011) as "*The experience of sensory events without any input from the surrounding environment*." (p.457). Hallucinations are perceptions that are inconsistent with the reality. From time to time we can see or hear something that really was not there. The difference between this and a hallucination is the awareness of this not being true. Auditory hallucinations are the most common, which includes the hearing of voices.

Earlier research has shown that people with schizophrenia may have problems with statistical inference (Frith, 2005), which is important when functioning in the real world. For example, through your motor-skeletal system you are able to plan and foresee events caused by you, if you want to grab a ball with your right hand you reach out for it and adjust grip force to grab it. This also lets you adjust the trajectory of your hand if at first you miss the ball. Your sensory motor system then gives you sensory feedback, like the touch of the ball, the colour of the ball etc.

Patients with schizophrenia are thought to perceive their predictions as more precise than they really are, which may lead them to attribute to external causes, events that they themselves have caused. For example, you may find it hard to tickle yourself because your motor system prepares you for what sensation is going to come. Because of problems predicting events, some schizophrenics are actually able to tickle themselves. As they are not able to correctly identify themselves as the reason or agent for a subsequent outcome, the following sensation is experienced as more intense. This form of prediction error could be linked to the abnormal perceptions (hallucinations) and beliefs (delusions) that some patients with schizophrenia are experiencing (Frith, 2005). In the case of delusions of control, the schizophrenic perceives him- or herself to be passive in their own actions, reporting that their body opened the door and went out, but they themselves had nothing to do with it. Frith argues, though, that errors in the statistical inference are not enough to explain delusions of control; a second factor is required. A relevant contrast is provided by people with damage in the supplementary motor area and/or anterior corpus callosum. They have an anarchic hand, where the hand acts on its own. The difference here is that people with an anarchic hand report not having control over their arm, but perceive the problem to be the arm itself. In contrast, a schizophrenic patient with the same perception of not being in control may then attribute that problem to alien forces controlling him or her. The difference lies in the attribution of agency to either one´s own hand or to other beings (Frith, Blakemore & Wolpert, 2000). This hypothesis claims that a problem with statistical inference is a necessary, but not sufficient cause of delusions of control. It may not be what leads to delusions, but may have something to do with how the delusions are accepted by the patient.

Autism

Autism is a neurodevelopmental disorder characterized by three main symptoms: (1) Impairment in communication; about one third of children with autism never learn to speak; (2) social interactions; among those children with autism that do develop speech, social conversations may be difficult; (3) restricted behaviour, interests and activities. Although a savant skill, like the one portrayed in "Rainman", is not typical of people with autism, many of them display very particular interests like memorizing bus timetables or zip codes. Much like schizophrenia, autism is believed to be, at least in part, caused by genetics (Barlow & Durand, 2011).

In this study I have looked at participants with an autism spectrum disorder called Asperger´s syndrome as a second control group. This disorder has a prevalence rate of 1 in every 110 births (Barlow & Durand, 2011). Children with Aspergers syndrome tend to be more verbal compared to other children with autism, and due to their interests in specific themes the disorder is often referred to as the "Little professor syndrome". Pelicano and Burr (2012) suggest that people with autism are not as affected by their previous experience as by immediate, sensory information; people with autism perceive things more accurately or factually. For example, if one is to make a time estimate for a bike route, one may find that variables like rain, snow, traffic etc. might have an impact on how precise this estimate is. So if one, due to snow, finds that one´s time estimate is off by more than normal, Pellicano and Burr (2012) assumes that this would not affect future estimates on snowy days for a person on the autistic spectrum, whereas a healthy person will modulate their experience with knowledge from previous experiences more, for example start biking to work a little earlier on snowy days. Van de Cruys et al. (2014) on the other hand argue that people on the autistic spectrum are affected by their previous experience, maybe even too much so. They suggest that the autists are not always able to distinguish between the effects of learnable differences in the environment and random noise, thus, all new information may be used to alter future predictions, no matter if they are relevant or not. In the event of snowfall and a prolonged bike ride, autists may draw the conclusion that only bike rides through snow *and* at that specific time of day will take a longer time than expected. There is little or no generalization, leading to noise having larger effects on learning than for healthy controls. This noise, however, would most likely never be applicable in upcoming events, leading to new prediction errors. Fletcher and Frith (2009) also point out how heavily weighted, previous experience may be part of what causes hallucinations in schizophrenia patients. In the example of the bike ride, a schizophrenic patient may not feel in control of speed or bike handling if experiencing statistically large deviations from predictions. So Fletcher and Frith and Van de Cruys et al., explain different cognitive dysfunctions in two different disorders with the same theory. To summarize; Pellicano and Burr (2012) and Van de Cruys et al. (2014) agree on the symptoms, but not on the bias, whereas Fletcher and Frith (2009) and Van de Cruys et al. agree on the bias, but disagree on which symptoms follow.

If Fletcher and Frith (2009) and Pellicano and Burr (2012) are correct in their assumptions, the way people on the autistic spectrum differ from healthy controls could be the opposite of the way people with schizophrenia differ from healthy controls. One may therefore expect the schizophrenics and the autists to be at separate ends of a continuum and the control participants to be somewhere in between with regard to statistical inference. However, Hallerbäck, Lugnegård and Gillberg (2012) found that nearly half of the schizophrenics in their study had an autism spectrum disorder according to self-reports made by the schizophrenics themselves and their parents.

Jumping to Conclusions Bias

Jumping To Conclusions Bias (JTC) is a cognitive decision making bias, defined by Rubio et al. (2011) as the tendency to make decisions based on little evidence. Another important aspect of JTC is that the decision maker is adamant in his or her decision, even if it later proves to be wrong (Moritz, Woodward, Jelinek & Klinge, 2008; Speechley, Whitman & Woodward, 2010). The most used and recognized task to investigate JTC is the Beads Task. The Beads Task was first used in a psychiatric investigation by Huq, Garety and Hemsley in

1988, where they found that Schizophrenics displayed more signs of JTC than did healthy controls. The basic task consists of two containers of beads in two different colours in for example a 20:80 ratio, the experimenter then draws one bead at a time from one of the containers, asking the participant each time, whether, based on the beads drawn so far, the participant is sure he or she knows from which container the beads came. JTC can be measured by the numbers of draws before the participants reports being certain from which container the beads have been drawn. This is called Draws to Decision. Based on a Bayesian theory of probabilistic reasoning (Hemsley & Garety, 1986), this task has been used in several variations to look at JTC in schizophrenic patients. Some have also used the task to look at JTC in other patient groups as well. Especially interesting are the results from Brosnan, Chapman and Ashwin´s (2014) study, where people with Asperger´s syndrome collected more evidence (drew more beads) before making a decision in the beads task than both the patient group (schizophrenia patients) and the healthy controls. If that difference is based on a process that governs statistical inference in a broad range of situations, then we can expect a difference in outcome between schizophrenia patients, healthy controls and people with Asperger´s in these tasks.

JTC has been studied by many different researchers over the last couple of decades and there is no longer any doubt that such a bias exists (Averbeck, Evans, Chouhan, Bristow & Shergill, 2011; Huq et al., 1988; Lincoln, Ziegler, Mehl & Rief, 2010; Speechley et al., 2010). Peters and Garety (2006) found in a longitudinal study that JTC is relatively stable in patients over time. As research progresses, one finds new methods, designs, theories and results. There are research that strongly support that patients with schizophrenia and especially those with delusions are prone to this bias (Huq et al., 1988; McKay, Langdon & Coltheart, 2006; Glöckner & Moritz, 2009; Lincoln et al., 2010; Rubio et al., 2011). Moritz and Woodward´s (2005) results show that 42% of the patients with schizophrenia in their study show a JTC-bias. So et al. (2012) show that between one and two thirds of people with delusions show signs of this bias. Veckenstedt et al. (2011) also found a difference in decision-making between schizophrenics and healthy controls, which was attributed to JTC. They were, however, not able to detect any significant correlation between this bias and the participants´ degree of delusions. In addition it seems to be of importance whether the patients are in an acute psychotic or remitted state. Lincoln et al. (2010) found that only the acute patients showed significant signs of JTC. In addition, when the negative symptoms were controlled for there was no longer any significant correlation between JTC and delusions.

Even though some studies (Lincoln et al., 2010; Veckenstedt et al., 2011) have not seen significant correlations between JTC and delusions, several studies have already shown that those two variables in one way or another are correlated (Garety et al., 2005; Glöckner & Moritz, 2009; Huq et al., 1988; Lincoln et al., 2010; McKay et al., 2006; Rubio et al., 2011).

Freeman, Pugh and Garety (2008) found 40 healthy controls who showed signs of JTC, in this group they found a strong correlation between style of data gathering and delusions. Freeman et al. says that although it is not likely that JTC will lead to delusions, this bias may nevertheless contribute to the explanation of why some individuals are more prone than others to accept these delusions as true. A study by Van Dael et al. (2006) found a difference between the JTC-scores of 45 patients with psychosis, 47 first-degree, non-psychotic relatives, 41 psychosis-prone individuals and 54 healthy non-psychotic controls without family ties to a psychotic patient. In the healthy control group only 11.3% showed a JTC bias, whereas out of the non-psychotic relatives, 25% showed a JTC bias as measured by number of beads requested. This number was even larger for the psychotic group, 32.5%. This coincides with Kendler et al. (1993) who argue that the closest family of schizophrenics are more at risk of developing schizophrenia disorders and show schizotypal signs and symptoms than are others.

Maher (1974) suggested that delusions might be formed in an attempt to explain the perceptual anomalies in psychosis. Colbert and Peters (2002) theorized that a JTC bias is caused by a need for closure (NFC). In all the people that experience perceptual anomalies, only some develop delusions. NFC may be a motivating factor, contributing to the formation of delusions, through a need for an explanation of their perceptual anomalies. In Colbert and Peters´(2002) study of seventy people from the general population, they did find that both biases were associated with high scores on a delusion inventory, but nothing to say there was a direct relationship between JTC and NFC. McKay et al. (2006) wanted to investigate this further and set out to see if the two are in fact related. The only correlation they found between JTC as measured by draws-to-decision in beads task and NFC as measured by NFC scale was between JTC and NFC subscale decisiveness. Participants who scored high on decisiveness actually used more draws to decision. They too, however, found that JTC and NFC both correlated with delusion proneness as measured by the same delusion inventory as Colbert and Peters (2002), the PDI. This suggests that both JTC and NFC make independent contributions to delusions, but are in no way connected with each other. In accordance with the findings of McKay et al. (2006), I believe that there will be no relationship between NFC score and JTC score as measured by CBQ.

No one has yet been able to establish how this JTC bias works, but Moritz et al. (2008; 2009) suggest that schizophrenic patients have a lower decision making threshold which can make them satisfied with less information before drawing a conclusion, which in turn will make them gather less information that may be contradictory to their convictions before making a final decision. The liberal acceptance account suggest that schizophrenics base their judgements on very little evidence, but that the judgement is made when an option surpasses an internal threshold of acceptance. This internal threshold of acceptance is believed to be lowered for schizophrenics compared to healthy people (Moritz et al., 2008). By the liberal acceptance account schizophrenics and healthy controls could have the same probability estimates, but schizophrenics would not need the same extreme probabilities to be sure. “The overestimation of conviction hypothesis” suggest an overestimation of one´s conviction early in the decision making process, which means that people with JTC will give more attention to evidence acquired early, no matter their relevance (Lincoln et al., 2010; Rubio et al., 2011). “Hypersalience” means that one overestimates the importance of evidence that support one´s own hypothesis while the influence of conflicting evidence remains unchanged (Speechley et al., 2010). When a decision has been formed, this hypersalience will help the patients make an early decision as well as strengthening their conviction of this being the right decision. This would imply that both schizophrenics and healthy controls need equally extreme probabilities to feel sure, but that the schizophrenics will see each piece of information as more convincing, which would mean that the schizophrenics reach the threshold of certainty more quickly than the healthy controls.

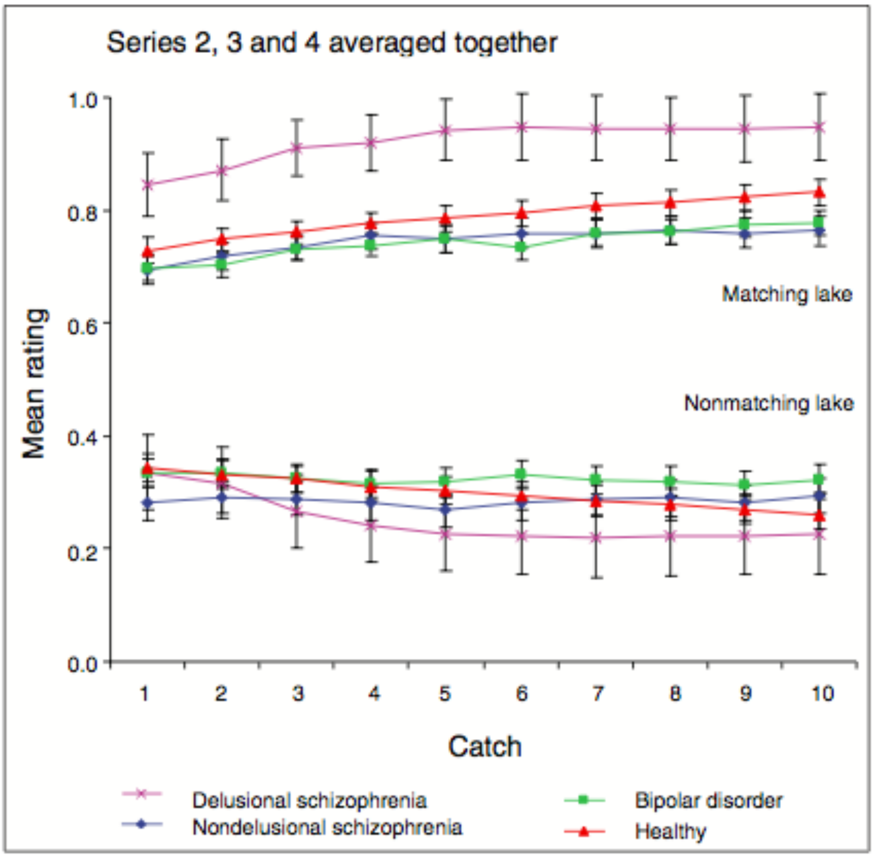

Fig. 1: *"Average matching lake (top) and nonmatching lake (bottom) ratings for series 2, 3 and 4. A "match" is a situation in which the ratio of fish in one lake makes it the best choice with regards to the colour of the current fish catch. Error bars represent the standard error of the mean."* **(Speechley et al., 2010, p.12).**

The figure above shows Speechley et al.´s results from a variation of the beads task, where they substitute beads from one of two containers by black and white fish from one of two lakes. The ratio of black to white in this experiment was 80:20 in lake A and 30:70 in lake B. This shows that the delusional patients give their most extreme probability estimates only for the hypothesis favoured by the data, but not for the hypothesis that conflicts with the data. This led Speechley et al. (2010) to conclude that delusions in schizophrenia are associated with hypersalience of evidence-hypothesis matches. That hypersalience is present when delusional patients are faced with evidence that match their previous assumption, but that their reasoning is closer to that of healthy controls in non-matches.

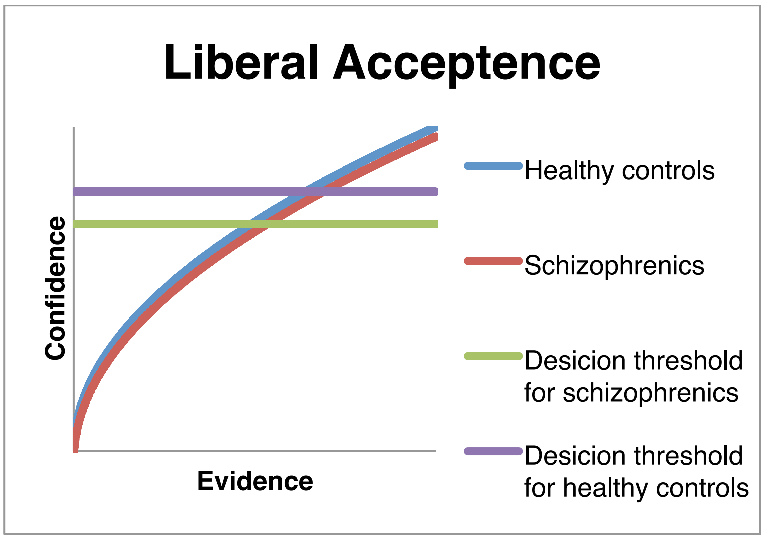

Fig. 2:Illustration of how schizophrenia patients and healthy controls arrive at their decision threshold according to Moritz et al. (2008) and the liberal acceptance account.

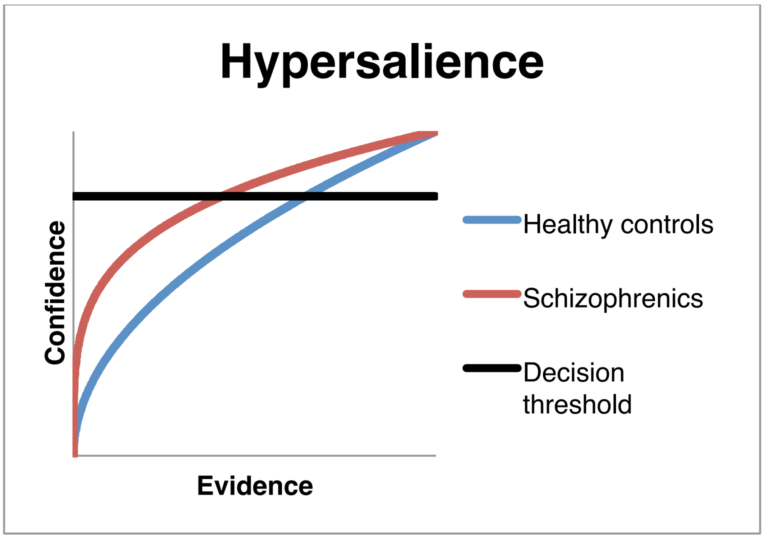

Fig. 3: Illustration of how schizophrenia patients and healthy controls arrive at a joint decision threshold according to Speechley et al. (2010) and the hypersalience account.

In summary, the liberal acceptance account (Moritz et al., 2008) suggests that schizophrenia patients and healthy controls have the same probability slope, but different threshold. The hypersalience account (Speechley et al., 2010) suggests that schizophrenia patients have a steeper probability slope, and they have the same decision threshold as healthy controls, but they reach this threshold earlier. See figure 2 and 3 for illustrations. Moutoussis, Bentall, El-Deredy & Dayan (2011) set out to see if the JTC bias in schizophrenics could be motivated by a cost-reward analysis. That the schizophrenics perceive the cost of sampling more information before deciding as worse, compared to being wrong, relative to healthy controls, or that JTC could be at least in part caused by random “noise”. A higher cost of sampling would be equivalent to a lower threshold, as seen in the liberal acceptance, because if you are averse to collecting more evidence you make your decisions when you reach less extreme probability estimates. Their results, however, showed that greater noise in decision making accounted for more of the group differences than a cost-reward model: paranoid patients scored much higher for noise compared to controls, and the cost-reward hypothesis was rejected.

