An investigation of the interaction between schizotypy and cognitive monitoring processes.

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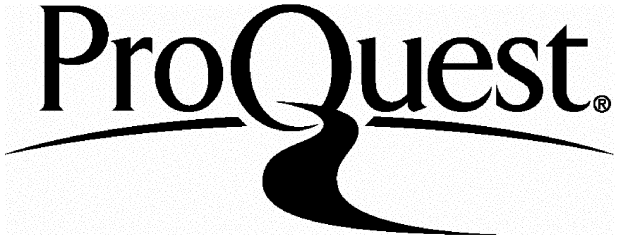

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Abstract

The concept of 'theory of mind' (or mentalising ability) refers to the capacity to attribute mental states to others in order to explain what they did, or predict what they will do. The role of theory of mind has been extensively researched in relation to autism and is thought to explain some of the social and communication abnormalities that are present in the disorder. C. Frith (1992) broadened the definition of mentalising to include the ability to represent *one's own* as well as others actions, and suggested that all of the commonly observed symptoms of schizophrenia could be understood as a result of a breakdown in the person's capacity to mentalise. The research presented in this thesis aimed to assess Frith's theory by comparing individuals who were found to be high and low in schizotypy. It was hypothesised that individuals who demonstrated high scores on measures of schizotypy would show poorer ability to generate willed action, and to monitor their own, and others mental states.

Mentalising abilities were assessed using four tasks: in the triangles task participants watched a series of computerised animations involving two shapes which engaged in increasingly complex sequences of interaction. Participants were asked to describe what they thought was taking place and their descriptions were used to assess their ability to employ theory of mind in relation to others. Participants then completed the me-pulse; a novel task which involved a variant on the prepulse inhibition paradigm; the Hayling test, and a go/No go task. The results broadly supported Frith's theory. On the triangles task, the high schizotypes imputed 'theory of mind' significantly more than low schizotypes when the shapes were moving randomly. On the Hayling test high schizotypy participants took significantly longer to complete both parts of the test than the low schizotypes. On the go/No go task, the high schizotypy group

made significantly more false alarms, indicating deficits in their ability to set shift and inhibit their responses. On the me-pulse task the low schizotypy participants showed a decrease in magnitude of response when the startling stimulus was self-initiated, in contrast the high schizotypy participants actually showed increased response amplitude in response to self-generated stimuli. Taken together, these results indicated support for the hypothesis that high schizotypes showed deficits in their ability to generate willed action, and to monitor the mental states of both others and themselves. The marked difference in the pattern of results between the two groups of participants provides further support for the concept of schizotypy. The fact that these anomalies in mentalising ability are seen in a non psychiatric population indicated some support for the idea of mentalising defects as a trait marker for psychosis, rather than simply a manifestation of the psychotic state.

Chapter 1: Introduction

It is almost one hundred years since Kraepelin (1919) described 'dementia praecox', the illness we now know as schizophrenia. Understanding schizophrenia has proven to be a challenge to clinicians throughout this century and classification systems and diagnostic markers have been subject to refinements and change (Andreasen, 1997). Whilst our understanding of the illness has advanced considerably since Kraepelin's day, there is still no 'cure' as such, and schizophrenia continues to challenge those who live and work with it.

Schizophrenia affects the lives of around one in a hundred people. The treatment that can be offered to patients has advanced considerably since the days when a diagnosis led to confinement in an asylum, often for the rest of one's life, within which patients were sometimes exposed to therapies that were ineffectual, or downright dangerous. Consider for example the insulin comas into which schizophrenic patients were induced, in order that they might 'sleep off' their illnesses. In fact there was generally no conceivable benefit (Ackner, Harris & Oldham, 1957).

Today, continuing refinements in neuroleptic medication have lead to the development of atypical anti-psychotics such as risperidone, olanzapine, and clozapine, which have enabled many more sufferers to resume their lives in a way that would once have been impossible. However, these medications are not without side effects, some of which are perceived as so debilitating that some patients do not adhere their medication regime. In a meta-analysis considering the adherence of over 23, 000 non-compulsory patients treated for schizophrenia since 1980, Nosé, Barbui and Tansella (2003) found on overall rate of non-adherence to treatment of

25.8%. A study by Lacro, Dunn, Dolder, Leckband and Jeste, (2002, cited in Nosé et al., 2003) which looked simply at adherence to medication (rather than to scheduled appointments also, like Nosé et al., 2003) and used tighter inclusion criteria, found that 41.2% of patients did not adhere. Non adherence to treatment has been found to have a major impact on the efficacy of treatment for psychotic disorders which tend to require contact with services over the long term in order for the patient to remain stable. Non adherence is associated with poorer outcome and increased rates of hospital admission (Gray, Wykes, & Gournay 2002, cited in Nosé et al., 2003). All mental health practitioners will be familiar with the phenomena of the 'revolving door patient' – someone whose illness is stabilised on medication whilst in hospital, but who does not adhere to their treatment programme when they return to the community, only to experience once more, such a profound deterioration in their mental state that others deem that they must return to hospital and recommence medical treatment, frequently against their will. Repeated episodes of this type are distressing to patients, and can lead to a hardening of their attitudes toward mental health professionals.

In the context of such difficulties, psychologists have been producing a growing body of work which aims to identify the cognitive deficits underlying schizophrenia. The hope is to develop psychological treatments aimed at ameliorating symptoms and preventing relapse, and there is evidence to support the use of cognitive behavioural approaches in particular (Kuipers et al., 1998).