Moutoussis et al.´s “noise”-term refers to a higher probability of making random decisions that entirely ignores evidence. This would mean that there is a smaller probability for a person high in noise making earlier decisions when there are more than two sources simply by reducing the probability that another draw will be chosen over one of the containers. If we for example say that 15% of all choices result in randomly picking one of the alternatives, when there are only two containers. Then we can assume that in 5% of choices the container with more white beads will be chosen, in 5% the container with more black beads and in 5% the choice will be to draw more beads. If we were to add another two containers of red and blue beads in 3% of choices the container with more white beads will be chosen, in 3% the container with more black beads, in 3% the container with more red beads, in 3% the container with more blue beads and in only 3% a person with that same 15% noise level will choose to draw more beads.

In Moritz, Woodward and Lambert´s study from 2007, however, an increase in the number of sources diminished the difference in results between schizophrenics and healthy controls. Another implication of the noisy choice hypothesis is that people who show JTC should also more often make choices not supported by the colours of beads seen. If someone with a noise level of 6% were to choose between seeing another bead, deciding the beads came from the container with more black beads or the container with more white beads, then even if all the beads drawn from the container were black, 2% of choices would result in the conclusion that the beads came from the container with more white beads. The previous example of 15% noise shows that this higher noise level would result in such an unjustified decision in 5% of choices. Freeman et al. (2008) showed that people who showed JTC chose the wrong jar 46% of the time, whereas people who did not show this bias chose the wrong jar only 16% of the time. The proportion of random choices increased the proportion of choosing the jar not favoured by the beads that had been drawn, for example choosing the jar with more white beads after having seen black beads.

The ability to make quick inferences may be advantageous and sometimes even crucial, for example when deciding if a drowning man is having a swim or if he is in fact drowning. Then the ability to make a quick decision and act on it may be lifesaving. On the other hand, JTC is often not the best decision making strategy. The research on this bias is therefore important and through the knowledge we already have about this bias, several cognitive training programs have been developed to help patients lessen their degrees of biases, delusions or other cognitive aspects of schizophrenia through metacognition. Social Cognition and Interaction Training (SCIT) (Combs et al., 2007), Metacognitive Training for Psychosis (MCT) (Moritz, et al., 2011; Moritz, Veckenstedt, Randjbar, Vitzthum & Woodward, 2011) and the Maudsley Review Training Program (MRTP) (Waller, Freeman, Jolley, Dunn & Garety, 2011) are three metacognitive training programs that among other things aim to teach the patients how it can be good to withhold decisions in cases where evidence may be ambiguous and also to be more flexible in their decisions, making them receptive to other views and evidence that may change their minds. Even though Brakoulias et al. (2008) found no significant difference in patients before and after Cognitive Behavioural Therapy (CBT), there is not yet enough research on the subject to discard CBT as a possible treatment for JTC, and further research may help develop such training programs.

In order to make inferences about the world, being able to distinguish the effects of one´s actions from the effects of something in the outside world is crucial. Schizophrenics seem to have some problems with statistical inference, which is why some of them may perceive their actions as being out of their control. Such a problem with inference will only happen if the deviation between expected and actual outcome is large enough. Bayesian inference suggests that the world as we view it is constantly updated by prediction errors. If the discrepancy between what we predict and the outcome is too large, we learn from this and update our predictions for upcoming events. Fletcher and Frith (2009) have developed this theory quantitatively. If one is used to making large prediction errors, one will not necessarily be surprised by the outcome. Here it is important to distinguish different ways in which prediction errors can be large. Imagine Alice and Bob throw balls over an average distance of 20 metres, but Alice´s standard deviation is 1 metre, while Bob´s standard deviation is 2 metres. Then if they both throw a ball 22 metres, then in external units they have identical prediction errors of 2 metres. The prediction errors differ relative to the actual precision, in that Alice´s throw deviate from her average by 2 standard deviations, Bob´s throw deviate by only one standard deviation, measured relative to their actual, objective precision. Their perceptions may be different. If Alice mistakenly believes that her throws are widely scattered, say with a subjective standard deviation of 4 metres, then she will believe the two metres deviation corresponds to only half a standard deviation, and she will not be at all surprised. If Bob mistakenly believes that his throws are tightly clustered around the average, say with a subjective standard deviation of half a metre, then the throw two metres above the average corresponds to a subjective prediction error of 4 standard deviations, and Bob should be very surprised. He then has a choice between recalibrating his subjective standard deviations, or suspecting an outside factor that made his ball go farther. Figure 4, underneath, illustrates Bob´s perceived (blue line) and actual (red line) precision. The red area illustrates a prediction error that will cause Bob to be surprised.

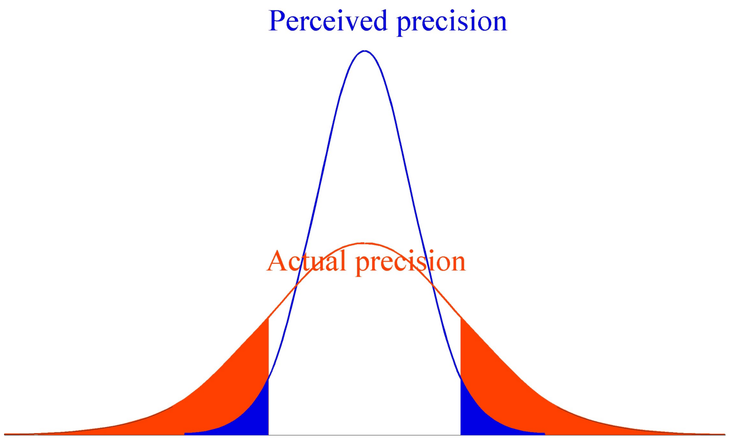

Fig. 4: An illustration of Bob´s Percieved and actual precision.

Pellicano and Burr (2012) and Van de Cruys et al. (2014) both set out to explain the perceptual peculiarities in autism by the same underlying mechanism; Bayesian inference. Pellicano and Burr suggest that autists see the world more “accurately” than others, meaning that they are not as influenced by their prior experiences. Van de Cruys et al.´s (2014) suggestion that the autists´ problems with statistical inference are very much influenced by their prior experience, does not coincide with Pellicano and Burr´s view. As we experience small enough discrepancies between our prediction and actual outcome, we attribute this to noise, but Van de Cruys et al. argue that the autists will discard their prediction as wrong, which will lead to new learning all the time, as no two experience are the same, thus overfitting. This means that they are not able to distinguish between input that contains learnable regularities and random noise, and that they upregulate their prediction error too often and induce narrow priors (Van de Cruys, de-Wit, Evers, Boets & Wagemans, 2013).

Fletcher and Frith (2009) also developed a theory based on Bayesian inference. They argue that another patient group, namely schizophrenics, have problems with inference; that a failure to integrate new evidence leads schizophrenics to make false prediction errors. Schizophrenia patients are believed to view their predictions as more precise than they really are. Fletcher and Frith link this to schizophrenics´ positive symptoms, such as delusions and hallucinations. Seeing that the same theoretical background (Bayesian inference) and previous data at least partly based on the beads task results have been interpreted in three different ways, leading to three fairly different hypotheses regarding schizophrenia and autism, I use a modified beads task to try to approach the problem in a different way. First, by trying to measure any discrepancy between perceived and actual precision more directly with shape precision task I do not rely on the beads task alone. Second, I also maximize the chances that at least one of the processes supposed to underlie JTC will produce group difference.

Rodier et al. (2011) told their participants that the container from which the beads were drawn would remain the same throughout the trial, however, halfway through the trial they mirrored the first half (black beads was now white and opposite) making it look like there was a change in containers. Some of the participants chose to change their belief about from which container the beads were drawn even though they were told that there was no such change. There was a positive correlation between delusional beliefs and reports of a change. This would suggest that patients with delusions relatively easily would abandon their delusions by contradictory evidence, which is not compatible with delusions being resistant to contradictory evidence. If people change their minds even when they are told that the source of beads will remain the same throughout a sequence, then explicitly allowing for that possibility should maximize the chances of hypersalience to produce group differences, as people can justify large changes in probability. Further, when participants are aware of any such changes in source being possible, then people who think they know the probabilities of white versus black beads more precisely than they really do, should be more likely to think that there has been a change, and they should therefore show greater changes in their probability estimates. We introduced an unexpected uncertainty by telling our participants that the containers have a 50% chance of changing once or several times during a trial.

Daprati et al. (1997) looked at schizophrenics´ experience of agency in a sensorimotor experiment. Schizophrenics and a healthy control group carried out a series of simple hand movements behind a mirror so that they could not directly see their hand. A video of either their hand or someone else´s hand performing the same or different movements was then projected onto this mirror. The task was to correctly identify whether or not the hand projected was their hand or someone else's. The schizophrenic participants with hallucinations and delusions were less able to identify their own hand and more often than non-hallucinating schizophrenics mistook the experimenter´s hand as their own when the experimenter was performing the same movement as the participants.

Knoblich, Stottmeister and Kircher (2004) conducted a similar study where three groups of schizophrenia patients and a healthy control group were asked to follow the line of a circle showed on a monitor, on a writing pad. This pad was placed out of sight for the participant, but they could see their tracking on the monitor. In the first trial the relationship between the diameter of the circle on the monitor and the diameter of the correct movement on the pad was the same, 1:1. Over several trials, this relationship changed and the participants had to draw smaller circles on their writing pad to match that on the screen. An interesting find from this study was that the schizophrenic patients with hallucinatory syndrome or formal thought disorder were not able to detect such a scalar change. They were however able to adjust their drawing, so that the size of their drawn circles matched that of the circles on the monitor. This is evidence that schizophrenics may have problems with self-monitoring. Although it is reasonable to conclude that these results indicate differences in statistical inference, they only offer an indirect measure of the central idea. Our shape precision task is as direct a measurement as we could think of. The Shape Precision task makes it possible to measure perceived precision, whereas the modified version of the beads task measures sensitivity to change in probability and a bias to see such a change. A greater perceived precision in our shape precision task should correlate with a greater perception of change, or a steeper slope. If the participants have a high perceived precision it will make them see random variation as a change in the source of beads, because if they think their probability estimation is precise, then a smaller change can be accepted as good evidence that the source of beads has changed.

In this study I aim to investigate differences in perceived precision compared to actual precision in a novel task called shape precision task. In our modified Beads task I look at perceived probability compared to the actual probability, which has been calculated beforehand. I want to see if there are any such differences between the groups and if so, do these differences correlate with biases from our questionnaires? Based on Fletcher and Frith´s

(2009) work, we suspect that schizophrenics will show a narrower confidence interval, relative to their precision, in our precision task, believing their working memory to be more precise than it really is. This could be because their confidence intervals are narrower, while actual precision is normal, or because confidence intervals are normal, while actual precision is poor, or this could be the result of a combination of the two. We also suspect the Asperger control group will have a wider confidence interval, taking more evidence into consideration before deciding, based on research by Pelicano and Burr (2012).

Theory of Mind (ToM)

"Theory of Mind (ToM) refers to the capacity to infer one´s own and other persons´ mental states." (Brüne, 2005, p. 21). In other words, ToM is the ability to understand one´s own and others thoughts and intentions. Moran et al. (2011) found that people with Asperger´s did not judge attempted and accidental harms any different in regards to morality, whereas their healthy controls judged attempted harms as more impermissible than accidental harms in regards to morals in a ToM-test. This suggests that people with Asperger´s have a problem taking other peoples´ intentions into consideration. Studies have found evidence that support the hypothesis that schizophrenics may have problems with ToM (Fanning, Bell & Fiszdon, 2012; Langdon, 2005; Lugnegård, Hallerbäck & Gillberg, 2015; Lugnegård, Hallerbäck, Hjärthag & Gillberg, 2013). See Horan, Blanchard, Clark and Green (2008) for a review. Some have said that schizophrenics may in fact have too much theory of mind, attributing too much intention, in contrast to the anarchic hand mentioned earlier (Abu-Akel, Wood, Hansen and Apperly 2015; Ciaramidaro et al., 2015). As opposed to the lesion patient, who blames a faulty hand, schizophrenics would blame some external intentional agent taking control over their hand.

Blakemore, Sarfati, Bazin and Decety (2003) showed schizophrenics and healthy controls four types of videos of two shapes moving around the screen. In half of the videos there was no relationship between the movements of the two shapes (non-contingent). The non-contingent movies also differed in whether movement was animate (self-propelled) or not (changing trajectory only when colliding with the wall). In the other half the movement of the shapes was affected by one another (contingent), either intentional; where shape A moved when it "saw" shape B, or mechanical; shape A was launched into motion by shape B, (shape A "pushed" shape B into motion). They found that the healthy controls and a group of schizophrenics without persecutory delusions rated the relationship between the two shapes as stronger in both contingent movies compared to the non-contingent movies. The schizophrenics with persecutory delusions, however, perceived and rated a relationship between the two shapes in both the animate contingent, but also in the animate non-contingent movies. They did perceive the difference in the inanimate movies. This shows how the delusional schizophrenics did not have a general thinking disorder, but rather a specific overattribution of intention.

In addition to the aforementioned tests and surveys we also use the Cognitive Bias Questionnaire (CBQ), which measures the participant´s degree of five cognitive biases. JTC, intentionalizing, catastrophising, emotional reasoning and dichotomous thinking are all considered important biases for the pathogenesis of psychosis. The Short Need for Closure scale (SNFC) is used to map the participants NFC, "*a motivated need for certainty*" (McKay et al., 2006, p. 422). We also use Beck´s Depression Inventory (BDI) as a control measure, as there is reason to believe that depression may affect the results. The biases in CBQ are all considered important biases for the pathogenesis of psychosis. However, I am not convinced that the JTC in CBQ is the same bias as is identified earlier by studies using beads task.

Hypotheses

- Patients with schizophrenia are thought to perceive their predictions as more precise than they really are; therefore I predict that the patients´ confidence intervals are narrower relative to their actual precision, compared to controls´, that they will have a smaller ratio between the variables "Confidence" and "Precision" in the shape precision task. It is also possible that people with Autism believe they remember less precisely than they really do. I therefore predict that people with Autism will have a larger confidence interval compared to precision than both schizophrenics and the controls (Pelicano and Burr, 2012). If however, Van de Cruys et al. (2014) are right, one should expect that the autistic group also would have narrower confidence intervals compared to healthy controls.
- If changes in source are allowed, then people who think they know the probabilities of white versus black beads more precisely than they really do should be more likely to think that there has been a change and they should therefore show greater changes in their probability estimates. I predict that the schizophrenics and Asperger controls will overestimate change more so than the healthy controls in the beads task and have a steeper slope, whereas the healthy controls will have a lower slope score.
- Results from studies with tasks like the beads task, show that 30-50% of patients with schizophrenia show a JTC bias. I therefore predict that schizophrenics will score higher on JTC bias in the Cognitive Biases Questionnaire, the healthy controls will have a lower score, whereas the Asperger controls will score the lowest on JTC in CBQ, *assuming that these two different measures of JTC measures the same thing.* Whether they do or not will be tested by correlating the JTC scores from CBQ with the slope score from the beads task.
- Several studies have found evidence that support the hypothesis that both schizophrenics and autists may have problems with ToM. I therefore predict that the schizophrenia group and Asperger control group will have a smaller difference between permissible and non permissible score on the ToM test than the healthy controls.

Through CBQ and SNFC scale I hope to find which cognitive bias, if any, correlates with JTC or with perceived precision of predictions.

- I here predict that the perceived precision, the confidence variable from the Shape Precision task, will correlate negatively with slope in beads task. If there is a correlation between perceived precision and slope, then how autists deviate from controls depends on whether Pellicano and Burr (2012) or Van de Cruys et al. (2014) are right.
- I predict that JTC as measured by CBQ correlates positively with beads task performance.

Method

Participants

In this study 20 schizophrenia patients were recruited through contact with the responsible psychiatrists at Østmarka, part of St. Olavs hospital. I stressed the importance of the patients participating in the study not being acutely psychotic at the time of testing, because they had to be accountable to give informed consent. The 19 healthy controls were recruited through acquaintances and age-matched with the schizophrenia patients. The 4 high functioning autists with an Asperger's Syndrome diagnosis were recruited from "Trondheims Autismeforening".

	Schizophrenics	**Healthy Controls**	**Asperger Controls**
Number	20	19	4
Female	3	8	4
Mean age (SD)	26.15 (5.14)	24.53 (2.61)	27.25 (10.11)

Table 1: Demographics.

Procedure

The study was approved by the regional ethics committee (REK-131107) and all participants were given a two-page document with information about the study, which they signed to give their informed consent to participate. The same documents is attached in appendix A. They then drew a four-digit number, which served as their Subject-ID throughout the study to ensure anonymity and enable us to compare the results. I kept track of which person belonged to which subject-ID in a notebook for remarking additional information about participants and enabling a possible withdrawal. The notebook was destroyed after completion of the study. The control participants then filled out a form with demographics (see appendix C), while the responsible psychiatrist for each of the Schizophrenic participants filled out a slightly different form for demographics to ensure accuracy about diagnoses and medications (see appendix B). All participants were then given information about the Shape Precision Task through illustration and text. A small demo was given to make sure that they understood the task before the participants carried out the computerized test. Upon completion participants read a text explaining the Beads Task (see appendix E), any questions were answered and a small demo was carried out to make sure the task was understood. The control participants were then given the surveys online before they received a short debrief and any questions they might have about the study and/or about the tests were answered. To minimize the strain on the Schizophrenia patients they were given a paper leaflet with the questionnaires or a URL to the online version of the questionnaire and kindly asked to fill them out within a week. Surveys were then collected and I filled them into the survey online. If patients had not completed the survey they were kindly reminded and asked to do so. Unfortunately only 7 of the 20 patients filled out the survey.

Tests

The two computerized tests were the shape precision task and a modified version of the beads task.

Shape precision task

The Shape Precision task is a novel task, developed by Robert Biegler and Gerit Pfuhl. It is designed to test the participant's precision of short-term memory, as well as their own estimation of their short-term memory, which is a measure of the participant's prediction error.