This thesis aims to contribute further to our understanding of the symptoms that schizophrenia patients experience through an investigation of mentalising processes in individuals high in schizotypy. In this introductory chapter, I will consider the

debate as to whether the cognitive deficits shown by schizophrenia patients are global, or specific in nature. There will then follow an introduction to the ideas of C.Frith (1992) who has suggested that a specific deficit in terms of mentalising, or theory of mind, accounts for all of the signs and symptoms of schizophrenia. The existing literature on mentalising processes in schizophrenia will be reviewed, focusing on whether they show support for, or challenge, the theoretical account of Frith (1992). The concept of schizotypy will then be introduced and Frith's account re-visited in terms of schizotypy. A critical evaluation of the literature then leads to the rationale for the empirical research of this thesis which concerns theory of mind, not only in relation to others, but also in relation to self. The literature review is not exhaustive but focuses on the ability to monitor the actions and intentions of both the self and others.

Deficits in schizophrenia: Global or Specific? The role of IQ and Executive Functioning in Schizophrenia.

Researchers have debated the issue of whether the cognitive deficits exhibited in schizophrenia patients are specific, or more global in nature. Studies which have considered the role of IQ and of executive functioning are essentially posing this question.

Certainly, studies have consistently shown that people with schizophrenia exhibit poor performance across a wide range of neuropsychological tests, for example Heinrich and Konstantine (1998, cited in Townsend, Malla, & Norman, 2001) conducted a meta-analysis of 204 studies of schizophrenic patients which had been published over a seventeen year period, and concluded that schizophrenia is marked by the presence of a broad range of cognitive deficits. However, there is still a debate

about the precise nature and onset of these deficits in relation to the onset of illness. In comparison to chronic schizophrenic patients, first episode patients show much better performance on cognitive tests and minimal impairment in executive functioning (Hutton et al., 1998, cited in Townsend et al., 2001) suggesting that progression of the illness goes hand in hand with a deterioration in functioning. However, comparisons of first episode patients and chronic patients are fraught with complications, since chronic patients have often been institutionalised, and have generally been taking medication for many years. Researchers have tried to address these confounding variables by assessing first episode patients in comparison to healthy controls. It remains difficult to draw firm conclusions from the literature since studies still vary in terms of the nature of the sample under consideration (hospital or community based?) the measures used to assess, and medication status (neuroleptic naïve or not?) (Townsend, et al., 2001)

Mohamed, Paulsen, O'Leary, Arndt, and Andreasen, (1999) studied first episode patients who were neuroleptic naïve, using a battery of tests which assessed a wide range of cognitive functions, and concluded that they showed substantial impairments in multiple areas, including learning, attention, processing speed and executive functioning. Given that the patients were in an early phase of their illness, and had never been medicated, Mohamed et al. (1999) concluded that widespread cognitive dysfunction must be primary, and cannot be attributed to long term illness, treatment or hospitalisation. They concluded that schizophrenia itself, is characterised by *'cognitive dysmetria'* a generalised deficit, manifested by impairment in all cognitive systems. However, research by Townsend et al. (2001) obtained quite different results. Townsend also studied first episode patients in order to eliminate chronicity of symptoms as a confounding variable, but in this instance

participants were outpatients whose symptoms had been stabilised using novel antipsychotics. Townsend compared current and pre-morbid intellectual functioning and did find evidence of a decline but one which was far more subtle than that reported in many other studies – overall the cognitive performance of these patients was still within the normal range. Townsend comments that since their sample of patients were stabilised using novel anti-psychotics they have managed to circumvent the effects of medication on cognition, but without using patients who were still preoccupied by their symptoms, (which seems likely to have been the case in the Mohamed study). However, Townsend et al. do acknowledge that they cannot be certain that medication had no effect on cognition, for there is some evidence that the use of novel anti-psychotics in the early stages actually *improves* cognitive performance (Stip & Lussier, 1996, cited in Townsend et al., 2001). In conclusion, Townsend et al. comment that if the subtle decline in functioning were to continue, then this might indicate that the course of a schizophrenic illness is indeed characterised by deterioration in cognitive functioning. However, they also note that it may be that ongoing treatment leads to increased deficits in cognitive functioning, or that patients at a later stage of their illness show more significant deficits than first episode patients because patients whose functioning improves leave the system. In summary, the relationship between schizophrenia and overall cognitive functioning is still unclear.

Research considering more specific deficits, such as those in executive functioning, shows a greater degree of consensus. Executive functioning refers to the process of co-ordinating a series of lower level operations in order to carry out more complex, often novel tasks. Tranel, Anderson and Benton (1994, cited in Suhr, 1997) emphasise that it is a *multidimensional concept*, which includes forward planning,

working memory and cognitive flexibility. Assessments of executive functioning have included tasks such as the Wisconsin Card Sorting Test, (WCST, Heaton, 1981) which evaluate the ability of the respondent to inhibit a learned response. Respondents who show continued perseverative errors in the face of error information are thought to have executive functioning deficits since they lack the cognitive flexibility to change their 'cognitive set'. The neuro-anatomical site of these processes is thought to be the prefrontal cortex.

There is a substantial body of evidence to suggest that schizophrenia patients exhibit executive functioning deficits in comparison with controls (Donohoe & Robertson, 2003). Further, a study by Morice and Delahunty (1996) indicated that this deficit exists *independently of general cognitive impairments.* They compared seventeen schizophrenic patients and seventeen healthy controls using the National Adult Reading Test, (NART, Nelson & Willison, 1991) the Weschler Adult Intelligence Scale, (WAIS, Weschler, 1981) and tests of executive functioning which assessed three key dimensions; planning ability, ability to inhibit a response (WCST, Heaton 1981) and tests of working memory (which grew progressively more complex). The scores of the two groups were comparable with respect to the NART, however, the schizophrenic patients showed a significantly lower Full Scale IQ, and it was hypothesised that this might be the explanation for their poorer performance on all three tests of executive functioning. As such, Morice and Delahunty subdivided the schizophrenic patients into those showing a discrepancy between pre-morbid and current IQ of fifteen points or more, and those showing a discrepancy of fifteen points or less. The latter group showed no significant difference in FSIQ to the controls. When the data on executive functioning was re-analysed it was found that the group whose FSIQ was comparable to the controls still showed significantly

poorer performance in terms of forward planning and cognitive flexibility. Morice and Delahunty (1996) concluded that although working memory impairments appear to occur in tandem with deteriorations in overall IQ, impairments in cognitive flexibility and forward planning occur independently of other processes.