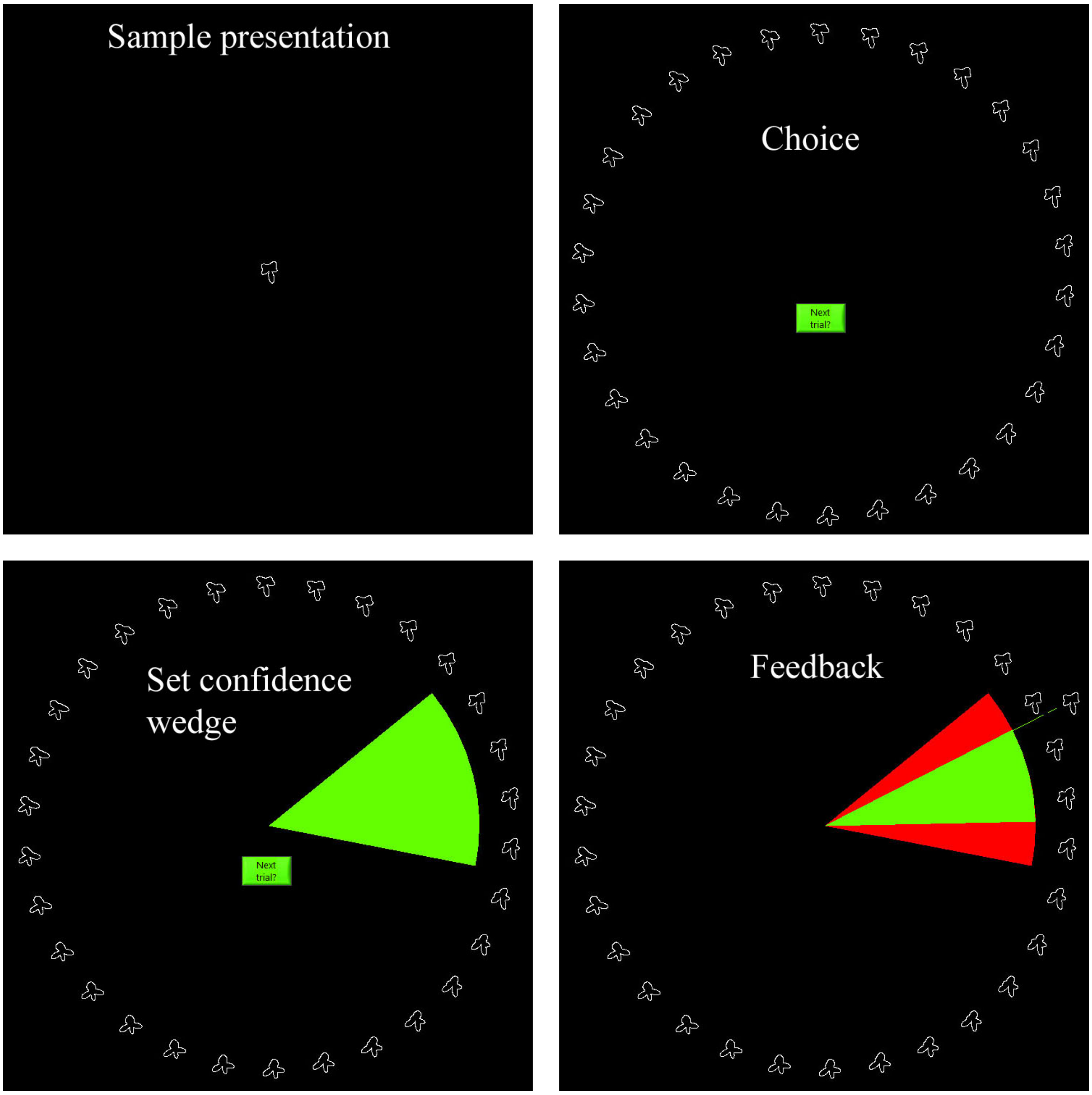

Fig. 5: Illustration of Shape Precision Task.

Figure 5 shows what the Shape Precision task looked like for the participants, minus the labels in white. The participants click on a small cross in the middle of the computer screen and an abstract shape is shown, but only for a second before the shape disappears. Another click on the same cross lets a circle of 30 similar shapes appear on the screen. The participants' task is to indicate which of the shape among all these 30 shapes is closest to the sample shape. They indicate the shape they believe is the closest to the shape they have just seen, spatial memory is not relevant, see figure 5. They can adjust the size of a wedge to include as many shapes as they believe are necessary for them to include the correct one. After adjusting their wedge and pressing the "ctrl"-button to submit their response, the correct answer will appear on the screen as well as the number of points achieved. If one has included the sample shape in the wedge 8 points will be awarded. Points will be subtracted for making the wedge too large. However, making the wedge too small results in no points. The challenge is to balance between including too many objects which will result in minus points and not including enough objects to include the correct shape, which will result in 0 points. The size of the wedge is thereby a measure of the participants' confidence judgements. Thus, the task measures the actual precision of one´s short term memory by the angle between the best guess and the actual location of the target, but it also measures perceived precision by the angular width of the confidence variable. The participants were given the instructions on sheets of paper with illustrations and short descriptions of each stage of the test. See Appendix D for Screen Shots of the task, accompanied with an explanatory text.

The dependent variable "Precision" refers to the actual precision of one´s short term memory in the Shape task. Precision is the participants' average distance, measured from the centre of their wedge to the correct shape in all trials. Precision is measured in degrees. Another dependent variable is "Confidence"; this is the average angular width from the participants´ best guess to the edge of the wedge. "Target Found" measures how often the participants are able to include the correct shape and is an estimate of the participants´ precision. The dependent variable "Gain" is the average score for all trials. The score is zero if the participants miss the correct shape completely, if they include the correct shape in their wedges they are rewarded with 8 points, minus any residue included in their wedges. This is the feedback or the score that participants receive after each trial. The dependent variable "Ratio" is the ratio of the confidence interval to precision. This is calculated by dividing the size of the confidence variable by the precision variable for each of the trials within one subject, before these values are averaged.

Beads Task

The beads task was created by Phillips and Edwards in 1966. The task has been widely used in previous research on JTC in Schizophrenia in particular and it is based on a Bayesian assumption about probabilistic reasoning. Huq et al. (1988) were the first to use the beads task in research on psychosis. We have chosen to adjust the original beads task, although we have kept the overall idea. We use two virtual bags of black and white beads; the first bag contains 80 black and 20 white beads, the second bag contains 80 white and 20 black beads. Huq et al. used an 85/15 ratio, the colours were different and they used jars instead of bags, but the basic idea is the same. In the original task, without seeing which jar the beads were drawn from, participants were shown one bead at the time. The order of beads drawn was set for Huq et al.´s participants whereas our order was completely random. The participants' task was then to signal when he/she had seen enough beads to be certain of which jar the beads were drawn from and the trial would then be over, the number of draws made within such a trial is called draws to decision. More Schizophrenics than controls decided after one or two draws, which would be interpreted as a Jumping to Conclusions bias (Huq et al., 1988).

One of the changes we have chosen to make here is that the participants have a time frame for their decisions of ten seconds for each bead, to make it more likely that people provided a subjective probability estimate rather than the result of an explicit calculation. By wanting to make the task consistent with what people may experience, not that people draw beads out of bags on a regular basis, the bag from which the beads were drawn had on an average a 50% probability to change within a sequence of 20 beads. Importantly, the participants were aware that this change could happen. This gives the participants an excuse to change their probability estimates from one extreme to the other, making it more likely that we will see an effect of hypersalience or overestimation of conviction, that patients will either change their minds quickly, or stick to their first guess. Unlike the original task, which imposes a restraint which is not applicable to the real world, where things could change, ergo one should be ready to alter one´s inferences. This also lets participants do the task over and over again and it would not matter if they had heard about the task beforehand. This possible change in bags with random samples drawn every time makes it harder for participants to apply a simple rule of thumb to manipulate ones results one way or the other and lets us use the task over and over again. Also Rodier et al., (2011) found that people changed their minds in regards to which bag they chose, even when they had been told that no such change was happening.

Previous research has shown schizophrenics with a JTC bias have a tendency to decide quickly and to be rather adamant in their convictions. One would therefore expect the Schizophrenics to need more draws before changing their decision in the event of a change in bags. On the other hand, Rodier et al. (2011) found that draws to decision correlated negatively with delusional ideation, and with how sure the participants were if they were to change their minds, but they found no correlation between delusional ideation and the number of beads required to change one´s mind. Therefore this change in the Beads task is very interesting. I did not ask the participants to signal when they are absolutely certain of which bag the beads are drawn from, which would be the draws to decision version. The participants´ task in our version is to, after each bead has been drawn, indicate how likely it is that the beads were drawn from either bag with the help of a slider bar.

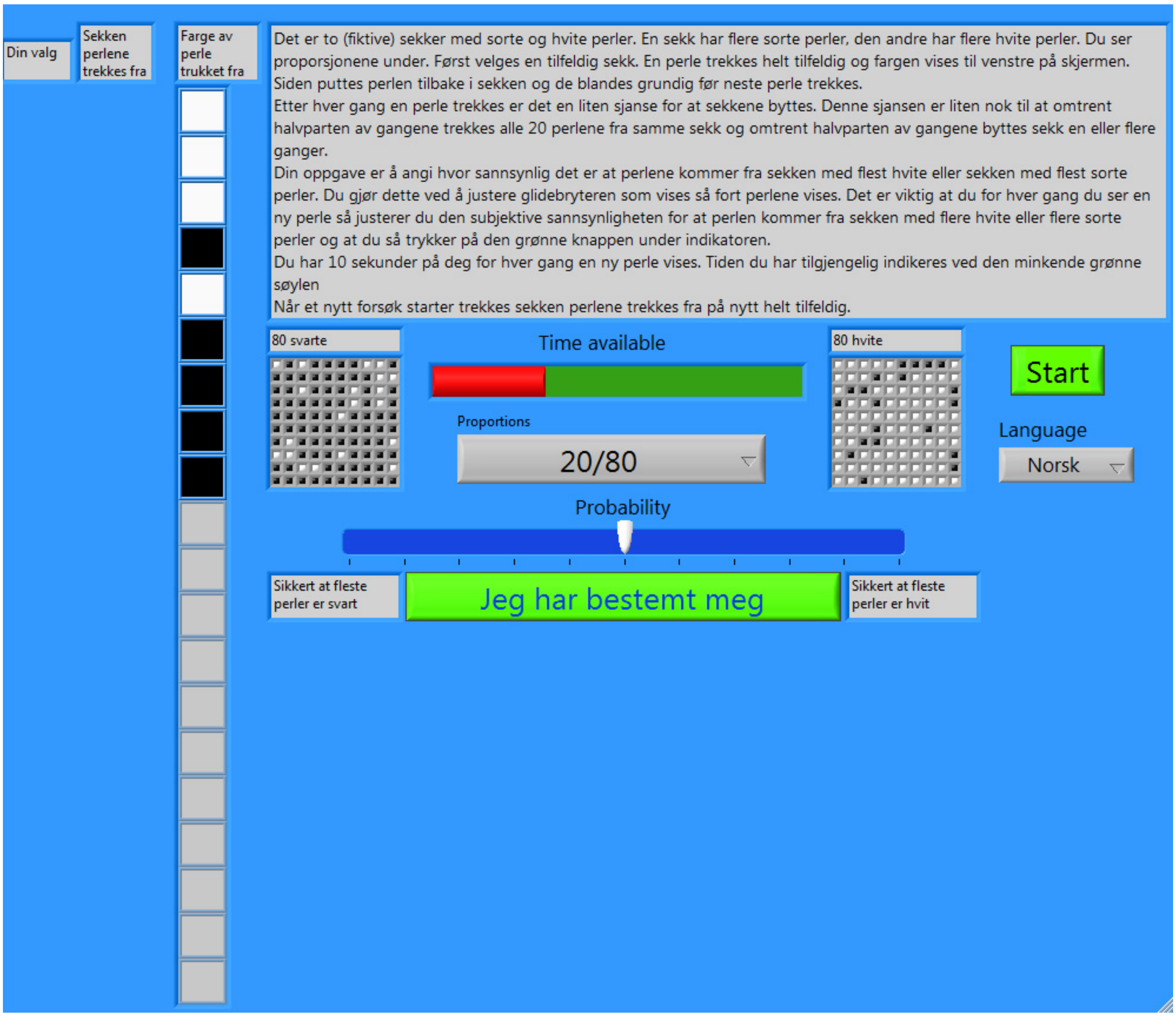

Fig. 6: Screenshot of the revised beads task after 9 draws in a trial. The text was presented to the participants before the trial began. The red bar expanded to the right at a uniform speed, taking 10 seconds to make the green disappear, which is when time ran out to make a probability estimate. A slider bar allowed the participants to indicate their subjective probability estimate of the series of beads having been drawn from the bag with more white or the bag with more black beads. After estimating probability, participants were required to press the green button underneath saying "Jeg har bestemt meg", or "I have decided". The text was given in Norwegian, but the English translation is this: "There are two (virtual) bags with black and white beads. One bag has more black beads, the other has more white beads. You see the proportions below. First, one bag is chosen at random. A bead is chosen randomly, and the colour shown to the left. Then the bead is put back in the bag, and they are thoroughly mixed before the next bead is chosen. After every time a bead is chosen, there is a small chance that the bag will be switched. It is small enough that about half the time all 20 beads are drawn from the same bag, and about half the time the bag can switch one or more times. Your task is to decide how likely it is that the beads come from the bag with more white or the bag with more black beads. You do that by adjusting the slider that shows up as soon as beads are being displayed. It is important that each time you see a new bead you adjust the subjective probability that it comes from the bag with more white or from the bag with more black beads, and that you then press the green button below the slider. You have a total of 10 seconds to decide each time you are shown a new bead. The time that is available to you is represented by the shrinking green bar. When a new trial starts, the bag from which the beads are drawn is again chosen at random."

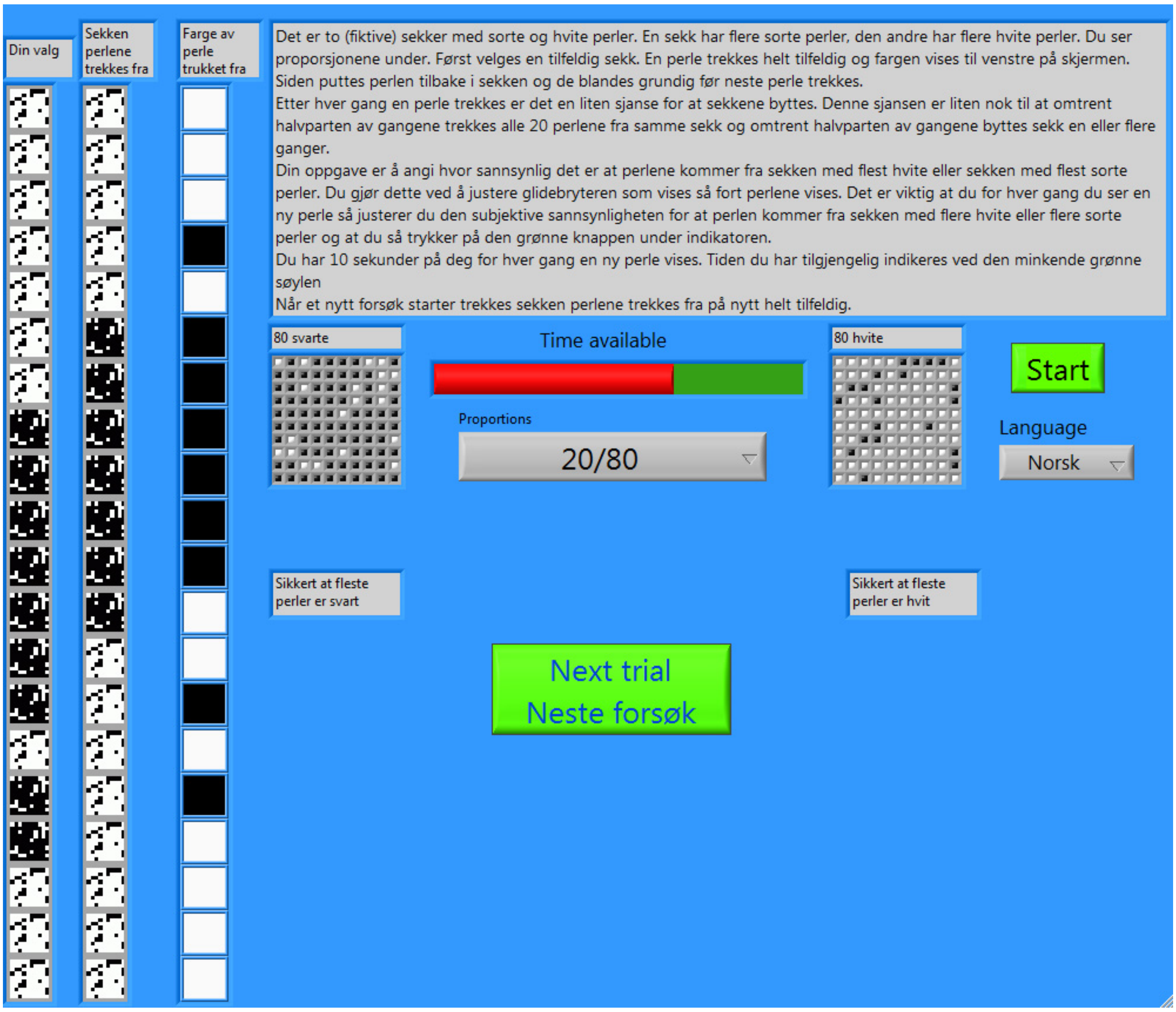

Fig. 7: Screenshot of the revised beads task after the completion of a trial. The column to the left is what bag the participants have estimated to be the more likely source, the one in the middle shows which bag the beads were actually drawn from and the column to the right are the beads that were shown to the participants.

When the participants have completed a trial with 20 draws, two rows appears next to where the beads were indicated (See fig. 7). These rows represent from left to right, respectively, the bag from which the participant reported that the bead was drawn from and the bags the beads were actually drawn from. This allows the participants to look at their own decisions in retrospect and compare them to the blueprint before moving on to the next trial. This feedback does not report the subjective probability reported. All participants` complete 5 trials of one sequence each á 20 beads. The sequence in each trial is random, a fixed sequence might have made it easier to compare the results and in this case we could have used a fixed sequence. But there are intentions to use this test later in a repeated measure design and a fixed sequence might yield to learning effects. In appendix E, you can see a screenshot of the beads task as it was first presented for the participants.

A mathematician, Håkon Tjelmeland at NTNU, created two mathematical optimal solutions for the beads task. The first model was of an ideal Bayesian observer giving optimal probabilities for each bead, knowing that the source can change through a sequence, but is ignorant about the probability of which the bag changes. The second model is of an ideal Bayesian observer, giving the optimal probabilities for each bead, who knows the probability of a change in source through a sequence. The first model was used as a blueprint to which we compared the participants´ results. For each pair of successive beads, I calculated how much the probability estimates had changed. I calculated those slopes both for participants and for the first mathematical model. Each series of 20 beads yielded 19 slopes. These values were averaged across all trials. The average slope indicates how much each new bead changed a participant´s probability estimate. I then subtracted the mathematically optimal value, from that of the participant. A negative slope suggests an underestimation of change and a positive slope suggests an overestimation of change relative to the optimal Bayesian model. You can see Tjelmeland´s mathematical optimal solution in appendix F.

Surveys

All of the four surveys; Cognitive Biases Questionnaire, Short Need for Closure scale, Theory of Mind and Becks Depression Inventory were translated into Norwegian and presented via a webpage (survey.svt.ntnu.no). All surveys were filled out via public Internet connections to ensure anonymity. Most of the Schizophrenia patients filled out a paper version of the survey and I put the results into the online version. If there is a group difference in the results of the precision task, we can see if there is a correlation between prediction error and one of the biases measured by the surveys.