C. Frith (1992) sought to clarify the relationship between executive deficits and the signs and symptoms of schizophrenia. He argued that they could all be understood as part of a wider deficit in *meta-representation.*

What is 'meta -representation?'

Researchers working within the field of autism have conducted a great deal of research into the concept of 'meta-representation'. This refers to the ability of an individual not simply to *have* hopes, intentions, beliefs and so on, but to *represent* and therefore reflect on, the fact that they have hopes, intentions and beliefs, *as do other people.* Being able to reflect upon the mental state of another – to have a *'theory of mind'* (ToM) gives an individual vital clues to enable them to predict that person's thoughts or behaviour in a given circumstance. It has been argued that possession of a theory of mind, or mentalising ability, conveys distinct evolutionary advantage, since an appreciation of the mental state of another, the knowledge available to him, and the beliefs he has, paves the way toward manipulating those beliefs, and so helps to win the competition for scarce resources. Having an accurate ability to mentalise is thought to be involved in many of the complex social behaviours in which humans engage - for example lying, telling jokes, using irony - all of which involve speech acts which have a different underlying meaning from that which appears on the surface, and which can only be understood with reference to the mental state of the other.

Increasing evidence from the field of cognitive neuropsychology implicates the activation of specific brain regions in the ability to exercise theory of mind, most commonly in the medial frontal and temporo-parietal regions (Fletcher et al., 1995; Gallagher et al., 2000).

However, Brüne (2003) writes 'With respect to psychopathology it may be hypothesised that the specialisation of the human brain on information processing from the social environment may have contributed to an enhanced susceptibility to dysfunction as the evolutionary 'cost' of developing advanced 'mind reading' capacities' (p. 57). Indeed there is now a well-established body of research documenting the fact that individuals with autism repeatedly fail to represent the mental states of others on theory of mind tasks.

Although researchers have now developed a range of tasks aiming to assess an individual's mentalising ability perhaps the classic test is the 'false belief test' examined through the use of the 'Sally Anne dolls' (Wimmer & Perner, 1983). This task involves the use of two character puppets, Sally and Anne. Subjects are shown that the Sally doll puts her marble in a basket and goes out to play. Whilst she is away, the Anne doll is shown to take the marble out of the basket, and place it in a box. Sally then returns and wants to play with her marble. Subjects are asked 'Where will Sally look for her marble?' Healthy children of age 3 ½ regularly fail this test, and state that Sally will look in the box, demonstrating an inability to represent the knowledge that Sally has in her mind. However, by the age of 4 ½ to 5, they begin to show an appreciation that Sally will look for the marble in the place that she left it – she does not know that it has been moved and so will act on her false belief. What

differentiates children who have autism, from children who do not, appears to be the fact that this 'theory of mind' mechanism does not develop in quite the same way. Baron-Cohen, Leslie and Frith (1985) compared performance on the Sally-Anne dolls test amongst children with autism, children with Downes Syndrome, and healthy controls, and found that only 20% of the autistic children were able to pass the test, in comparison with 85% of the children with Downes syndrome and age matched healthy controls. Leslie and Thaiss (1992) have demonstrated that although autistic people very often do badly on these theory of mind tasks, they generally perform as well as controls on tests that do not require mentalising ability. Taken together, such research illustrates that lack of ability on theory of mind tasks is not simply a function of low IQ, but represents a deficit in a particular aspect of cognitive processing. It has been argued that possession of a defective theory of mind accounts for much of the difficulty that autistic individuals experience in socialising and communicating with others, and for their lack of interest in symbolic and imaginative play. Again, there is research linking this to structural brain abnormalities, for example a study by Castelli, Frith, Happé and Frith (2002) compared the cerebral activation patterns of healthy people and people with Asperger's syndrome. The healthy controls showed activation in the dorsal region of the medial frontal cortex, but this region showed less activation amongst the Asperger's group.

Parallels between autism and schizophrenia

In 1991, C. Frith and U. Frith commented on the similarity between the behavioural patterns of autism and the symptoms shown by patients with schizophrenia. Both show social withdrawal, flattened affect, poverty of speech and inappropriate or odd

behaviours. C.Frith (1992) went on to propose that the same deficits that had been consistently implicated in the aetiology of autistic conditions could equally be applied to the aetiology of schizophrenia. Frith's theory is highly symptom specific. He is critical of researchers who have simply studied schizophrenic patients as one homogenous grouping, and argues that this diagnostic homogenisation is the reason behind much of the contradictory and incoherent research in this area. He proposes a classification system in which schizophrenic phenomena are divided into:

- Positive – abnormal by their presence
- Negative – abnormal by their absence
- Symptoms – experiences that the patient can tell us about
- Signs – behaviours that the clinician must observe.

Frith makes no apology for offering something of a 'grand' theory of schizophrenia in which all of the signs and symptoms that are seen can be explained by reference to defects in the system of *meta-representation.* He argues that there are three related domains;

I) awareness of one's own goals

II) awareness of one's own intentions

III) awareness of the intentions of others.