Cognitive Biases Questionnaire (CBQ)

The Cognitive Biases Questionnaire (CBQ) was developed by Peters et al. in 2013.s It is designed to capture 5 cognitive biases, Jumping to Conclusion, intentionalising, catastrophising, emotional reasoning and dichotomous thinking, all of which seem to be relevant in psychosis (Irwin, Dagnall & Drinkwater, 2012). CBQ is a multiple choice questionnaire that consists of 30 short descriptions of situations from everyday life. These 30 descriptions are divided into two themes; 15 of these are related to abnormal perception and 15 to threatening events. A hypothetical situation is presented together with three alternative ways to react. The participants are asked to imagine themselves in each situation as vividly as they possibly can and to pick the alternative response (A, B or C) that best describe what they feel about the situation. The responses A, B and C each represent A) absence of bias, B) presence of bias with some qualifications or C) presence of bias (Irwin et al., 2012). For every cognitive bias, there are six descriptions for each of the five cognitive biases. All of the responses, ranging from A to C are ranged from 1 to 3, where 1 equals no bias, 3 equals that there is a bias. The maximum possible score on this questionnaire is 90, 45 for each theme. The scoring key for this questionnaire is as follows: TE = Threatening Events, AP = Abnormal Perception, I = Intentionalising, C = Catastrophising, DT = Dichotomous Thinking, JTC = Jumping To Conclusions, EBR = Emotion Based Reasoning. The scores for each theme, but also biases are then calculated and used in the analysis. What is called Jumping To Conclusions in this questionnaire has not yet been tested against choice patterns in the beads task. It is therefore not yet known whether the questionnaire and the beads task measure the same thing. You can see the full, translated version of CBQ used in this study in appendix G.

Short Need for Closure Scale (SNFC)

The Need for Closure Scale was developed by Webster and Kruglanski in 1994 (revised by Roets & Van Hiel, 2007) and is a scale to measure an individual´s NFC. See Appendix H for my translation and the scale as it was presented to the participants. NFC is a continuum and people high in NFC prefer structure, order and predictability, and detest chaos, ambiguity and unpredictability (Roets & Van Hiel, 2011).

The scale originally consisted of 42 items, the revised only 41, but several researchers have attempted to shorten the scale on seemingly random grounds. The Short Need for Closure Scale (SNFC) was created with the intent to make a validated shortened scale (Roets & Van Hiel, 2011). They chose the three items with the best factor loadings on each of the five facets, and found a high correlation with the full length version and reduced the full length questionnaire to 15 questions that are answered on a Likert scale with six options from 1-strongly agree to 6-strongly disagree. The scale still consists of the five original facets with three questions for each; preference for order, preference for predictability, decisiveness, discomfort with ambiguity and closed-mindedness. McKay et al., (2006) found that intolerance of ambiguity and decisiveness correlated with delusion proneness, but that none of the other three facets of NFC did. JTC bias also correlated with delusion proneness, but based on this evidence, one cannot conclude that the NFC is what drives the JTC in a delusion prone individual. Of the five facets of NFC, only decisiveness correlated with JTC, but those who, in the questionnaire, reported being more decisive needed to see *more* beads to make a decision. One can conclude that these two biases both make largely independent contributions to being prone to delusions. If there is a difference between groups in the precision task, this questionnaire can give us an idea of whether this difference correlates with NFC.

The SNFC scale is coded from 1 to 6 for all 5 facets, this reflected the Likert-scale, but for some of the items the questions were reversed, meaning that the scores also had to be reversed (1=6, 2=5, etc.). The score on all items was added up for each facet.

Theory of Mind (ToM)

The Theory of Mind (ToM) task that I used is based on Young, Cushman, Hauser and Saxe (2007). It contains a standardized series of scenarios with a description of a fictive situation. The protagonist of the story may or may not intend to harm another person, the victim. Further the stories differ in their outcome, either the victim is or is not harmed. The participant´s task is to say whether or not he/she believe the protagonist acted in a way that was permissible or impermissible. Young et al. have developed several such scenarios; I translated those to Norwegian and chose the protagonist´s knowledge about the situation, his/her action and eventually the outcome. Here is one example of one such scenario:

<table>
<tr><td colspan="2">BIKE
Ginny's classmate wants to borrow her bike to go mountain biking. Ginny's bike has just come back from the repair shop. The brakes had not been working.</td></tr>
<tr><td>The brakes on Ginny's bike are working perfectly now, so the bike is safe to ride.</td><td>The brakes on Ginny's bike still aren't working at all, so the bike is very dangerous to ride.</td></tr>
<tr><td>The people at the repair shop told Ginny that the brakes are fully fixed now, and gave her a demo to explain how they were fixed, so she believes the bike is safe.</td><td>The people at the repair shop told Ginny that the brakes are still broken, and gave her a demo to explain why they aren't fixed, so she believes the bike is unsafe.</td></tr>
<tr><td>Ginny lends the bike to her classmate. Her classmate bike up a mountain and has a wonderful time.</td><td>Ginny lends the bike to her classmate. Her classmate bikes off a cliff on the side of the mountain road because she can't brake.</td></tr>
</table>

Table 2: An overview of one of the scenarios from Young et al. (2007). I first chose whether or not the bike was fixed, then whether Ginny knew about any defect or not and in the end I chose an outcome, whether or not Ginny´s friend hurts herself or not.

In the example of the bike-scenario from table 2, I composed this scenario:

> ”*BIKE*
> *Ginny's classmate wants to borrow her bike to go mountain biking. Ginny's bike has just come back from the repair shop. The brakes had not been working.*
> *The brakes on Ginny's bike still aren't working at all, so the bike is very dangerous to ride. The people at the repair shop told Ginny that the brakes are still broken, and gave her a demo to explain why they aren't fixed, so she believes the bike is unsafe.*
> *Ginny lends the bike to her classmate. Her classmate bikes off a cliff on the side of the mountain road because she can't brake*.”

The participants are then asked to rate the action of the protagonist as permissible or impermissible through a 4 point Likert-scale. I included 12 such stories in our survey, where 3 of them had a negative intention and a negative outcome, 3 had a negative intention with a neutral outcome, 3 had a neutral intention with a negative outcome and 3 of them had a neutral intention with a neutral outcome. I have attached the ToM-survey as presented to the participants, you can see it in appendix I.

This ToM-survey looks at the participants’ ability to understand the protagonist´s thinking and intentions. This is particularly interesting for the ASD-group as earlier research has shown that people with autism may have difficulties with these kinds of empathetic assignments (Baron-Cohen, Leslie & Frith, 1985). Healthy controls are expected to rate outcomes with a negative intent as less permissible than those with a neutral intent, the Asperger controls are expected to rate negative outcomes as less permissible than positive outcomes, unaffected by the protagonist´s intent.

Corcoran, Mercer and Frith (1995) looked at Theory of Mind in 55 schizophrenic patients with non-psychotic psychiatric controls as well as healthy controls in a “hinting” task. Participants were shown a dialogue and were then asked to infer the intentions behind obvious hints dropped by the protagonists in the dialogue. If the participants were able to infer another appropriate intention than what was uttered by the protagonists they were awarded two points. If the participants just repeated what they had just heard or were completely wrong in their inference the subjects was presented with more of the story helping them further to understand the hint. If the participants were able to infer an appropriate intention at this point they were awarded one point. Failure to identify the intention at this point would result in null points. Corcoran et al. found that patients with schizophrenia scored lower in the task compared to both control groups. The schizophrenics with paranoid delusions performed the poorest of all on the hint task.

Fanning et al. (2012) conducted a study to investigate a link between social cognition impairments and impairment in neurocognition, both symptoms of schizophrenia. Their results showed that more than ⅔ of the patients showed impairments in both domains, ¼ of the patients showed impairments in social cognition, but not in neurocognition, but only a single patient showed impairments in neurocognition, but not in social cognition. So in the question of what came first, these results are interpreted as evidence that neurocognition is a "*"necessary" basis of social cognition."* (Fanning et al., 2012, p.70). Bar-on, Tranel, Denburg and Bechara (2003) claim that emotional and social intelligence, are independent of cognitive intelligence. However they separate the personal judgement in decision-making from cognitive intelligence and claim that the neural systems supporting judgement in decision making may overlap with the neural systems supporting emotional and social intelligence. Abu-Akel et al. (2015) recently conducted a study where 201 healthy subjects´ perspective-taking abilities were tested. They found that in people who scored high in both psychotic and autistic traits, the effects of the two on socio-cognitive performance cancelled each other out to some extent. This, along with Brosnan, Ashwin and Gamble (2013) is interpreted as support for the two disorders being on opposite ends of a continuum in regards to problems related to theory of mind, supporting Crespi and Badcock´s (2008) hypothesis that autism and schizophrenia are diametrical disorders of the social brain.

I have chosen to score the different scenarios by whether or not they are morally permissible, which means that the outcome is not interesting, only the intentions of the protagonists. If the protagonist believes nothing bad will happen, the scenario is scored as morally permissible, 1. If, however, the protagonists´ intent is harm the scenario is scored as morally impermissible, 4, irrespective of outcome. The participants´ total score of morally permissible (1 or 2) is then summarized, so is their score of morally impermissible (3 or 4) and the difference between these two total scores is the dependent variable Permissible_diff. As there are 6 morally permissible, and 6 morally impermissible scenarios, the first score should ideally be 6 (1x6) and the second score should be 24 (4x6) with a difference of 18. The smaller the difference, the worse the participants are at ToM.

Beck Depression Inventory (BDI)

Aaron T. Beck developed the Beck Depression Inventory (BDI) in 1961. The BDI is attached in appendix J. It is a well-recognized, standard test for assessing the level of depression with high validity and reliability in separating depressives from non-depressives (Beck, Steer & Carbin, 1988). We have used the latest version of BDI, the BDI-II. Beck, Steer and Brown developed this revision in 1996 in an attempt to comply with a change in several of the diagnostic criteria for major depressive disorder. Some of the questions were revised, some items were replaced or revised and the cut-offs used in the original BDI was revised. The BDI-II contains 21 questions. The answers are scored on a scale from 0 to 3, where the higher scores indicate depressive symptoms. After completing the survey, this scale codes answers and the score are simply added together for a total score of BDI-II, which is our dependent variable for this survey.

The cut-offs from the revised version (Roelofs et al., 2013) are:

- Minimal Depression, BDI-II range 0–13,
- Mild Depression, BDI-II range 14–19,
- Moderate, BDI-II, range 20–28
- Severe Depression, BDI-II range 29–63.

This test was used to see if any of the participants showed signs of being depressed, as depression might interfere with peoples´ motivation to perform well on tasks.

Procedure

All of the participants were given a short description of the background and aims of the study before signing an informed consent form. This consent form was signed by all of the participants and collected before the testing began. After completion, participants were debriefed and if interested also told our research hypothesis. I gave them our researchers´ contact details in case they had any further questions or if they no longer wanted to participate in the study and asked for retracting of their results.

The participants also filled out a form with demographic variables. All of the participants were given a few sheets of paper, with pictures of the precision task and a few words explaining the task. When the participants had gone through the papers I answered any remaining procedural questions before giving a short demo of four trials of the precision task.

The participants were all asked whether they understood the task before launching the precision task.

After completing the precision task the participants read a short text describing the beads task in the computer program. Any questions were answered with focus on procedural clarifications and a short demo was given. The participants were thereafter asked whether the task was understood before launching the beads task. The precision task was always completed before the beads task. After the computerized tests were completed, the healthy controls and persons with an autism spectrum diagnosis went online to fill out the survey. In the case of the schizophrenia patients I either sent them the URL to the online version of the survey or they received a paper version of the survey. I emphasized that they should fill it out within one week, but did not further press them. After one week I collected the paper versions of the survey or reminded those who had not filled them out yet to please do so.

The healthy controls were tested either alone in an office with dim lighting to increase the contrasts of the computer screen or in a computer room at The Department of Psychology, NTNU together with other participants, providing ideal testing options too in regards to lighting and noise.

The schizophrenia patients were tested alone in a room at Østmarka, the mental institution in which they were admitted. They did not complete the surveys and computerized tests all at once, but the two were divided as to minimize the strains on the patients. Some of the questions in the questionnaire were of a personal character so it might also be possible that I reduced the demand characteristics by letting the patients fill them out alone instead of being or feeling observed.

All of the Schizophrenia patients did the Shape Precision task, one of them, however did not complete the beads task. And only 8 schizophrenics filled out and returned the surveys. All healthy controls finished both computerized tests and all of the survey.

All of the schizophrenia patients and healthy controls were tested on a laptop, a Lenovo 3000 G530 Notebook Model 444622G. Whereas the Asperger controls were tested stationary computers, on a Dell OptiPlex 9030 AIO.

Data Analysis

When I finished the data gathering process, all data was copied into SPSS. For the shape precision task and beads task data was copied directly from the output files from the program used to run the tests. The surveys were scored in advance with the standardized scoring for each survey. As there were only 4 participants with Aspergers, they were excluded from the analyses of group differences, but included in the correlation analysis to yield a larger sample and possibly a wider range of values.

All analyses were run in IBM SPSS, version 21 on a 13" Macbook Air, with OS X 10.8.3. For shape precision task, ANCOVAs with descriptive statistics were run for all four dependent variables; Precision, Confidence, Target found, Gain and Ratio with Age and Sex as covariates. For the beads task an ANCOVA with descriptive statistics was run on dependent variable Slope with Age and Sex as covariates. One participant from the schizophrenic group did not complete the beads task, so N was reduced to 19 for the schizophrenic group with regards to dependent variable Slope. Only 7 schizophrenics completed and returned the surveys, so N was reduced drastically for the next group analyses. As the schizophrenic group was so small, the healthy control group was reduced by matching them to fit the schizophrenic group of 7 that completed the survey with regard to age and sex. This way both groups had N=7 for the group analyses of surveys. An ANOVA with descriptive statistics was then run for dependent variable JTC from the cognitive biases questionnaire. The last ANOVA with descriptives was then done for ToM results, using dependent variable Permissible_diff. Spearman´s correlation was then run for the computerized tasks and the survey results. For the explorative correlation where I had no previous hypothesis, I corrected the significance level to .0125, a lenient correction á la Bonferoni, .05/4 (number of tasks-1); also Spearman´s correlation is more conservative than Pearsson´s.

Results

Demography

Group	N computerized tests (female)	N surveys (female)	Age		BDI	
			M	SD	M	SD
Schizophrenics	20 (3)	7 (2)	26.15	5.14	12.44	10.30
Healthy Controls	18 (8)	19 (8)	24.53	2.61	6.32	7.96
Asperger Controls	4 (4)	4 (4)	27.25	10.11	11.25	5.74
Total	42 (15)	30 (14)	25.53	4.81	8.66	8.70

Table 3: Demographics for the three groups.

In table 3 you can see the demographical distribution of all participants. There were 20 schizophrenic patients (only 19 in the modified beads task), 3 of which were female, who participated in the Shape precision and beads task. Unfortunately, only 7 of the schizophrenics (2 female) completed and returned the surveys. The schizophrenic group had an average score of 12.44 with a standard deviation of 10.30 in the depression inventory, whereas the healthy controls had a mean score of 6.32 and a standard deviation of 7.96 in the BDI. The Asperger group had a mean score of 11.25 and a standard deviation of 5.74 on the BDI. The results of the BDI yielded no group difference $F(2,28) = 2.95$, $p > .05$.

Schizophrenics

Participant number	Age	Sex	Diagnosis	Antipsychotic drug dose equivalent to chlorpromazine
1	23	Male	F20.8	100 mg
2	34	Male	F20, F15.5	
3	26	Male	F25, F70	400 mg
4	30	Male	F20	
5	21	Male	F20.3	
6	32	Male	F20	400 mg
7	19	Male	F20	300 mg
8	22	Female	F20	1600 mg
9	21	Male	F20	
10	31	Male	F22	666 mg
11	33	Male	F20, F15.2	119 mg
12	28	Male	F22	400 mg
13	25	Male	F20	400 mg
14	24	Female	F22	67 mg
15	18	Female	F20, F60.9	67 mg
16	29	Male	F20.8	150 mg
17	26	Male	F20.3	26 mg
18	26	Male	F20	400 mg
19	35	Male	F20, F95.2	
20	21	Male	F20	

Table 4: Demographics for each of the schizophrenia patients.

In table 4 you can see the 20 participants with a diagnosis along the schizophrenic spectrum, their age, sex, diagnosis and their medication at the time of testing. Dosage and medication has been converted to mg of a standard drug, chlorpromazine, with the help from Solveig Klæbo Reitan, Chief physician and specialist in psychiatry at St. Olav's Hospital. For some of the patients information about medication and dosage was not available.

Group differences in Shape Precision Task.

Variable	Group (N)	Mean	SD	SE	F(1,37)	Sig. (0.05)
Precision	Schizophrenics (20)	41.72º	19.81º	4.43º		
	Healthy controls (18)	25.43º	7.97º	1.88º		
					10.54	0.003
Confidence interval	Schizophrenics (20)	30.61º	13.38º	2.99º		
	Healthy controls (18)	22.99º	6.61º	1.56º		
	Group difference				5.42	0.026
Target found	Schizophrenics (20)	46.6%	16.9%	3.78%		
	Healthy controls (18)	57.52%	11.96%	2.82%		
					3.92	0.056
Gain	Schizophrenics (20)	-3.97	6.9	1.54		
	Healthy controls (18)	2.18	2.33	0.55		
					11.31	0.002

Table 5: Descriptive results from four variables of the shape precision task: Precision, Confidence, Target found, Gain.

In the Precision variable the schizophrenic group´s best guess regarding the identity of the shape in question on average deviated from the actual shape by 41.72º with a standard deviation of 19.81º. The healthy controls were more precise. Their best guess deviated from the correct shape by an average of 25.43º, with a standard deviation of 7.79º. $F(1,37) = 10.54$, $p < .01$, $\eta^2 = .237$.

In the Confidence variable the average size of the confidence interval set by the schizophrenics around their initial guess was 30.61º, with a standard deviation of 13.38º. Healthy controls believed their memories to be more precise in absolute terms, setting average confidence intervals of 22.99º, with a standard deviation of 6.61º. $F(1,37) = 5.42$, $p < .05$, $\eta^2 = .137$.

In the Target Found variable, Schizophrenics on average found the correct shape 46.6% of the trials, with a standard deviation of 16.9%. The healthy controls found the correct shape on average in 57.52% of the trials, with a standard deviation of 11.96%. However, this difference is not significant. $F(1,37) = 3.92$, $p > .05$, $\eta^2 = .103$.

In the Gain variable the schizophrenic group scored an average of -3.97 points with a standard deviation of 6.9. The healthy controls scored significantly higher and their average score was 2.18 with a standard deviation of 2.33. Which means that the healthy controls were better at finding the correct shape and limiting the surplus area in their wedges. $F(1,37) = 11.31$, $p < .01$, $\eta^2 = .25$.

As you can see from table 5, the group differences were significant at a P-level of .05 in three of the four variables; Precision, Confidence and Gain. I therefore present these results in the following diagrams. I also include a diagram of the differences in ratio of perceived to actual precision, the confidence- and precision variable (fig.10).

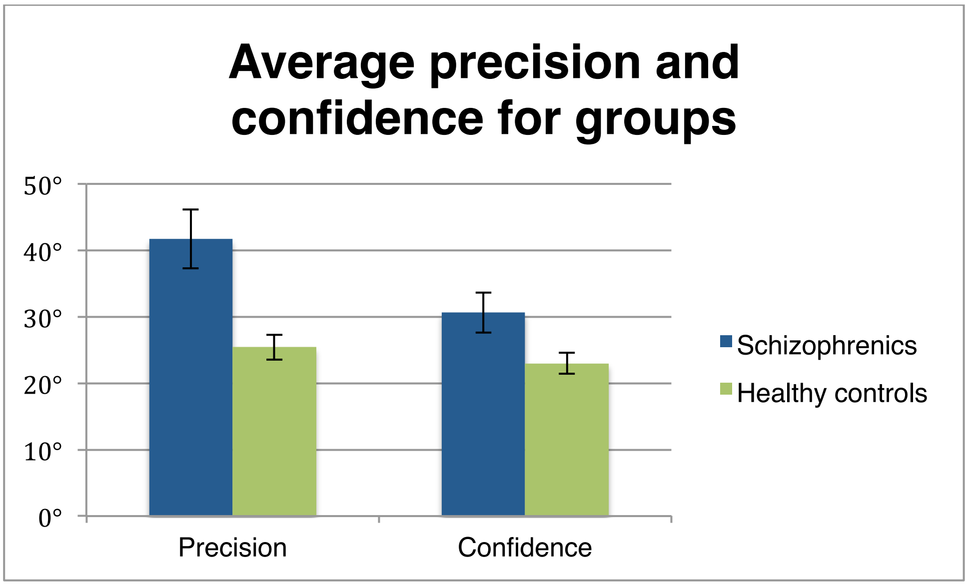

Fig. 8: Average precision and confidence for each group in degrees with standard error.

Figure 8 show the average precision for schizophrenics (41.72º) with a standard error of 4.43 and the average precision for the healthy controls (25.43º) with a standard error of 1.88. Partial $\eta^2 = .237$ and the average confidence in the schizophrenics (30.61º) with a standard error of 2.99 and for the healthy controls (22.99º) with a standard error of 1.56, $\eta^2 = .137$.

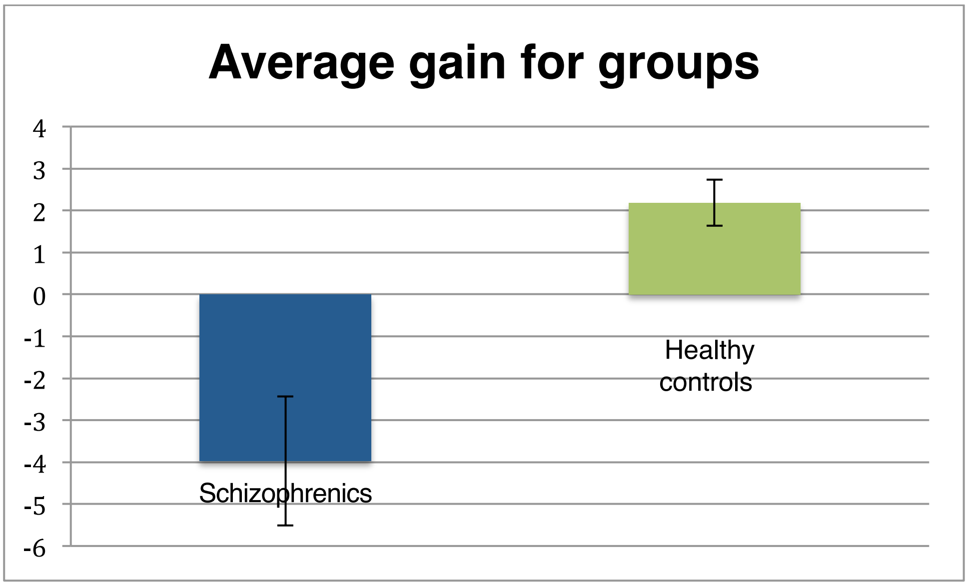

Fig. 9: Average gain for both groups with standard error.

Figure 9 shows a negative average gain in the schizophrenic group (-3.97 points) with a standard error of 1.54 and for the healthy controls (2.18 points) with a standard error of 0.55, $\eta^2 = .250$.

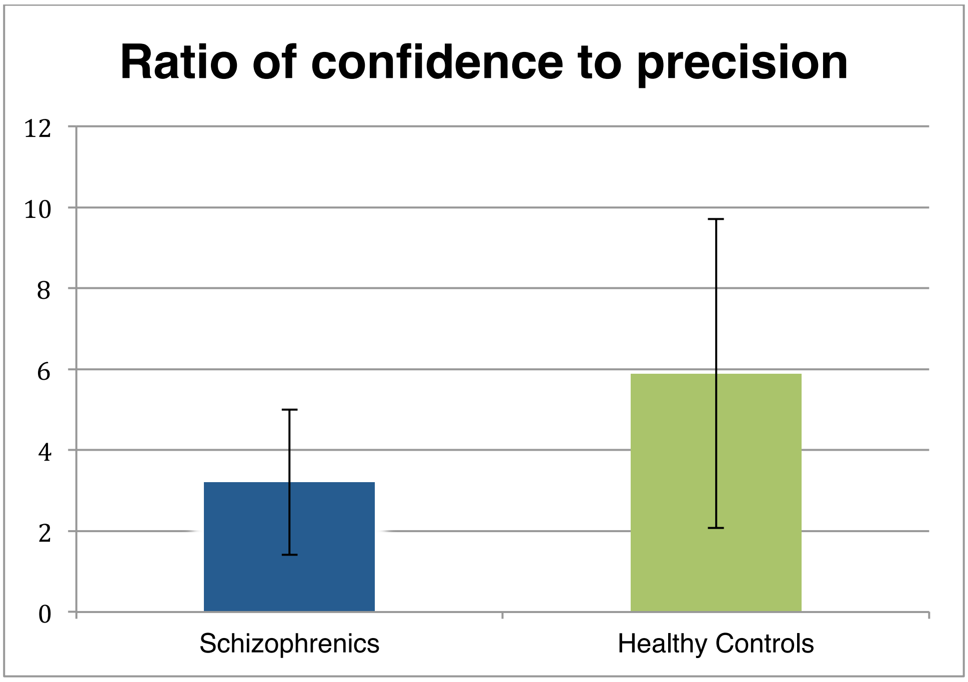

Fig. 10: Shows the ratio of confidence to precision schizophrenia group and the healthy control group, with standard deviations.

In figure 10 you can see the ratio of the confidence to precision variables from the shape precision task. The average ratio of the schizophrenia group was 3.20 (SD=1.79), the average ratio of the healthy control group was 5.89 (SD=3.82). $F(1,36) = 5.85$, $p = .021$, $\eta^2 = .147$.

Group differences in slope in the Beads Task

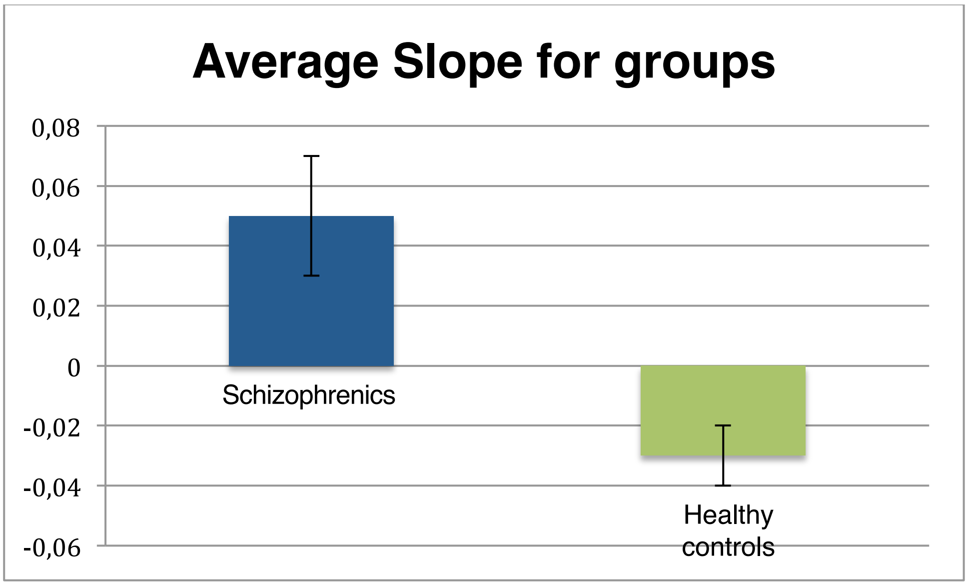

Fig. 11: Average slope for both groups with standard error.

As you can see in figure 11, in the beads task, slope variable, schizophrenics scored on average 0.05, with a standard deviation of 0.1 and standard error of 0.02. The healthy controls scored on average a negative score of –0.03, with a standard deviation of 0.06 and a standard error of 0.01. $F(1,36) = 10.24$, $p < .05$, $\eta^2 = .237$. Which would mean that the schizophrenic participants, on average, overestimated change as they had a positive slope, whereas the healthy controls on average underestimated change and had a negative slope. The baseline for comparing participants slope here is the ideal observer without knowledge of probability.

Surveys

For the group analyses of the survey variables the healthy controls were matched to fit the 7 schizophrenics that completed the survey with regards to variables Age and Sex. Both groups consisted of only 2 female and 5 male participants. There is a slight difference in average age, 26.86 years for the schizophrenic group and 25.57 years for the healthy controls. This difference is however quite small, and the difference is not significant at a .05 level.

F(1,13) = .27, *p* = .612. In other words, the average age difference is so small, we do not have to do ANCOVAs for the survey results, ANOVAs are sufficient.

Group differences in JTC bias as measured with CBQ.

Group (N)	Mean	SD	SE	F(1,13)	Sig. (0.05)
Schizophrenics (7)	11	2.52	0.95		
Healthy controls (7)	11.43	1.4	0.53		
Group differences				0.16	0.741

Table 6: Descriptive statistics of JTC from the CBQ.

Table 6 shows the average group differences in JTC-bias as measures by the CBQ, after matching the controls to the remaining schizophrenics. There was not a large difference in mean score of JTC; the schizophrenics had an average score of 11 with a standard deviation of 2.52, whereas the healthy controls had an average score of 11.43 with a standard deviation of 1.4. This small difference was not significant. *F*(1,13) = .16, *p* = .741.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.Precision																	
2.Confidence	.324*																
3.Target Found	-.619**	.192															
4.Slope m1	.336*	.195	-.140														
5.TE	.134	-.152	-.175	-.084													
6.AP	-.063	-.120	-.026	-.252	.339												
7.I	.106	.230	-.091	-.252	.515**	.040											
8.C	-.221	-.203	.131	-.208	.372*	.552**	.064										
9.DT	.216	.248	.165	.073	.194	.378*	.364*	-.079									
10.JTC	.046	-.239	-.134	.094	.621**	.355	-.033	.030	.044								
11.EBR	.096	-.302	-314	-.172	.492**	.685**	.028	.371*	.119	.340							
12.NFC_order	-.192	-.149	.142	-.406*	.291	.055	-.036	.061	-.095	.456*	.085						
13.NFC_predictability	-.026	.199	,031	-.115	.124	.104	-.084	-.087	-.161	.223	.187	.460*					
14.NFC_decisivness	-.144	-.036	.181	-.228	.358*	.258	-.003	.309	.031	.259	.298	.648**	.457**				
15.NFC_ambiguity	-.008	.239	.060	-.070	.409*	.046	.368*	-.089	.202	.317	.157	.472**	.654**	.458**			
16.NFC_closedminded	-.263	-.028	.070	.123	.174	.173	.154	-.011	.225	.041	.175	-.107	.203	.200	.294		
17.Permissible_diff	-.311	-.202	.258	-.479**	.085	.344	-.136	.209	-.023	.039	.286	.196	.284	.407*	.143	.238	

Table 7: An overview of the Spearmans Correlation between the results from the two computerized tests, cognitive biases as reported by CBQ and the different facets of SNFC, N=42 for the computerized tasks, N=29-31 for the survey results.

***. Correlation is significant at the .05-level (2-tailed).**

****. Correlation is significant at the .01-level (2-tailed).**

Correlations

Through Pearson´s correlation (table 7) I found significant correlations between Slope and Precision $r(39) = .336$, $p = .032$, but none of the other variables of the shape precision task. JTC as measured by CBQ did not correlate with Slope $r(27) = .094$, $p > .05$. ToM did not correlate with EBR $r(29) = .286$, $p > .05$. I predicted that there would be no relationship between NFC facets and JTC, JTC correlated with NFC_order $r(28) = .456$, $p = .011$

From my explorative analysis only one of the correlations survived our lenient Bonferroni correction criterion; there was a rather strong negative correlation between Slope and ToM $3(27) = -.479$ $p <.0125$.

Group differences in ToM

Group (N)	**Mean**	**SD**	**SE**	**F(1,25)**	**Sig. (0.05)**
Schizophrenics (7)	6.14	4.38	1.65		
Healthy controls (7)	12.29	3.99	1.51		
Group differences				7.54	.018

Table 8: Descriptive results from ToM task

Table 8 shows that the difference between morally permissible and morally impermissible is smaller, on average for the schizophrenic group, with the mean score of 6.14, a standard deviation of 4.39 and a standard error of 1.65. The healthy controls on average did better in the ToM task, their average score was 12.29 with a standard deviation of 3.99 and a standard error of 1.51, this was significant at a .01-level. $F(1,13) = 7.54$, $p = .018$

Discussion

In the shape precision task, I predicted that the schizophrenics´ confidence interval would be narrower relative to actual precision, compared to controls. On average, the patients actually drew larger confidence intervals, compared to the healthy controls. However, the size of the shape is completely irrelevant without knowing how good their precision was, as put in the words of Fletcher and Frith (2009, p.55); "*Dopamine-neuron firing encodes the precision or uncertainty of prediction errors and this precision weights the influence of prediction errors on interference (…) It is not the prediction errors per se that are faulty, it is the way that they are used and quantified. The size of the prediction error is meaningless without an estimate of its precision".*

The variable "Target Found" provides such an estimate; how many percent of the trials the correct shape was found. So even though the schizophrenics´ wedges were larger on average, they located the correct shape less often than the controls. This would mean that although the schizophrenic participants covered more shapes in their wedges they tend to miss the correct shape more often than the healthy controls. This difference, however, is not significant, but there is a tendency that is interesting. The difference in the gain variable, was significant, this shows that the healthy controls had a smaller prediction error, as they were better at identifying the correct shape, while reducing any surplus area. This variable, however, only take into account the trials where the participants found the target, not the ones where the target was missed. In the trials where schizophrenics correctly identified the target, they included too much surplus area, awarding them with minus points. This suggests that the healthy controls were better at identifying the correct shape, while limiting the surplus area of the cone, which awarded them with more points.

There was also a significant group difference in the ratio of confidence and precision, which means that there is a group difference in the ratio of the perceived to actual precision. The schizophrenics had a smaller, average ratio than did the controls. The ratio is calculated by dividing the width of the wedge by the distance from the target to the centre of the wedge, a smaller ratio means that one has a narrower confidence interval relative to actual precision. This result support the main hypothesis which states that patients with schizophrenia are thought to perceive their predictions as more precise than they really are.

It is, however, possible that the group difference in the results from the shape precision task could have an alternative explanation, namely that the schizophrenics and healthy controls differ in terms of criterion, not in perceived precision. Perhaps patients do have the exact same ratio of perceived to actual precision in their heads, but the schizophrenics might be more content with including a smaller proportion of targets. This would be analogous to the liberal acceptance account hypothesis (Moritz et al., 2008) stating that the schizophrenics do not collect as much evidence as a healthy control participant. If, however, this is the explanation of the difference between the two groups, then the size of the confidence interval should depend very much on how often people want to include the target, and people should differ from each other in that proportion. And those differences should predict the size of the confidence interval. That would mean that the correlation between confidence interval size and proportion of targets should be high, but it is only .192 and not significant (see table 7 for all correlations). If the size of the confidence interval is determined by perceived precision, and perceived precision is proportional to actual precision, then the correlation between confidence interval and precision should be high. It is .324. Because of this it would be necessary to collect more data, before it can be concluded that it is in fact perceived precision rather than differences in participants´ intended proportion included that has been measured.

I also predicted that the schizophrenics would overestimate change and have a steeper slope score in the beads task. The schizophrenics had a positive, steeper slope, whereas the healthy controls on average had a negative slope. This means that the schizophrenics overestimated change relative to the optimal Bayesian model and that the healthy controls underestimated change compared to the optimal Bayesian model. This is interpreted as support for the second hypothesis that schizophrenics will have a steeper slope than healthy controls. This in turn is support for Speechley´s (2010) hypersalience account, where schizophrenics´ internal threshold of acceptance is the same as for healthy controls, but they arrive there faster. This also helps explain why the schizophrenics perceived a change more often than healthy controls only after seeing one bead in opposite colour from the previous bead. This is the opposite of what Rubio et al., 2011 suggest. They suggest that there is a mishap in the integration of new evidence when strong initial assumptions have been established. If this were true, that schizophrenics have a tendency to ignore disconfirmatory evidence, patients would not be quicker than controls in changing their minds.

Whether the bags changed or not was completely random, therefore the distribution of bag-changes was uneven across subjects, given the few trials. This did however allow for more different probabilities that there was actually a change in bags, than a set order would have. And the possibility that the beads could change made it difficult for the participants to manipulate their results in the beads task even if they had heard of the task before. Because I was the one explaining the tasks, being so invested in this project, I could have unconsciously guided the participants towards how I anticipated that the different groups would perform. I therefore let the participants look at sheets of paper with pictures and explanatory text for the shape precision task, and read a paragraph of explanatory text in the beads task, before I would answer any questions to make the explanation and introduction to the tasks as similar as possible for all participants involved. I was in the same room as all of the participants when they completed the computer tasks and this may have led to an experimenter expectancy bias. On the other hand, the tasks judged the participants´ short-term memory and assessment of probability, and I would expect the only effect that I had on them was that they wanted to do their best, rather than to distort any results. I presume that none of the participants knew what performance was expected from them before the computerized tests were completed and they had their debrief as the informed consent form only gave away a minimum of information about previous research and what we expected from the study.

I expected to find a connection between perceived precision as measured by shape task and a greater perception of change in the beads task. I assumed that there would be a negative correlation between the participants´ size of perceived precision, measured by the confidence variable, and the perception of change as measured by the beads task. However, there was a positive correlation between the two, which means that participants who overestimated change in the beads task also had broader wedges in the shape precision task. Maybe the perceived precision as measured in the shape precision task is not the same thing as the perceived precision of probability that is measured by the beads task. Or maybe what is measured by the beads task is something entirely different all together. Further research with beads task including unexpected uncertainty and a task measuring perceived and actual precision would therefore be interesting.

I predicted that the schizophrenia group would score higher on JTC in CBQ than would the healthy control group. However, the CBQ results showed no significant difference between the two groups with regards to JTC bias. In fact, the healthy control group scored marginally higher on JTC on average than did the schizophrenic group. As previous studies (Huq et al., 1988; Garety et al., 2005; Moritz & Woodward, 2005; Veckenstedt et al., 2011) have found that schizophrenics more often than healthy controls show a JTC bias, this is interesting even without significant results. This could simply be due to our relatively small sample (7 in each group), but it could also be due to something else, Lincoln et al. (2010) only found that the acute schizophrenic patients showed significant signs of JTC, seeing that none of our patients were acutely psychotic during the day of testing. This could have had an effect on the results, but as there are ethical as well as practical implications of testing acutely psychotic patients, they are for example not able to give informed consent, this was the only option in this study.