And his theory maps each of these three onto a triad of impairments into which he claims schizophrenic phenomena can be divided. Note that for Frith the crucial difference in the way that these impairments affect those with autism and those with schizophrenia is that autistic individuals are thought to be born with defects in their system of meta-representation. Schizophrenic patients on the other hand, may have a

well functioning system of meta-representation until it severely breaks down and their illness appears. As such they still continue to try to use the system but as long as it is malfunctioning they make meta-representational mistakes.

Frith postulated that the impetus for human action is derived either from Route A – in which an individual responds to an *external stimulus* – or Route B – in which an individual's actions are *internally generated.* He also claims that within the system of executive functioning is a *monitoring system* which continuously (unconsciously) monitors whether actions are self-generated or driven by external stimuli, enabling the individual to identify the source of current goals, plans and actions. On the basis of these ideas his theory attempts to account for both positive and negative symptoms and signs.

- Negative signs – these essentially consist of poverty of speech and of action. Patients with these signs respond to conversation using the minimal number of words possible and generate little action themselves. Frith noticed that these patients *can* respond appropriately when a response to a task is provided by the experimenter, i.e. they can use Route A, and generate action in response to environmental stimuli, but they respond extremely poorly when required to use route B, and generate action themselves. This is demonstrated by the the poor response of these patients on word fluency tests. Frith therefore proposes that patients who show poverty of action and speech are unable to use Route B, i.e. generate willed action. The presence of this defect means that when required to generate spontaneous action or speech they instead say nothing, (poverty of speech), perseverate, or respond inappropriately to signals in the environment. **Route B is impaired. This leads to a disorder of willed action, such that the**

patient lacks awareness of his/her own goals, or appreciation of how to select the necessary actions to achieve their goals.

- Positive symptoms – these include auditory hallucinations, and passivity phenomena such as thought insertion, or delusions of alien control. Frith takes as his starting point research suggesting that hallucinations are linked to internal speech. He argues that hallucinations occur when individuals fail to recognise that the speech that they hear is self-generated. For Frith, these symptoms are caused by a breakdown in the system of self-monitoring whereby the source of action can no longer accurately be labelled as internal or external. He suggests that this is also the reason for symptoms like passivity phenomena, and delusions of control. Frith argues that thinking is normally accompanied by a sense of effort and deliberate choice, but if this sense of deliberation is not there, then the individual will quite likely see the source of his thoughts as externally generated. Likewise a person should be aware of their own internally generated intention to act; if this breaks down the source of action may be misperceived as external rather than internal. **Route B is impaired. These patients have a disorder of self-monitoring, in this case their pathology results from a breakdown in awareness of their own intention to act.**

- Paranoid delusions – the individual makes incorrect inferences about the intentions of others, and begins to assume that the other is making an attempt to communicate, or to do harm, when there is none. For Frith, these correspond to the third defect of meta- representation; **there is a breakdown in the ability to monitor the intentions of others.**

- Schizophrenic speech – Individuals are unable to self-monitor and edit their speech as it is generated, in such a way that would make it appropriate and intelligible to the listener. This results in speech that is incoherent and derailed. These individuals also fail to adequately consider what knowledge the listener has, and often assume that others are in possession of facts that they are not, making their conversation impossible to follow. Difficulties in monitoring the mental state of the other makes it hard for the person with schizophrenia to generate intelligible speech, but also to comprehend the speech of the other, particularly when the other uses irony, and metaphor for example, and imputation of mental state is required. **Frith suggests that the disorders of schizophrenic speech include both disorders of self-monitoring, as well as disorders in monitoring the mental states of others**.

Table 1 (overleaf) summarises Frith's account of triad of impairments in schizophrenia.

Table 1

Schizophrenic presentation	Disorder of self-monitoring?	Disorder of other monitoring?	Friths account?
Positive symptoms			
Passivity phenomena, Auditory Hallucinations	Yes	No	Route B impaired. Disorder of awareness of own intentions
Paranoid delusions	No	Yes	Inability to monitor intentions of others.
Schizophrenic speech	Yes	Yes	Inability to monitor their own and other intentions
Negative signs			
Apathy, withdrawal, poverty of speech	Yes	No	Route B impaired. Lack of awareness of own goals. Inability to generate willed action.

In summary, Frith is proposing that abnormalities in meta-representation account for all of the signs and symptoms of schizophrenia. Meta-representation is itself made up of three component parts: awareness of one's own goals, awareness of one's own intention to act, and awareness of the intentions of others. The signs and symptoms of schizophrenia can be divided into three subtypes: disorders of willed action, disorders of awareness of own intentions, and disorders of monitoring the intentions of others; each of which maps onto a disorder of meta-representation. If there is a breakdown in an individual's awareness of his own goals, this will lead to disorders of action and will. If there is a breakdown in awareness of intention to act, this will result in lack of self monitoring so that ideas and actions which are self generated

will be perceived as having been generated from outside; hallucinations and passivity phenomena may result. If there is a breakdown in awareness of the intentions of others, their communications will be difficult to comprehend and their actions misperceived; paranoid beliefs and ideas of reference may result.

In his more recent work, Frith (Frith, Blakemore & Wolpert, 2000) has further developed his account of the breakdown in self-monitoring that patients experiencing passivity phenomena and /or hallucinations experience. He states that in healthy individuals a cognitive mechanism known as a *'forward model'* makes a clear distinction between internally and externally produced action by making a prediction as to the sensory consequences of an act. It then compares this prediction to the *actual* sensory consequences of the act, and if the act is self-generated, the forward model matches up the prediction and the actual response and cancels out the sensory consequences of the motor act. Hence one cannot tickle oneself (Weiskrantz, Elliot & Darlington, 1971, cited in Frith, Blakemore & Wolpert, 2000). However, Frith states that an impairment in this predictive system weakens the discrepancy between the predicted consequences of a motor act, and the actual consequences of the act, such that internally generated actions are indistinguishable from those which are generated externally. To support these claims Frith cites experimental evidence by Blakemore (2003) to suggest that within healthy individuals the sensory consequences of self-generated movements are perceived differently from identical sensory experiences which are generated externally. Blakemore asked participants to rate the intensity and degree of pleasure produced by a self-generated sensation, (a tactile stimulus on the palm of the hand) and one produced by a robot. The participants rated the self-produced sensation as being far less tickley, intense and pleasurable than that produced by the robot. However, in the second part of the

experiment, Blakemore invited participants again to take action to generate the stimulus, but this time the experimenters secretly created a delay in the production of the sensation that would be perceived. Participants reported a progressive increase in the sensations generated by the action as the delay was increased. This supports the hypothesis that the forward model generates a prediction as to the sensory consequences of an action. If the sensory consequences closely match those predicted, then the attentional response is diminished. If however, the sensory feedback does not match that which was predicted (i.e. due to a temporal delay in the production of the sensation) then the sensory consequences are amplified. Frith argues that amongst individuals with delusions of control there is a defect in either the predictive or comparative aspect of the forward model, such that even when actions are self-generated there is a major discrepancy between the sensory feedback which was predicted and that which results. To test these ideas on a clinical population Blakemore (2003) compared the sensory perceptions of a group of patients with delusions of control and auditory hallucinations with those of age matched healthy controls. Each group was asked to rate the sensation of a tactile stimulus on the palm of the hand, which was either self-produced, or produced by the experimenter. The results indicated that the control group experienced the self-produced stimuli as far less tickley, intense and pleasant than that produced by the experimenter, but the clinical sample rated the self produced stimuli as having similar effects to the sensations which were generated externally, supporting the hypothesis that auditory hallucinations and passivity experiences are associated with a defect in the forward model mechanism, such that it is difficult for the individual to differentiate between self and externally generated sensations.

Friths's research

Frith has produced a substantial body of research to support his ideas.

Corcoran, Mercer and Frith (1995) undertook a series of studies aiming to illustrate that people with schizophrenia have difficulty inferring the thoughts and beliefs of other people. In the 'Hinting Task' participants were presented with a scenario involving two characters. At the end of the scenario, one character drops a verbal hint. The participant is asked to explain what they think the character really means. The performance of fifty-five people with a diagnosis of schizophrenia was compared with that of thirty healthy controls, and fourteen patients who were suffering from anxiety or depression, but had no psychotic element to their illness. Corcoran et al. found that patients with passivity features performed as well as the other psychiatric controls and those in remission (recall that under Frith's theory patients with passivity features are thought to be defective in their ability to *self-monitor).* But the schizophrenic subjects with paranoid delusions demonstrated a significantly poorer response. (Patients exhibiting negative behavioural signs also demonstrated a poor performance, which Corcoran et al. suggest is a result of their more widespread cognitive dysfunction).

Frith and Corcoran (1996) conducted another investigation of the ability of people with schizophrenia to monitor the mental states of others, but this time using simple stories with cartoon illustrations. All of the stories involved a false belief or deception and so it was necessary for participants to mentalise in order to appreciate what was going on. Again, those with passivity features and those in remission performed well. However, those with paranoid delusions were less accurate in their ability to make inferences about the character's mental state. The subjects with

behavioural signs (mostly negative) showed difficulty in inferring mental states also, but they showed additional difficulties in answering control questions in which they were required to recall a factual part of the preceding story, suggesting a more global level of impairment.

In a third piece of research undertaken by Corcoran, Cahill and Frith, (1997) schizophrenic participants were shown two sets of jokes in cartoon form. In the first set, it was vital for participants to be able to appreciate the mental state of the main character in order to appreciate the joke. In the second set, the jokes took a purely physical form, and there was no such requirement to mentalise. Schizophrenic subjects who were in remission again performed on a par with normal controls. But again the subjects who were still symptomatic showed markedly more difficulty in understanding the jokes which required an appreciation of mental state. Difficulties were most pronounced amongst those with negative behavioural signs but those with paranoid delusions also showed inaccuracies inferring mental states.

Corcoran et al. argued that these findings illustrate theory of mind deficits in participants diagnosed with schizophrenia; deficits which are specific to the signs or symptoms that the subject displays. Schizophrenic subjects displaying predominantly negative features showed patterns of response that had most in common with autism because their scores on simple tasks were generally poor. These participants showed a failure to recognise hidden intentions and to appreciate false beliefs, and their responses to questions were lacking in the use of mental state language. However, what differentiated these subjects from people diagnosed with autism is that they often also failed the memory control questions. Corcoran et al. connected their findings to those of many other research studies which have emphasised a broad

range of deficits in this group, notably in executive functioning and memory processes, and suggested that individuals with negative behavioural signs share with autism the *extent* of their problems using theory of mind, *but not the specificity.*

Amongst the participants with paranoid delusions, there was again, evidence of poor performance on theory of mind tasks, but the level of difficulty was not quite as severe; mentalising problems were more specific, and there was no evidence of memory problems. This concurs with the findings of neuropsychological investigations which have suggested that patients with positive symptoms tend to be cognitively more intact (Corcoran & Frith, 1993). Interestingly, on all tasks Corcoran et al. found that amongst subjects whose symptoms were in remission, performance on theory of mind tasks was comparable with that of normal controls. This suggests a key distinction between the theory of mind difficulties of subjects who have autism, and subjects who have schizophrenia. For the schizophrenic subjects with paranoia the difficulties are *state dependent* and they remit with an improvement in their psychotic state. Amongst patients who exhibit chronic negative features and whose symptoms do not remit, there is a long-term breakdown in mentalising ability.