Even though confounding variables are possible, I believe that what we have measured here is something entirely different than the JTC that has been measured earlier with the draws to decision in beads task. There was no correlation between JTC and the results of our beads task, which suggests that the two measurements measure something completely different. Peters et al. (2013) did not check whether what they chose to label JTC in the CBQ correlated with results from a draws to decision beads task. Also, the questions and answers associated with JTC in CBQ (questions number 6, 9, 17, 18, 21 and 29) do not immediately strike me as being more (or less) related to JTC than the other questions of the questionnaire. See Peters et al. (2013) for an overview of the scoring. Therefore they should have named this facet of CBQ something entirely different.

Another important difference between these two approaches measuring JTC is that the CBQ is a self-report measure, whereas task performance, in beads task, is an objective measure of JTC. Moritz, Ferahli and Naber (2004) state that schizophrenics have problems with insight, or self-awareness and that their neurocognitive self-evaluation (about memory for example) is not a reliable source for assessing schizophrenics´ neurocognitive functioning. Although they make a valid point, if this is true it would have severe implications on future research; one should not trust self-report measures with schizophrenics in regards to mapping cognitive distortions at all. Peters et al. (2013) suggests that the subjective JTC could be associated with emotional processes, at least more so than objective JTC that could be more associated with cognitive factors. It would be interesting to have something like the draws to decision task in the beads task in addition to the current measure, to see if there would be a difference in results from this and that of the JTC results from CBQ.

From the findings of Langdon et al. (2005), Fanning et al. (2012) and Lugnegård et al. (2013; 2015), I predicted that the schizophrenics would differ in their responses in the ToM from that of the healthy controls. The schizophrenics' difference between morally permissible and morally impermissible was significantly smaller than that of the healthy controls. Indicating that the healthy controls are better at distinguishing moral dilemmas based on other peoples' intentions, which in turn means that they have a better Theory of

Mind than the schizophrenic group. This coincides with the findings of Corcoran et al. from 1995 that schizophrenics are worse at perceiving hints than healthy controls.

I also engaged in an exploratory analysis, to see if there were any of the biases measured by the CBQ or SNFC-scale that correlated with JTC and could give us more information about this bias. Colbert and Peters (2002) suggested that JTC was caused by NFC. McKay et al. (2006), however, found that there was no correlation between NFC and JTC, except from a positive correlation between draws to decision and NFC-subscale decisiveness. The current study found that JTC correlated with SNFC-subscale order, but none of the other SNFC-subscales. This supports the hypothesis that JTC and NFC do not correlate, although it is important to note that this JTC is not the same bias as has been measured earlier by McKay et al. (2006) among others.

Freeman et al. (2006) found that participants who showed JTC in a salient reasoning task, where they were to say if a given emotional word was drawn from a bag of 60:40 negative or 60:40 positive words, were more likely to score higher on NFC scale. However, none of the other JTC-tasks, for example a beads task with a 15:85 ratio of beads, yielded evidence for a link between the two biases. This study however did use JTC as measured by experimental tasks rather than self-report as was done in the present study.

Initially, the BDI survey was included so that we could exclude any participant who showed signs of depression, in case depression could distort the results. As there was no group difference in BDI score, no participants were excluded on the basis of their BDI score. In reviewing the literature before I started testing, several tests and surveys seemed interesting. Among others a humour scale. This scale was used as a proxy for measuring creativity, assuming that delusions might come from too quick decisions from too little evidence and that a contributory factor might be an inability to think of alternatives, a lack of creativity. After a pilot study this scale was cut out of the study and replaced with ToM. The tests and surveys together with reading the consent form and filling out a scheme of demographics now took approximately one hour. We considered any more than this too much. Our schizophrenia group was already small, and the response rate on the surveys was even smaller.

Even though one always would like to test for every variable with relevance, I believe that any longer tests or surveys could have made these numbers decline. Knowing what I know now, I would have taken the BDI out of the surveys given to the schizophrenia patients, as their psychiatrists could have told me whether or not they had deemed the patient depressed. The survey results are based on answers on multiple choice questionnaires and self report surveys, many of which are of a private character. One of the disadvantages of this could have been that the participants may have lied to put themselves in a better light, or to appear/not to appear, as they believed a person in their sample group should, or to answer the questions in a way they think I would like them to. This is always a risk of self report, but I believe that the advantages of this method, like cost and time use, compared to interviews and observations, weighs up for this risk. Ideally one could have combined the surveys with for example observations, but given the timeframe priorities had to be made.

It is also curious that Fletcher and Frith (2009) and Van de Cruys et al. (2014) can arrive at such different symptoms when they seem to agree on theory. It might be, that what Van de Cruys et al. is talking about is a different kind of reaction to a prediction error than Fletcher and Frith. When Fletcher and Frith talk about how previous prediction errors influence the patients´ next predictions, what errors are learnt or not, depend on effect size applied to the sensorimotor domain. What Van de Cruys et al. could be talking about is prediction errors defined by large effect size applied to the hedonic domain, how surprising it is how much you like or dislike an experience. In other words, if an autist is surprised by how much like or dislike of he/she experiences from the prediction error, then, and only then will there be learning. Again, in the example of the bike ride, Fletcher and Frith´s schizophrenic would attribute the difference in time spent biking to and external source if the prediction of time was off with more than for example one standard deviation. Whereas mean that Van de Cruys et al.´s autist would only recalibrate their perceived precision if the prediction error caused a surprising amount of like or dislike, for example if he/she hates coming late. I have not looked into this in the present study, but it would be interesting for future research to see if such an explanation in differences between reactions to prediction error can explain Fletcher and Frith´s and Van de Cruys et al.´s differences in theory.

Conclusion

The sample in this study was relatively small. A larger sample would have given more statistical strength, but then again it would have taken more time, time that was not available for this project. There were, however, some interesting trends, which could be interesting for future research. Unfortunately I was not able to recruit enough participants on the autistic spectrum, further research on the two disorders are needed to establish whether or not these two are diametrical disorders. If this is true I can only imagine that it will have major implications on both the diagnostic and the treatment practices of psychiatry. One surprising finding was that there was no significantly higher prevalence of JTC in the schizophrenia group. It would be interesting to compare the JTC as measured by the CBQ and that of draws to decision in beads task to see if they are at all related. The main findings support previous theory that schizophrenics differ from controls with regard to statistical inference and perceived precision relative to actual precision, but also in regards to ToM.

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APPENDIX A – Form for Informed Consent

Forespørsel om deltakelse i forskningsprosjektet:

Kognitive forventninger og begrensninger i prosessering av sensoriske data

Bakgrunn og hensikt

Dette er et spørsmål til deg om å delta i en forskningsstudie for å undersøke hvordan vi prosesser informasjon som kommer fra sansene våre. Det er Psykologisk Institutt, NTNU i samarbeid med St. Olav og Autismeforeningen Trondheim som er ansvarlig for gjennomføring av studien. Studien ønsker å undersøke tre forskjellige grupper; universitetsstudenter, pasienter med en psykoselidelse og personer med autisme for å se om disse ulike gruppene skiller seg ut på ulike tester knyttet til hukommelse og andre kognitive prosesser.

Hva innebærer studien?

Studien innebærer at du skal løse to oppgaver ved hjelp av en datamaskin, samt at du fyller ut tre spørreskjema. De to oppgavene som skal løses på datamaskinen tar omtrent 30 minutter å gjennomføre, mens de ulike spørreskjemaene tar omtrent 20-30 minutter å fylle ut. Hvis det er slik at du ønsker tilbakemelding for hvordan du gjorde det på de ulike tester og spørreskjema kan du få denne informasjon ved å kontakte Robert Biegler på telefon 73 55 11 09, eller på epost: robert.biegler@svt.ntnu.no, etter endt gjennomføring av de ulike oppgaver knyttet til studien.

Mulige fordeler og ulemper

Det er en studie som ikke innebærer noen form for terapeutiske intervensjoner eller bruk av medikamenter. Det er ikke kjent fra tidligere at det å løse de ulike kognitive tester og fylle ut de ulike spørreskjema skulle medføre noen form for psykologisk ubehag. Om du likevel føler at du har behov for å snakke med noen i prosjektgruppen etter endt deltagelse i studien kan du kontakte psykologspesialist Roger Hagen på telefon 73 59 66 55 eller psykologspesialist Stian Solem på telefon 73 55 04 93. Vi vil da ta en samtale med deg i etterkant.

Hva skjer med informasjonen om deg som vi samler inn?

Data som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene og prøvene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger og prøver gjennom en navneliste. Dette betyr at alle data er avidentifiserbare. Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg. Denne navnelisten blir destruert når vi har gjennomført datainnsamlingen. Det vil da ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

Frivillig deltakelse

Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på neste side. Om du nå sier ja til å delta, kan du senere trekke tilbake ditt samtykke. Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte Dr. Robert Biegler ved NTNU, på telefon 73 55 11 09.

Med vennlig hilsen prosjektgruppen

Robert Biegler	Gerit Pfuhl	Stian Solem	Roger Hagen
Førsteamanuensis	Forsker/Postdoc	Førsteamanuensis	Førsteamanuensis
NTNU	NTNU	NTNU	NTNU

Samtykke til deltakelse i studien

Jeg er villig til å delta i studien

(Signert av prosjektdeltaker, dato)

Jeg bekrefter å ha gitt informasjon om studien

(Signert, rolle i studien, dato)

APPENDIX B – Form for Demographic Variables – Schizophrenic Participants

Demografiske variabler

Forsøks-ID:________________

1. Kjønn:

Kvinne ☐

Mann ☐

2. Alder:

______ år

3. Sivilstatus

Enslig ☐

Har kjæreste ☐

Gift/samboer ☐

Skilt/separert ☐

Enke/enkemann ☐

4. Jobbstatus (kryss av for alt som stemmer).

Fulltidsjobb ☐

Deltidsjobb ☐

Fulltidsstudent ☐

Deltidsstudent ☐

Attføringspenger ☐

Uføretrygd ☐

Pensjonert ☐

Arbeidsledig ☐

5. Høyeste fullførte utdanning

Grunnskole ☐

Videregående skole, yrkesfag ☐

Videregående skole, allmennfag ☐

Høgskole/universitet, inntil 3 år ☐

Høgskole/universitet, mer enn tre år ☐

Doktorgrad ☐

6. Diagnose(r), med symptomer ved testdato (sett inn testdato):

7. Medisinering, Navn på preparat og dose:

8. Sykdomsperiode, fra første innleggelse for psykose og frem til i dag:

9. Endring i tilstand fra testdato til fullførelse av spørreskjema (sett inn dato for innlevert spørreskjema)

10. Foreligger det en IQ-test av pasienten? Eller grunn til å tro at personens IQ ligger over eller under gjennomsnittet?

APPENDIX C – Form for Demographic Variables – Control participants

Demografiske variabler

Forsøks-ID:______________

1. Kjønn:

Kvinne ☐

Mann ☐

2. Alder:

______ år

3. Sivilstatus

Enslig ☐

Har kjæreste ☐

Gift/samboer ☐

Skilt/separert ☐

Enke/enkemann ☐

4. Jobbstatus (kryss av for alt som stemmer).

Fulltidsjobb ☐

Deltidsjobb ☐

Fulltidsstudent ☐

Deltidsstudent ☐

Attføringspenger ☐

Uføretrygd ☐

Pensjonert ☐

Arbeidsledig ☐

5. Høyeste fullførte utdanning

Grunnskole ☐

Videregående skole, yrkesfag ☐

Videregående skole, allmennfag ☐

Høgskole/universitet, inntil 3 år ☐

Høgskole/universitet, mer enn tre år ☐

Doktorgrad ☐

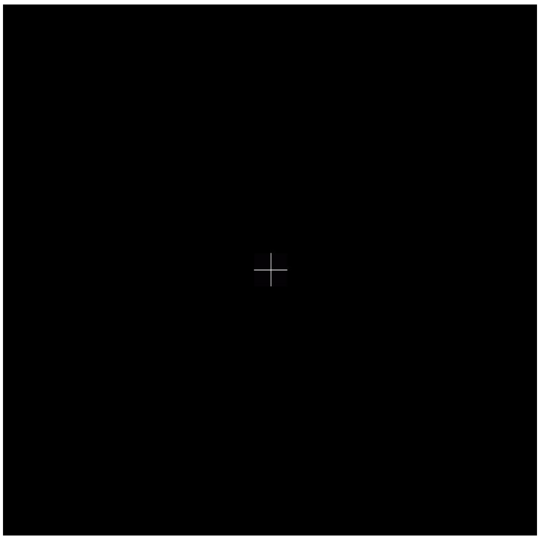
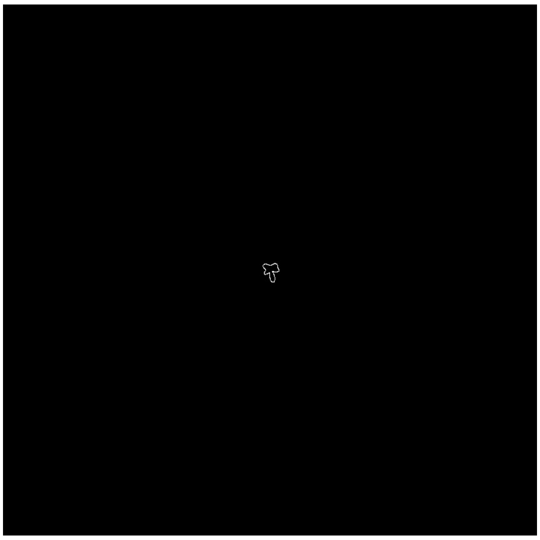
6. Er du diagnostisert med en psykisk lidelse? Hvis ja, hvilke(n) og tar du noen medikamenter i forbindelse med dette?

____

____

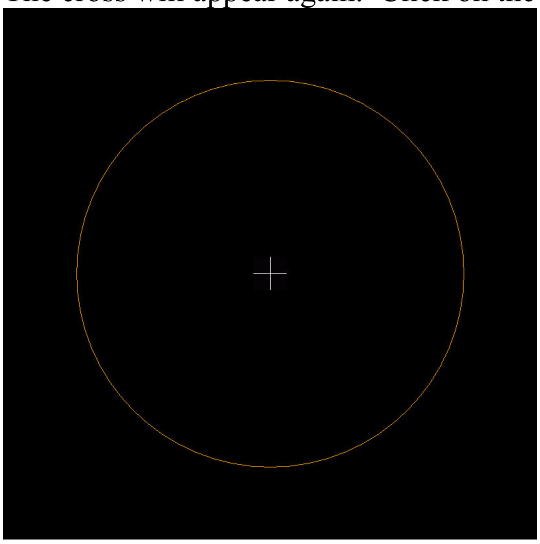
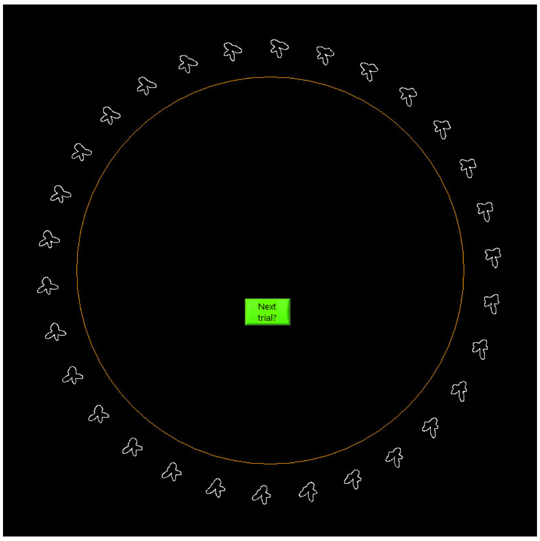
____

APPENDIX D – Instructions Shape Precision task

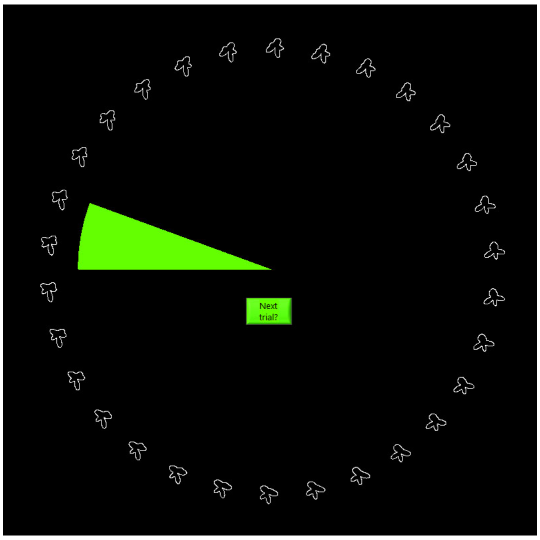
Each trial starts with a small white cross appearing roughly in the centre of the screen. Click on the centre of the cross.
A squiggly shape will appear at a randomly chosen location on the screen. Remember that shape.

The cross will appear again. Click on the centre.

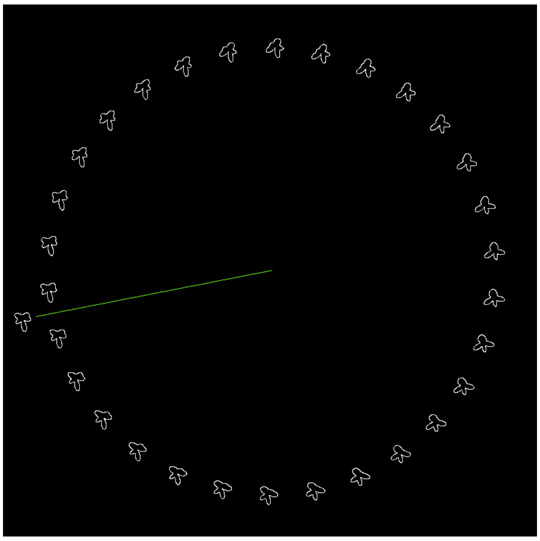



You will see 30 shapes. Click inside the circle, either as close as possible to the shape you remember, or between the two most similar shapes. You will see a line from the centre of the circle to that spot you have chosen. If you have totally forgotten, you have the option to go on to the next trial by clicking on the green button.

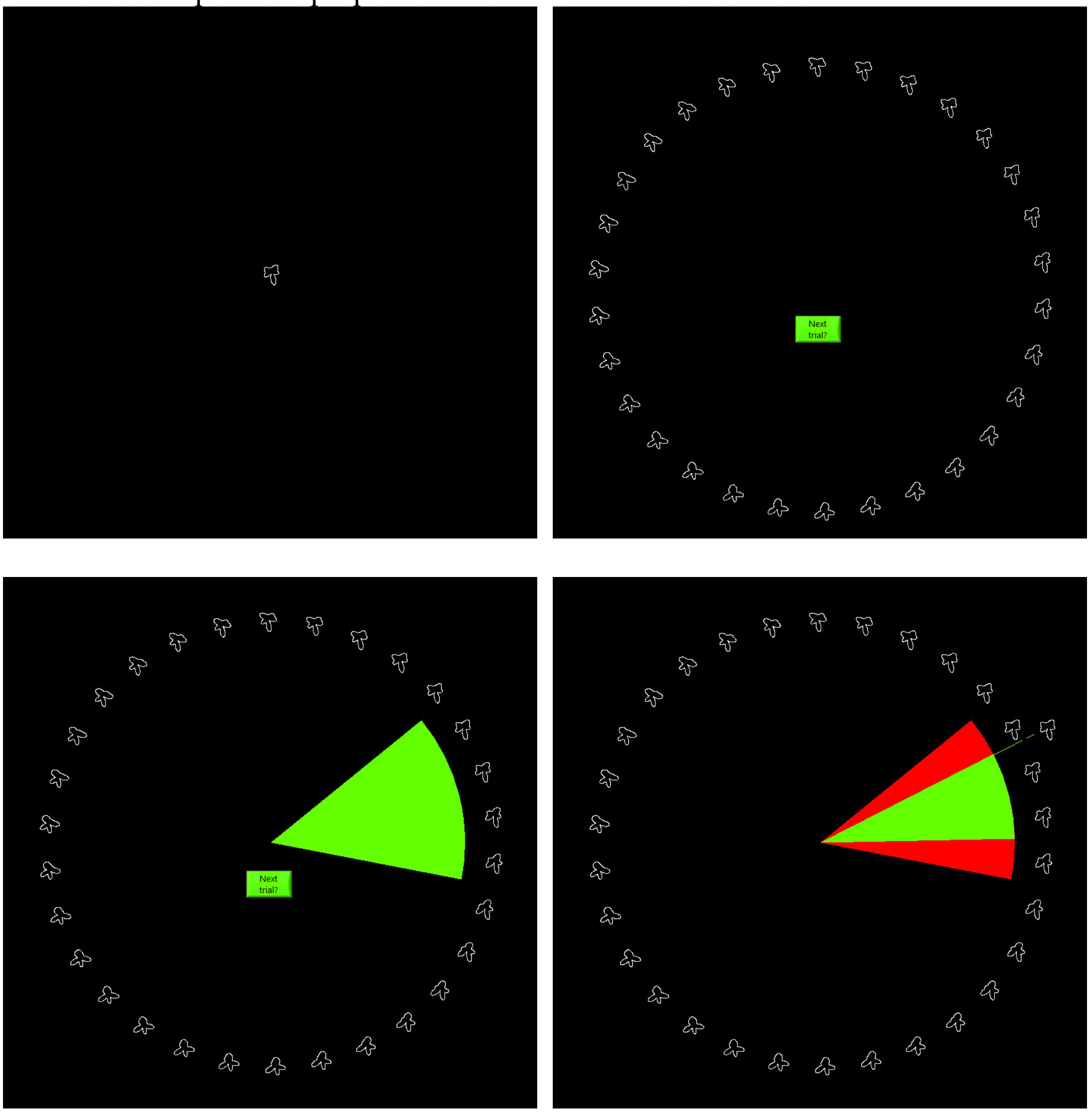
You may not have chosen the correct shape. Next, please tell us how confident you are of your memory of the shape by dragging the mouse to make a wedge wide enough that you are confident that the shape you saw is included. But do not make the wedge wider than it needs to be. You get 8 points for a wedge that is just wide enough to include the correct shape, you lose points for making it wider than it needs to be, in proportion to the surplus area, and you get 0 points for making the wedge too small.
Press the *Control* key when you have adjusted the wedge to the size you think best.



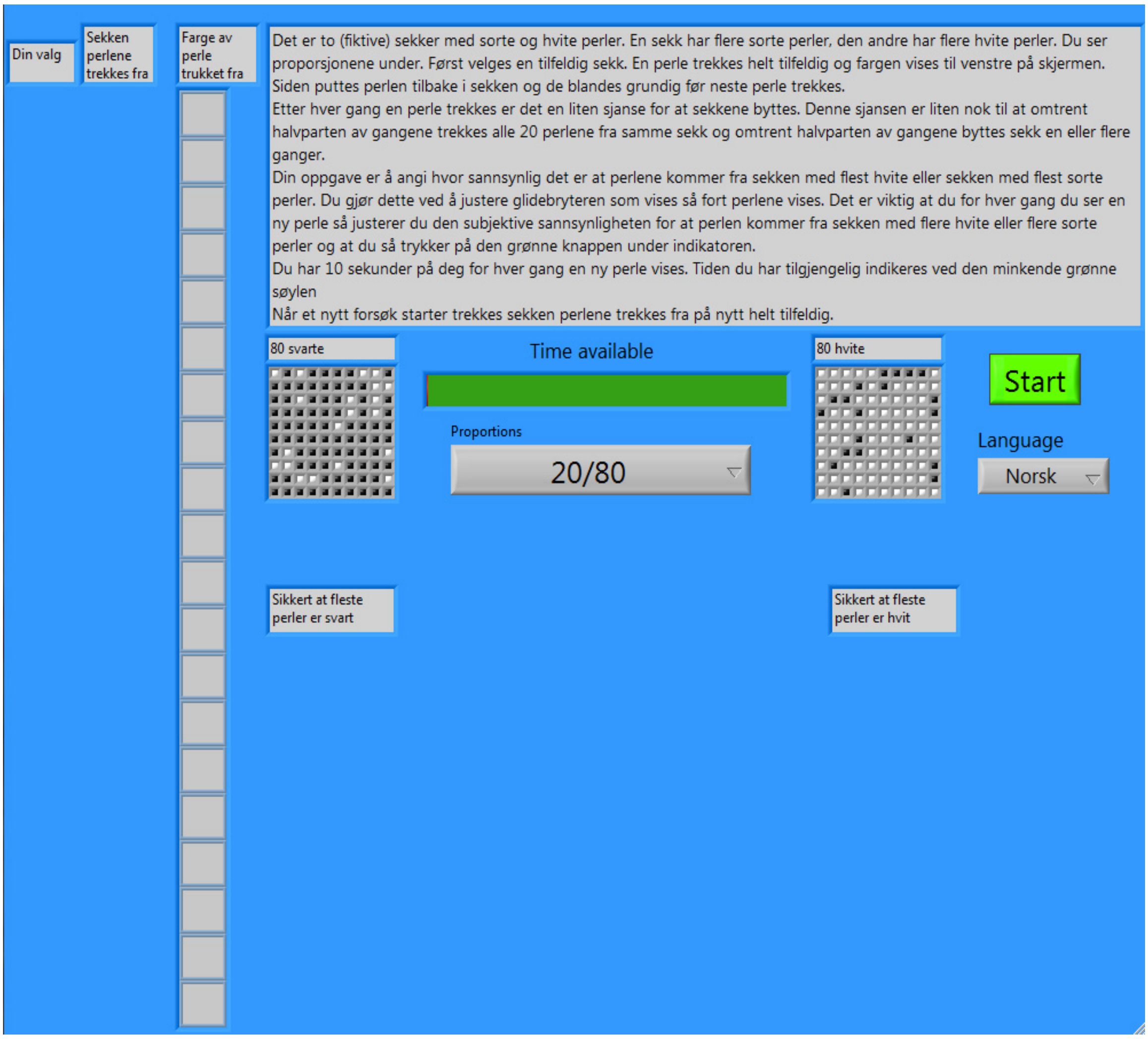
In this example, the wedge was too small. The program shows you the correct shape and direction, and here they are outside the angle included by the wedge. You would get 0 points for that.



These images show another shape to be remembered, the 30 shapes to chose from (for some reason, Print Screen failed to include the orange circle), and the green wedge the participant expected would include the sample shape. Feedback (lower right) shows that the sample shape was within the angle of the wedge. The participant received 6.6 points: 8 points for making the wedge large enough, minus 1.4 points for making it too large, as shown by the red areas. The loss of points is proportional to the size of the red areas.



APPENDIX E - Instructions Beads Task



APPENDIX F – Code for Mathematically Optimal Model for the Beads Task

Game rules:

- There are two jars, jar A and jar B. The jars are filled with white and black balls. In jar A the fraction of white balls is p, whereas in jar B the fraction of white balls $1-p$.
- The game starts by the administrator drawing one of the jars at random. Let $x_1 = 0$ if the result is jar A and $x_1 = 1$ otherwise. Thus,
$$\mathrm{P}(x_1 = 0) = \mathrm{P}(x_1 = 1) = \frac{1}{2}.$$
- If $x_1 = 0$, the administrator is sampling a ball from jar A at random, and if $x_1 = 1$ the administrator is sampling a ball from jar B at random. The ball sampled is shown to the player and put back into the same jar as it was sampled from. Let $z_1 = 0$ if the draw results in a white ball, and $z_1 = 1$ otherwise. Thus,
$$\mathrm{P}(z_1|x_1) = p^{I(z_1=x_1)}(1-p)^{1-I(z_1=x_1)},$$
where $I(\cdot)$ equals 1 is the argument is true and zero otherwise.
- For $i = 2, \ldots, n$ sequentially:
  - The administrator puts $x_i = 1 - x_{i-1}$ or $x_i = x_{i-1}$ with probabilities q and $1-q$, respectively.
  - If $x_i = 0$, the administrator is sampling a ball from jar A at random, and if $x_i = 1$ the administrator is sampling a ball from jar B at random. The ball sampled is shown to the player and put back into the same jar as it was sampled from. Let $z_i = 0$ if the draw results in a white ball, and $z_i = 0$ otherwise. Thus,
$$\mathrm{P}(z_i|x_i) = p^{I(z_i=x_i)}(1-p)^{1-I(z_i=x_i)}.$$
- Then the player should guess from which jar the last ball is coming.

Solution strategy: The optimal decision should be based on
$$\mathrm{P}(x_n|z_1, \ldots, z_n).$$
The optimal decision is to guess on jar A if $\mathrm{P}(x_n = 0|z_1, \ldots, z_n) > 1/2$, and jar B otherwise. How to compute $\mathrm{P}(x_n|z_1, \ldots, z_n)$ depends on whether or not q is known to the player. If q is known to the player this is a fixed number, whereas if q is unknown to the player the reasonable strategy is to put a prior on q, for example a uniform distribution over the interval $[0, 1]$. In the following we first consider how to compute $\mathrm{P}(x_n|z_1, \ldots, z_n)$ when q is known to the player. Then of course $\mathrm{P}(x_n|z_1, \ldots, z_n) = \mathrm{P}(x_n|z_1, \ldots, z_n, q)$. From the above assumptions it follows that
$$\begin{aligned}\mathrm{P}(x_1, \ldots, x_n|z_1, \ldots, z_n, q) &\propto \mathrm{P}(x_1, \ldots, x_n, z_1, \ldots, z_n|q)\\ &= \mathrm{P}(x_1, \ldots, x_n|q) \cdot \mathrm{P}(z_1, \ldots, z_n|x_1, \ldots, x_n)\end{aligned}$$

$$= \frac{1}{2} \prod_{i=2}^{n} \left[q^{1-I(x_i=x_{i-1})} (1-q)^{I(x_i=x_{i-1})} \right] \prod_{i=1}^{n} \left[p^{I(z_i=x_i)} (1-p)^{1-I(z_i=x_i)} \right].$$

What becomes computationally important is that this product can be factorised into

$$\mathrm{P}(x_1, \ldots, x_n | z_1, \ldots, z_n, q) \propto h_{1,2}(x_1, x_2) \cdot h_{2,3}(x_2, x_3) \cdot \ldots \cdot h_{n-1,n}(x_{n-1}, x_n), \tag{1}$$

where

$$h_{1,2}(x_1, x_2) = \frac{1}{2} q^{1-I(x_2=x_1)} (1-q)^{I(x_2=x_1)} p^{I(z_1=x_1)} (1-p)^{1-I(z_1=x_1)},$$

$$h_{i-1,i}(x_{i-1}, x_i) = q^{1-I(x_i=x_{i-1})} (1-q)^{I(x_i=x_{i-1})} p^{I(z_{i-1}=x_{i-1})} (1-p)^{1-I(z_{i-1}=x_{i-1})}$$

for $i = 3, \ldots, n-1$, and

$$h_{n-1,n}(x_{n-1}, x_n) = q^{1-I(x_n=x_{n-1})} (1-q)^{I(x_n=x_{n-1})} p^{I(z_{n-1}=x_{n-1})} (1-p)^{1-I(z_{n-1}=x_{n-1})} \cdot p^{I(z_n=x_n)} (1-p)^{1-I(z_n=x_n)}$$

To obtain $\mathrm{P}(x_1, \ldots, x_n | z_1, \ldots, z_n, q)$ of interest one should sum over each of $x_1, x_2, \ldots, x_{n-1}$ in turn. The factorisation in (1) imply that this can be done efficiently. No simple closed form formula is available for the result as a function of $z_1, \ldots, z_n$, but for given values $z_1, \ldots, z_n$ the result can be computed efficiently. *Need to implement the algorithm. I have essentially an implementation in C++. It should be easy the implement this also in Matlab.*

If q is unknown to the player and a uniform $[0, 1]$ prior is adopted, the distribution of interest is again $\mathrm{P}(x_n | z_1, \ldots, x_n)$. Neither in this case a closed form solution is available. Moreover, an efficient numerical direct algorithm for computing the quantity does neither seem to exist. The quantity can, however, be estimated by simulating from the distribution

$$\mathrm{P}(x_n, q | z_1, \ldots, z_n)$$

by Markov chain Monte Carlo (MCMC) algorithm. A Gibbs sampler algorithm can be adopted where one alternates between sampling from the full conditionals

$$\mathrm{P}(q | x_1, \ldots, x_n, z_1, \ldots, z_n) \quad \text{and} \quad \mathrm{P}(x_1, \ldots, x_n | z_1, \ldots, z_n, q).$$

The primer can be shown to be a beta distribution, whereas a sample from the latter can be efficiently generated because of the factorisation in (1). *Again I have essentially an implementation in C++, and a corresponding implementation in Matlab should be easy to make.*

APPENDIX G – Cognitive Biases Questionnaire (CBQ)

COGNITIVE BIASES QUESTIONNAIRE

I dette spørreskjemaet vil du finne flere beskrivelser av dagligdagse hendelser. Etter hver situasjon er det beskrevet flere måter personer kan reagere på, merket A, B og C. Vennligst forestill deg selv i hver situasjon på en så levende måte som mulig.

Når du har forestilt deg at hendelsen har skjedd med deg, vær vennlig og velg det alternativet som best beskriver det du tenker om situasjonen. Hvis ingen passer helt til slik du ville reagert, velg det som er mest nærliggende. Hvis mer enn ett av alternativene passer, velg det du oftest ville ha tenkt. Når du har bestemt deg for det alternativet du mest sannsynlig ville ha tenkt, sett en sirkel rundt den tilhørende bokstaven.

Det ingen rette eller gale svar. Jobb deg igjennom skjemaet relativt raskt, vær sikker på at du velger det alternativet som ligger nærmest din *umiddelbare* reaksjon.

1. Forestill deg at du mottar et brev og at du legger merke til at det ikke er forseglet. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A**: Noen har med hensikt allerede åpnet dette brevet **B**: Jeg lurer på om dette har blitt åpnet igjen etter at det ble skrevet **C:** Jeg tenker ikke på det
2. Forestill deg at du går nedover gaten og du hører at noen roper navnet ditt, men du ser ingen når du snur deg. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Her er det noe merkelig som foregår **B:** Det er noe veldig farlig ved dette **C:** Det må være jeg som innbiller meg ting
3. Forestill deg at maten din smaker annerledes enn det den bruker å gjøre *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Noen kan med hensikt ha gjort noe med maten min **B:** Denne maten må ha blitt laget med andre ingredienser i dag **C:** Noen har med hensikt forgiftet maten min
4. Forestill deg at du er på vei på jobb og du legger merke til at alle trafikklysene blir røde når du nærmer deg dem. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det kommer til å ta meg lengre tid å komme meg på jobb denne morgenen **B:** Det var alt jeg trengte, jeg kommer til å bli skikkelig forsinket nå **C:** Dagen min kommer til å bli ødelagt
5. Forestill deg at du står på et busstopp da bussen du har ventet på kjører halvfull forbi deg uten å stoppe. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Folk er alltid så slemme **B:** Noen ganger er ikke folk snille **C:** Sjåføren må være i et dårlig humør i dag

6. Forestill deg at du har skikkelig vondt i hodet. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det må være noe galt med meg **B:** Det er mange grunner til at jeg kan ha denne smerten **C:** Det må være noe virkelig alvorlig, som en hjernesvulst
7. Forestill deg at mens du er på bussen er det en fremmed som stirrer på deg. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Måten denne personen ser på meg uroer meg litt **B:** Denne personen må ville meg noe ondt siden han stirrer på meg på denne måten **C:** Denne personen oppfører seg veldig uhøflig ved å stirre på meg på denne måten
8. Forestill deg at du sitter hjemme og plutselig får en rar følelse. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg lurer på hvorfor jeg får denne rare følelsen, kan det være at noe faretruende er å gang **B:** Denne følelsen er et bevis på at noe fælt er i ferd med å skje noen jeg kjenner **C:** Jeg må være overtrøtt eller noe
9. Forestill deg at du søkte på en jobb og du fikk den ikke. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Kanskje jeg kan få tilbakemelding på hvorfor jeg ikke fikk jobben **B:** Jeg lurer på om jeg ikke gjorde det så bra på intervjuet **C:** Jeg kommer aldri til å få meg en jobb
10. Forestill deg at du er på et tog når du plutselig får en sterk følelse av å ha vært her før. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Dette er et slags forvarsel på at noe fryktelig har eller vil skje **B:** Jeg lurer på om dette er et slags forvarsel **C:** Dette er en rar, men ikke uvanlig opplevelse.
11. Forestill deg at noen du liker eller en venn sier nei til å gå ut med deg. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det hender ofte at jeg blir avvist i slike situasjoner **B:** Noen ganger lykkes du andre ganger gjør du det ikke **C:** Jeg blir alltid avvist for enhver ting jeg forsøker
12. Forestill deg at en dag du går inn i en butikk hører du folk som ler. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det må være meg de ler av **B:** Jeg lurer på om det er meg de ler av **C:** Latteren har sannsynligvis ikke noe med meg å gjøre
13. Forestill deg at det er politibiler utenfor huset ditt. Plutselig innser du at du føler deg ukomfortabel. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det er rart hvordan bare det å se politi har en foruroligende innvirkning på folk **B:** Jeg lurer på hvorfor jeg føler meg så ukomfortabel, kan bilen utenfor ha noe med meg å gjøre **C:** Jeg må ha gjort noe galt siden jeg føler meg så ukomfortabel, de er ute etter å ta meg
14. Forestill deg at du ser på TV, og plutselig blir skjermen blank. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Rare ting skjer hele tiden **B:** Denne typen ting ser ut til å skje ganske ofte **C:** Det må være noe galt med TV'en i dag