Other research supporting Frith

Frith's propositions have been taken up by other researchers, a number of whom have also uncovered evidence that schizophrenic patients show signs indicative of a deficit in meta-representation.

Research indicating a disorder of willed action

Of all his ideas, Frith's hypotheses regarding the relationship between disorders of willed action and schizophrenic symptoms have been subject to the least scrutiny. However, there is an increasing body of research indicating that schizophrenic patients exhibit deficits in the kinds of executive processes which might underpin this, such as the capacity to generate self-initiated behaviours and to inhibit a response. Self-initiated behaviours have tended to be assessed using verbal fluency tests. Studies have consistently found that schizophrenic patients produce fewer words and perseverate more than controls (O'Leary et al. 2000). Donohoe and Robertson (2003) conducted a review of such studies undertaken during the past ten years and found that nine out of ten found verbal fluency to be most strongly correlated with positive, rather than negative symptoms, suggesting support for Frith's hypotheses.

Completion of the Wisconsin Card Sorting Test (WCST, Heaton, 1981) requires the operation of a number of executive skills, the failure of which may result in a defect of willed action. The participant is required to draw together the ability to plan, to shift a cognitive set, and to inhibit a response in order to direct their behaviour toward achieving a goal (Laurent et al. 2001). The finding that schizophrenic patients show impaired performance on the WCST is now fairly robust, and has been noted in both active and remitted patients (Kolb & Whishaw, 1983). The finding that impaired performance is particularly associated with negative symptoms (Breier,

Schreiber, Dyer & Picker, 1991) also adds weight to Frith's suggestion that the negative symptom pattern results from a disorder of willed action.

Weisbrod, Kiefer, Marinzik and Spitzer (2002) compared the performance of schizophrenic subjects and normal controls on a go/No go task. This kind of task requires subjects to respond to certain stimuli, usually a letter or a tone (this is the 'go' condition) whilst inhibiting a response to some other stimuli (the 'No go' condition). Whilst subjects were undertaking these tasks, the researchers monitored differences in cerebral activation using EEG technology to track 'Event Related Potentials' – physiological correlates of mental processes. Their results showed that in the 'go' condition there were no significant differences between the performance of the schizophrenic subjects and the healthy controls. However, on the 'No go' condition, the task performance of the schizophrenic subjects was clearly worse than that of the controls, indicating a failure of response inhibition. Weisbrod et al. point out that it could be argued that the schizophrenic subject's poor performance was the result of some factor such as low motivation to engage in the task, were it not for the fact that they performed as well as the controls on the 'go' condition. ERPs were similar across the two groups on the 'go' condition, but showed disparities on the 'No go' condition, indicating dysfunctional frontal activity when response inhibition is required. Although Weisbrod et al. do not make this point, the data is supportive of Frith's hypotheses; the patients showed evidence of perseveration leading to difficulty engaging in willed action.

Research indicating a disorder of self-monitoring (awareness of own intention to act)

Bentall, Baker and Havers (1991) used reality discrimination tasks to investigate the hypothesis that hallucinations occur when internal, private events are mis-attributed to an external source. They compared the performance of a group of schizophrenic patients who experienced hallucinations, with two groups of controls: psychiatric patients who experienced delusions but with no history of hallucinations, and a group of healthy volunteers. During the first part of the experiment subjects were read out lists of categories, in some cases they were required to generate a paired associate, for other items they were simply required to repeat the associated pair which was supplied by the experimenter. After one week participants were asked to take part in a surprise source identification task in which the experimenter read back to the participant the self generated items, the items which had been presented to them, and items which they had not previously heard. Participants were required to classify each item as 'mine', 'given' or 'new'. When Bentall et al. examined the pattern of errors made by each group it was clear that the hallucinators had attributed more of the self-generated words to the experimenter than either the group of delusional patients, or the healthy controls, and Bentall et al. argue that this provides support for the hypothesis that hallucinators experience defects in self-monitoring, such that they misattribute more of their own thoughts to an external source.

Johns et al. (2001) comment that in Bentall et al.'s research the tasks required subjects to identify the source of verbal material some time after it had been presented, and suggest that 'immediate' source monitoring might be more relevant to understanding the processes which lead to verbal hallucinations. They compared the abilities of a group of healthy controls, to that of two groups of schizophrenic

patients – those experiencing verbal hallucinations and those who were not. All participants completed a verbal self-monitoring task, in which they were required to identify the source of speech which was being manipulated whilst the subjects spoke aloud. They were subject to four conditions in which the feedback they heard was 1) their own voice, undistorted, 2) their own voice moderately distorted, 3) their own voice severely distorted. In the final condition they heard an alien voice (that of one of the research confederates). Patients with schizophrenia who experienced verbal hallucinations showed more errors in identifying the source of their own distorted voices than those without verbal hallucinations and controls. Furthermore, hallucinators showed an external response bias in their errors, which was not evident amongst the non-hallucinators and controls. Johns et al. consider the possible interpretation that their findings reflected the hallucinators general tendency to make overconfident decisions, and therefore rushed responses. If this was the case then hallucinators ought to have shown similar misidentification errors in the alien feedback condition as well as when they heard their own distorted voice, but here in fact there was no significant difference between the groups. This suggests that hallucinators make show an externalising bias for speech that is self generated and distorted, rather than a generalised tendency to make over confident decisions.