15. Forestill deg at to personer i en kø på et supermarked kikker i din retning samtidig og deretter umiddelbart begynner å snakke med hverandre. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det er ikke første gangen dette har skjedd **B:** Denne typen ting kan skje i en kø **C:** Dette skjer hvorhen jeg går
16. Forestill deg at du er på en cafe og venter på en bekjent, og du plutselig føler en rar skjelven følelse. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Denne skjelvende følelsen ar et dårlig tegn, jeg tror ikke jeg burde møte denne personen **B:** Jeg må være nervøs for å møte denne personen **C:** Jeg lurer på om det å fole seg foruroliget betyr at noe forferdelig vil skje
17. Forstill deg at du ser en skygge bevege seg over veggen i et tomt rom. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg lurer på hva det var **B:** Øyene mine må spille meg et puss **C:** Det må ha vært noen eller noe der
18. Forestill deg at telefonen ringer. Når du svarer, legger den andre på. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg lurer på om det er noe mistenkelig med dette **B:** Det er definitivt noen som overvåker meg **C:** Noen hadde sannsynligvis feil nummer
19. Forestill deg at du ser nyheter på TV om en nylig katastrofe, og du kjenner at føler deg skyldig. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Hvis jeg føler meg skyldig må jeg være ansvarlig på en aller annen måte **B:** Det er normalt å føle seg skyldig når en katastrofe har hendt med noen andre **C:** Jeg lurer på hvorfor jeg føler meg skyldig, kanskje jeg uten å vite det er ansvarlig på en aller annen måte
20. Forestill deg at du hører på radioen og plutselig hører du forstyrrelser i form av spraking. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Noen har med hensikt tuklet med radioen min slik at den ikke lengre er riktig innstilt **B:** Jeg lurer på om noen har fingret med radioen **C:** Det er en eller annen forstyrrelse på radiobølgene
21. Forestill deg at du sitter på et tog, og du tror at du kan høre to personer bak deg snakke om deg. Når du snur deg ser du at de leser avisene sine, og prater ikke med hverandre. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** De snakket helt sikkert om meg, de bare later som om de leser i avisene sine **B:** Jeg er sikker på at jeg hørte de prate om meg, kanskje jeg tok feil **C:** Jeg burde finne ut om noen andre noen gang har hatt denne typen opplevelse, før jeg tar en avgjørelse om hva som egentlig hendte
22. Forestill deg at du er hjemme; alt er stille når du plutselig hører en rask hamring på veggen. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Naboene gjør dette med vilje for å plage meg **B:** Naboene driver kanskje med oppussing eller noe slik **C:** Naboene prøver å fortelle meg noe

23. Forestill deg at du leser en avis eller et blad, og at du leser en artikkel som du føler er spesielt relevant for deg. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Denne artikkelen ser ut til å ha blitt skrevet med folk som meg i tankene **B:** Jeg lurer på om noen skrev denne artikkelen til meg **C:** Noen har helt sikkert skrevet denne artikkelen spesifikt for meg
24. Forestill deg at en person du ikke kjenner ser på deg. Plutselig føler du deg utilpass. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det at jeg føler meg utilpass betyr at denne personen har til hensikt å skade meg **B:** Jeg lurer på hvorfor jeg føler meg utilpass, kan dette bety at denne personen tenker stygge ting om meg **C:** Det å bli sett på kan få folk til å føle seg utilpass, jeg bekymrer meg ikke noe om det
25. Forestill deg at du en kveld sitter alene hjemme og plutselig hører at en dør i et annet rom slår seg igjen. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Noe eller noen må ha kommet seg inn i huset **B:** Jeg lurer på om noen eller noe er der **C:** Det er sikkert bare trekk
26. Forestill deg at noen du kjenner ringer i det du tenker på dem. I det du tar av telefonen innser du plutselig at du føler deg opprørt. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Det er underlig at jeg føler meg opprørt, men jeg legger ikke så mye i det **B:** Jeg lurer på hvorfor jeg føler meg opprørt, kan det være noe spesielt med denne oppringningen **C:** Det å føle seg opprørt betyr noe, det må være dårlige nyheter
27. Forestill deg at du går nedover gaten og du legger plutselig merke til en plakat som reklamerer for en karriere og som virker å skille seg fra omgivelsene. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg lurer på hvorfor blikket mitt trekkes slik mot denne plakaten **B:** Kanskje jeg legger merke til den fordi karrieren min ikke er en suksess **C:** Det er et tegn på at livet mitt er mislykket
28. Forestill deg at du er på en buss; flere ganger stopper sjåføren brått slik at du snubler hver gang. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg lurer på om han gjør det med vilje for å terge folk **B:** Denne bussjåføren kan ikke kjøre ordentlig **C:** Han gjør det med vilje for å ydmyke meg
29. Forestill deg at du hører en venn skal ha fest og du er ikke blitt invitert *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg lurer på om de ikke liker meg så mye som jeg trodde de gjorde **B:** Kanskje jeg skal prøve å finne ut mer om situasjonen før jeg gjør meg noen antagelser **C:** Det er opplagt at de ikke liker meg
30. Forestill deg at du ligger på sofaen og døser foran TV'en og du skvetter til når våkner. *For meg er det da mest nærliggende å tenke: (sett ring rundt A, B eller C)*	**A:** Jeg bruker alltid å skvette til når jeg våkner etter å ha døset **B:** TV'en må ha vekket meg **C:** Jeg greier aldri å få noe søvn

APPENDIX H – Short Need For Closure Scale (SNFC)

Hvor enig eller uenig er du i disse utsagnene?	Helt enig	Svært enig	Enig	Uenig	Svært uenig	Helt uenig
Jeg liker ikke usikre situasjoner						
Jeg misliker spørsmål som kan besvares på mange ulike måter						
Et velorganisert liv med en fastsatt timeplan passer mitt gemytt						
Jeg føler meg ukomfortabel når jeg ikke forstår hvorfor noe hender meg						
Jeg blir irritert når en person er uenig med det alle andre i en gruppe mener						
Jeg liker ikke å gå inn i en situasjon uten å vite hva jeg kan forvente						
Når jeg har tatt en beslutning, føler jeg meg lettet						
Når jeg blir konfrontert med et problem, må jeg ha en løsning straks						
Om jeg ikke fant en løsning på et problem med én gang, ville jeg blitt utålmodig og irritert						
Jeg liker ikke å være sammen med folk som kan finne på å gjøre noe uventet						
Jeg misliker det når en persons utsagn kan bety mange forskjellige ting						
Å ha faste rutiner gjør at jeg nyter livet mer						
Jeg liker et ordnet og strukturert levesett						
Jeg vurderer vanligvis ikke mange ulike synspunkter før jeg gjør meg opp en mening						
Jeg misliker uforutsigbare situasjoner						

APPENDIX I – Theory of Mind (TOM)

ToM

Nå kommer forskjellige scenario. Les dem nøye og svar deretter på om hovedpersonens handling var tillatelig eller forbudt.

KAFFE

Grete og vennene hennes er på omvisning på et kjemisk anlegg. Når Grete går til kaffemaskinen for å hente kaffe spør Gretes venninne om å få sukker i kaffen sin. Det er et hvitt pulver i en beholder ved kaffen. Det hvite pulveret er et svært giftig pulver som som en av forskerne har glemt ved kaffemaskinen og er derfor giftig hvis det inntas.
Beholderen er merket "giftig", så Grete antar at det hvite pulveret er en giftig substans glemt av en forsker. Grete putter det hvite pulveret i venninnens kaffe. Venninnen drikker kaffen og alt går bra.

Å putte det hvite pulveret i kaffen var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

LABBEN

Daniel gir en besøkende en omvisning på labben sin. Før gjesten får komme inn i testrommet må alle testrørene med sykdomsantigener lukkes inn i et skap. Dette gjøres ved å vri om en bryter. Bryteren hadde vært ødelagt og en tekniker hadde nettopp vært der for å reparere den. Bryteren ble reparert, så testrørene er sikkert oppbevart. Derfor vil alle som kommer inn i rommet være trygge og ikke eksponert for antigenene.
Dan tror at bryteren er reparert etter en samtale med teknikeren, så han antar at det er trygt for dem å gå inn i rommet. Dan ber den besøkende om å gå inn i testrommet. Den besøkende får ingen sykdommer og overlever.

Å be den besøkende om å gå inn var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

MANET
Janne og naboen padler i en del av havet hvor det er masse maneter. Jannes nabo spør henne om hun kan bade. Det er ikke trygt å svømme i havet fordi manetene brenner, og kan være dødelige. Fordi Janne har lest informasjon som sa at manetene er dødelige, antar hun at det ikke er trygt å bade i havet. Janne sier at naboen kan bade. Naboen bader, blir brent av manetene og dør.

Å be naboen om å bade var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

BROEN
Raymond og kjæresten er ute på tur. De kommer over en lang, smal bro som strekker seg over en bratt dal. Broen er ekstremt ustødig og kan ikke bære vekten av en svært lett person en gang. Raymond tror at de som går over broen vil ødelegge den og falle ned i dalen fordi broen ser ustødig og gammel ut. Raymond sier ingenting når kjæresten begynner å krysse broen. Hun ødelegger broen og faller ned i den sikre død.

Å ikke si noe var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

SVØMMEBASSENGET
Line går forbi naboens svømmebasseng når hun ser et lite barn skal til å stupe uti.
Barnet skal til å stupe uti bassenget i den dype delen og ha det morsomt, svømme og leke hele dagen. På grunn av et klistremerke på siden av bassenget, tror Line at barnet skal stupe i den dype enden og svømme rundt. Line går forbi uten å si noe til barnet, barnet stuper og alt går bra.

Å gå forbi var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

SOPP
Katrine og en venn camper i skogen. Katrine ser vill sopp som vokser ved campen deres. Katrine studerer soppen og ser i soppguiden sin.
Soppen viser seg å være giftig og smakløs. De er av typen som kan gi kraftige brekninger og lede til døden.
Katrine ser et bilde av en spiselig sopp i boken som ligner veldig på de hun fant på campen, så hun antar at soppen er spiselig.
Katrine gir soppen til vennen sin, han spiser dem og begynner å brekke seg etter ti minutter.

Å gi vennen soppen var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

LATEX
Anne har en pasient som er inne for en rutinesjekk. Normalt bruker Anne latexhansker når hun undersøker pasientene sine. Denne pasienten har en dødelig latexallergi og kan ikke eksamineres med latexhansker uten å gå i sjokk. Etter å ha lest informasjonen i pasientens journal vet Anne at pasienten er svært allergisk mot latex og at å bruke latexhansker på ham vil føre til hans død. Anne tar på latexhansker og eksaminerer pasienten. Pasienten går i sjokk.

Å bruke latexhansker var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

MOTORBÅT
Georg er ute med motorbåten sin. På veien hjem skimter han så vidt en som svømmer langt unna der han befinner seg. Svømmeren holder på å drukne og vinker desperat etter hjelp. Georg ser at svømmeren vinker og tror han hilser. Georg kjører hjem uten å tenke mer på svømmeren. Svømmeren drukner.

Å kjøre hjem var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

ASTMA

Erik er på vei hjem når han ser en jogger på veiskulderen. Joggeren er foroverbøyd og har en hånd på brystet. Det ligger en tom astmainhalator på bakken. Joggeren har et alvorlig astmaanfall og må til sykehuset øyeblikkelig før han går i sjokk. Fordi Erik ikke ser inhalatoren, antar han at joggeren bare har stoppet for å få igjen pusten og at han vil fortsette joggeturen sin. Erik fortsetter å kjøre uten å tenke mer på joggeren. Joggeren kollapser og dør.

Å kjøre fra joggeren var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

VITAMIN:

Gunnar får beskjed av legen om å gi sin senile kone piller for hjertesykdommen sin. Legen sier at hun **ikke** må innta vitamin K i en time før hun tar hjertemedisinen. En dag prøver Gunnars kone en ny type frukt. Den nye frukten er ikke rik på vitamin K, så det er trygt for Gunnars kone å ta pillene rett etterpå. Gunnar sjekker det ut og tror at den nye frukten er svært rik på vitamin K, og at det derfor ikke er trygt å gi henne pillene med en gang. Gunnar gir kona pillene med engang. Alt går bra.

Å gi henne pillene var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

SESAMFRØ:

Kine er servitør. Hun gjør seg klar til å bære en rett ut til kundens bord. Kunden er sammen med vennene sine og han bestiller en rett som krever sesamfrø.
Kunden elsker sesamfrø og å spise sesamfrø vil ikke føre til problemer.
Etter å ha overhørt kundens samtale med vennene sine tror Kine at han elsker sesamfrø.
Kine har sesamfrø i retten, kunden spiser maten sin og alt går bra.

Å ha sesamfrø i retten var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

SYKKELEN:
Ginas klassekamerat vil gjerne låne sykkelen hennes for å dra på en terrengsykkeltur. Ginas sykkel kom nettopp tilbake fra verkstedet da bremsene ikke hadde fungert. Bremsene på Ginas sykkel fungerer fortsatt ikke, så sykkelen er veldig utrygg. De på verkstedet fortalte Gina at bremsene fortsatt ikke fungerer og forklarte hvorfor de ikke ble reparert. Gina antar derfor at sykkelen ikke er trygg å bruke. Gina låner bort sykkelen sin til klassekameraten. Klassekameraten sykler av en klippe ved stien fordi hun ikke får til å bremse.

Å låne bort sykkelen var:

	1	2	3	4	
Tillatt	☐	☐	☐	☐	**Ikke Tillatt**

APPENDIX J – Becks Depression Inventory (BDI)

BDI

I dette spørreskjemaet vil du finne setninger inndelt i grupper. Vennligst les alle setningene i hver gruppe nøye. Deretter velger du den setningen i hver gruppe som best beskriver hvordan du har følt deg den siste uka, i dag inkludert. Merk av setningen du har valgt.

Husk å lese alle setningene innenfor en gruppe før du velger, og pass på at du gir svar innenfor alle gruppene.

☐	Jeg føler meg ikke trist.
☐	Jeg er lei meg eller føler meg trist.
☐	Jeg er lei meg eller trist hele tiden og klarer ikke å komme ut av denne tilstand.
☐	Jeg er så trist eller ulykkelig at jeg ikke holder det ut.

☐	Jeg er ikke særlig pessimistisk eller motløs overfor fremtiden.
☐	Jeg føler meg motløs overfor fremtiden.
☐	Jeg føler at jeg ikke har noe å se frem til.
☐	Jeg føler at fremtiden er håpløs og at forholdene ikke kan bedre seg.

☐	Jeg føler meg ikke som et mislykket menneske.
☐	Jeg føler at jeg har mislyktes mer enn andre mennesker.
☐	Når jeg ser tilbake på livet mitt ser jeg ikke annet enn mislykkethet.
☐	Jeg føler at jeg har mislyktes fullstendig som menneske.

☐	Jeg får like mye tilfredsstillelse ut av ting som før.
☐	Jeg nyter ikke ting på samme måte som før.
☐	Jeg får ikke ordentlig tilfredsstillelse ut av noe lenger.
☐	Jeg er misfornøyd eller kjeder meg med alt.

☐	Jeg føler meg ikke særlig skyldbetynget.
☐	Jeg føler meg skyldbetynget en god del av tiden.
☐	Jeg føler meg temmelig skyldbetynget mesteparten av tiden.
☐	Jeg føler meg skyldbetynget hele tiden.

☐	Jeg har ikke følelsen av å bli straffet.
☐	Jeg føler at jeg kan bli straffet.
☐	Jeg forventer å bli straffet.
☐	Jeg føler at jeg blir straffet.

☐	Jeg føler meg ikke skuffet over meg selv.
☐	Jeg er skuffet over meg selv.
☐	Jeg avskyr meg selv.
☐	Jeg hater meg selv.

☐	Jeg føler ikke at jeg er noe dårligere enn andre.
☐	Jeg kritiserer meg selv for mine svakheter eller feilgrep.
☐	Jeg bebreider meg selv hele tiden for mine feil eller mangler.
☐	Jeg gir meg selv skylden for alt galt som skjer.

☐	Jeg har ikke tanker om å ta livet mitt.
☐	Jeg har tanker om å ta livet mitt, men jeg vil ikke omsette dem i handling.
☐	Jeg ønsker å ta livet mitt.
☐	Jeg ville tatt livet mitt om jeg fikk sjansen til det.

☐	Jeg gråter ikke mer enn vanlig.
☐	Jeg gråter mer nå enn jeg gjorde før.
☐	Jeg gråter hele tiden nå.
☐	Jeg pleide å kunne gråte, men nå kan jeg ikke gråte selv om jeg gjerne vil.

☐	Jeg er ikke mer irritert nå enn ellers.
☐	Jeg blir lettere ergerlig eller irritert enn før.
☐	Jeg føler meg irritert hele tiden nå.
☐	Jeg blir ikke irritert i det hele tatt over ting som pleide å irritere meg.

☐	Jeg har ikke mistet interessen for andre mennesker.
☐	Jeg er mindre interessert i andre mennesker enn jeg pleide å være.
☐	Jeg har mistet det meste av min interesse for andre mennesker
☐	Jeg har mistet all interesse for andre mennesker

☐	Jeg tar avgjørelser omtrent like lett som jeg alltid har gjort.
☐	Jeg forsøker å utsette det å ta avgjørelser mer enn tidligere.
☐	Jeg har større vanskeligheter med å ta avgjørelser enn før.
☐	Jeg klarer ikke å ta avgjørelser i det hele tatt lenger.

☐	Jeg føler ikke at jeg ser dårligere ut enn jeg pleide å gjøre.
☐	Jeg er bekymret for at jeg ser gammel eller lite tiltrekkende ut.
☐	Jeg føler at det er varige forandringer i mitt utseende som får meg til å se lite tiltrekkende ut.
☐	Jeg tror jeg ser stygg ut.

☐	Jeg kan arbeide omtrent like godt som før.
☐	Det kreves en del ekstra anstrengelse for å ta fatt på noe.
☐	Jeg må presse meg selv hardt for å gjøre noe.
☐	Jeg klarer ikke å gjøre noe i det hele tatt.

☐	Jeg sover like godt som ellers.
☐	Jeg sover ikke så godt som før.
☐	Jeg våkner 1-2 timer tidligere enn ellers og har vanskelig for å sovne igjen.
☐	Jeg våkner flere timer tidligere enn jeg pleide og får ikke sove igjen.

☐	Jeg blir ikke fortere trøtt enn ellers.
☐	Jeg blir fortere trøtt enn ellers.
☐	Nesten alt jeg gjør blir jeg trøtt av.
☐	Jeg er for trøtt til å gjøre noe som helst.

☐	Matlysten min er ikke dårligere enn ellers.
☐	Matlysten er ikke så god som den var før.
☐	Matlysten min er mye dårligere nå.
☐	Jeg har ikke matlyst i det hele tatt lenger.

☐	Jeg har ikke gått ned mye i vekt, om i det hele tatt noe, i den senere tid.
☐	Jeg har tatt av mer enn 2kg.
☐	Jeg har tatt av mer enn 4kg.
☐	Jeg har tatt av mer enn 6kg.

Jeg prøver bevisst å gå ned i vekt ved å spise mindre.

Ja ☐

Nei ☐

☐	Jeg er ikke mer bekymret for helsen min enn vanlig.
☐	Jeg er bekymret over fysiske plager som verking og smerter, eller urolig mage eller forstoppelse.
☐	Jeg er meget bekymret over mine fysiske plager og det er svært vanskelig å tenke på stort annet.
☐	Jeg er så bekymret over mine fysiske plager at jeg ikke klarer å tenke på annet.

☐	Jeg har ikke merket noen forandring i mine seksuelle interesser i det siste.
☐	Jeg er ikke mindre interessert i sex enn jeg var før.
☐	Jeg er mye mindre interessert i sex nå.
☐	Jeg har mistet helt interessen for sex.