Stirling, Hellewell and Quraishi (1998) set out to examine whether people with schizophrenia showing symptoms involving alien control have a deficit of self-monitoring or, if in fact their difficulties simply reflect a wider pattern of general cognitive deficits. They compared the performance of thirty-five schizophrenic patients and healthy controls on a drawing task and a battery of cognitive measures. In the drawing test, participants had to generate simple pictures and later identify which ones they had drawn themselves when faced with a variety of similar pictures, presented in various orientations. Stirling et al.'s results showed that there was a

pronounced correlation between drawing test performance and schizophrenic symptoms of alien control; these patients made far more errors in identifying their own drawings. Stirling et al. noted that this effect was relatively independent of performance on the tests of general cognitive functioning. They concluded that the people with schizophrenia showed specific deficits in their ability to self-monitor and that their result provided support for Frith's model.

Research indicating a disorder of monitoring the mental states of others.

Sarfati, Hardy-Baylé, Besche and Widlocher (1997) compared the performance of a group of schizophrenic patients with a group of psychiatric controls and a group of healthy volunteers, on a task that involved selecting a card to complete a story illustrated by a comic strip. In order to correctly complete the story, subjects were required to accurately assess the characters intentions, wishes, or false beliefs. Sarfati et al.'s results indicated that as a whole group, the schizophrenic patients showed impairment in their ability to attribute mental states relative to the controls. When the schizophrenic patient group was subdivided according to symptom type, it was found that the patients showing thought and language disorder (corresponding to the 'positive signs' in Friths' terminology) demonstrated the poorest performance.

Mitchley, Barber, Gray, Brooks and Livingston (1998) tested schizophrenic patients and psychiatric controls using a task that requires the understanding of irony, since this is thought to require appreciation of the speaker's mental state. Mitchley et al. found that patients who scored highly on measures of negative behavioural signs were the most impaired on the task, compared to the psychiatric controls. However,

they found no link between inability to understand irony and paranoid symptoms; as such their study provides only partial support for Frith's model.

Research challenging Frith

Whilst it can be seen that a number of researchers have uncovered evidence to support Frith's propositions, other studies pose a challenge to his ideas. In addition, commentators have pointed out that that Frith does not describe the factors which influence which forms of defective mentalising will be apparent in which patient, (Langdon & Coltheart, 1999).

Walston, Blennerhassett and Charlton (2000) consider the implications of patients who exhibit 'pure' delusional disorders. Pure delusional disorders are described by DSM IV (APA, 1994) as those which are encapsulated, and refer *only* to specific groups or persons. The individual's affect, speech and behaviour is otherwise intact. Walston et al. proposed that if Frith is correct, and persecutory delusions result from a defective ToM mechanism, then it should not be possible to find patients whose persecutory delusions are circumscribed in this way; logic suggests that their defective ToM mechanism would impact upon *all* of their social relationships and not be restricted to certain individuals. They trawled through the caseloads of 17 psychiatrists and 4 community nurses in their catchment area in the north of England, and managed to find four cases (out of 'some thousands of patients') that they argued exhibited 'pure' delusional disorder. Walston et al. state that outside of the delusional belief system each of these patients exhibited normal social reasoning and maintained some good relationships. They comment that if Frith's theory is correct it is difficult to understand how this could be so. Walston et al. used Frith's own tests

to evaluate ToM ability, hypothesising that these patients would perform as well as normal controls. They invited their four delusional subjects to undertake the 'hinting task' and the 'cartoons' test, and found that as they had predicted, their ToM capacity was unimpaired. Walston et al. used this finding to argue that in fact, the poor performance of many schizophrenic subjects on ToM tests is a result of the chronicity of their illness, rather than of selective ToM deficits.

Brüne (2003) undertook an investigation into the mentalising abilities of twenty three patients diagnosed as suffering from schizophrenia of the disorganised type (DSM 1V, ASA, 1994), a subcategory of the disorder in which patients show early onset of illness, severely compromised social behaviour, and poor prognosis. This group can be said to correspond to Frith's 'behavioural symptoms' group. Both patients and eleven healthy controls were assessed for IQ using a German verbal comprehension test, and then undertook a series of tasks, evaluating performance on both first, and second order false belief tasks and in understanding physical stories. Brüne found that there were no differences in the performance of the two groups on the physical story, but that differences were apparent when subjects were required to demonstrate mentalising ability. He noted however, that there were marked differences between the two groups in terms of IQ. Brüne therefore re-analysed their data, using only patients in the schizophrenia sample who had at least average IQ. Brüne found that all the remaining patients passed the first order false belief test, and 92% passed the second order false belief test (as opposed to 70% in his first analyses). He concluded that it is difficult to be sure to what extent failure to perform on mentalising tasks indicates a specific cognitive deficit, rather than more general cognitive deficiencies, such as low IQ. Brüne speculates that understanding when and how to apply social

strategies is problematic for schizophrenics, rather than mental state attribution per se.

In response to such criticisms Pickup and Frith (2001) gave schizophrenic patients both theory of mind tasks and control tasks, which were judged to be equally difficult, but which did not require the attribution of mental states. They found that the people with schizophrenia still demonstrated poorer performance on the ToM tests and suggested that this illustrates a specific ToM deficit which is not related to IQ or illness chronicity.

Other challenges which have been levelled at ToM accounts of schizophrenia include those of Russell (1998, cited in Pickup, 2000). He argued that schizophrenic patients do not have defective theory of mind, simply they are 'captured' by misleading pieces of information pertaining to a scene, and that their inappropriate focus on these details leads them to make inaccurate interpretations about what is taking place. Or again, both Harris (1995) and Currie (1996) argue that schizophrenic patients fail on theory of mind tests because they are unable to hypothesise about abstract situations and imagine scenarios as they might be.

Taken together, this selection of claims and counter-claims have lead to the criticism that in fact it is impossible to make clear assertions about which particular processes are defective in schizophrenic patients since their functioning can be affected by many confounding variables. For example they often take a cocktail of medications, have frequently been ill for some considerable period of time, have varied levels of pre-morbid functioning and may well have been hospitalised on numerous occasions (Lencz, Raine, Benishay, Mills & Bird, 1995). Each of these factors alone could be

expected to have some impact on the patient's performance on cognitive tests, and more so a combination of all of them together. In order to try to address these concerns researchers have turned their attention to schizotypy.

Schizophrenia: A valid concept?

Increasing refinements in the DSM IV (APA, 1994) criteria for schizophrenia have improved the reliability of the diagnosis. But questions remain as to its validity. Chadwick, Birchwood and Trower (1996) argue that a diagnostic category has validity if it helps the clinician to predict the outcome and course of the disorder, if it enables the clinician to make informed decisions as to the best treatment for the disorder, and if it enables the clinician to have some idea as to the aetiology of the disorder. They quote Bentall (1990) and Boyle (1990) who both argue on the basis of these three criteria that the concept of schizophrenia is invalid, and should be abandoned. They argue that the concept lacks *construct* validity, since there is no one symptom that every schizophrenia patient shows, and that the symptoms that are thought to characterise the disorder are seen in other disorders. They also assert a lack of *predictive* validity, since the course of the disorder and its outcome in a particular patient remains very difficult to predict, and the disorder does not always respond to a particular type of treatment. Bentall and Boyle also note that despite the production of a substantial body of research there is still no clear link to a specific aetiology. Chadwick et al. (1996) state the concept of schizophrenia has been partly responsible for the exclusion of these patients from consideration by cognitive therapy, until recent decades. They write that the concept is 'laden with pessimistic and at times baffling presumptions which serve to banish psychological analysis' (p.xiv). Amongst these assumptions they cite the implication that schizophrenic

experiences are in some way discontinuous from normal experiences, as exemplified by the psychoses/neuroses division perpetuated in many psychiatry textbooks.

Chadwick et al. argue that in fact there is no justification for considering schizophrenia to be outside of the range of ordinary psychological functioning. They reject the often asserted definition of delusional beliefs as those which are highly resistant to change, stating that in fact *all* core beliefs are resistant to change, not simply delusional ones. They assert that there is no convincing evidence that delusional thinking results from qualitatively different cognitive processes. Although there have been studies claiming to have uncovered an increased tendency toward conceptually driven information processing and studies claiming evidence of thinking which is excessively stimuli driven, there has been no evidence of a deficit in the thinking of delusional individuals. Chadwick et al. further reject the once popular assumption that the content of delusions and hallucinations is meaningless, arguing instead that they reveal significance and personal meaning which is connected to the individual's wider psychological vulnerability. Other authors have commented that the concept of schizophrenia is one that still has a great deal of stigma attached to it, in the minds of the general public. Crisp, Gelder, Rix, Meltzer, and Rowlands (2000) conducted a survey of the attitudes toward mental illness of 1737 adults and found that schizophrenia was one of the three disorders which elicited the most negative opinions, with approximately 70% of respondents regarding people with schizophrenia as 'dangerous to others' and 80% endorsed the view that people with schizophrenia are 'unpredictable'. 50% believed that those with schizophrenia never recover. Crisp et al. pointed out that this was not due to a generalised negative view of mental illness, for those surveyed were found to have

quite accurate knowledge of other disorders. Crisp et al. suggest that these attitudes contribute toward the 'social distancing' and 'isolation' that sufferers experience (p 6). As a result of such problems, authors like Chadwick et al. are highly critical of the concept of schizophrenia, arguing instead for a 'symptom based' consideration of individual psychotic phenomena, and an understanding of psychosis as something which is on a continuum from, rather than divorced from, ordinary psychological functioning.

Schizotypy

The concept of schizotypy refers to the idea that the propensity to develop a psychotic illness exists on a continuum. At the extreme end are those who develop full blown schizophrenic symptoms, but lower down the scale are individuals with schizotypal/schizoaffective personality disorders, and further down the scale still, are healthy individuals who have personality traits that mark a cognitive vulnerability to psychosis, (e.g. they have unusual beliefs such as in telepathy or magic, see Claridge, 1987).

Such a concept helps us to understand the commonly observed finding that studies of the normal population reveal that a sizeable minority experience phenomena such as hallucinations. For example, in a study conducted by Launay and Slade (1989) 30% of respondents reported hearing their own thoughts spoken out loud at least once. As such, the experience of hearing voices can hardly be said to exist outside of the range of normal experience. The concept also ties in neatly with 'stress-vulnerability' models of psychosis, which propose that a number of individuals may carry a biological/genetic vulnerability toward psychotic disorder, but this may never be expressed unless they encounter extreme stress.

Components of Schizotypy

Claridge et al.'s (1996) factor analytic studies reveal that schizotypy is *not* a unitary construct. Claridge et al. identified four factors:

- The first factor includes unusual perceptual experiences, thinking styles and beliefs,
- The second factor consists largely of cognitive distortion and anxiety, including attentional difficulties and distractibility
- The third factor is composed of asociality, including impulsivity and disinhibition,
- The fourth factor denotes 'introvertive anhedonia', solitariness and lack of feeling.

And other factor analytic studies have produced very similar findings, for example, Liddle's study (1987) identified three factors – 'reality distortion' (primary hallucinations and delusions), 'disorganisation' (thought disorder and inappropriate affect and behaviour) and 'psycho-motor poverty' (poverty of speech, blunt affect and lack of spontaneous movement).

Peters (1994) and Claridge (1997) have documented the fact that healthy volunteers who show high schizotypy scores demonstrate weaker performance on the kinds tasks which have pointed to deficits in schizophrenia, such as reduced sustained attention (Obiols et al, 1997), reduced latent inhibition (Baruch, Hemsley & Gray, 1988) and poorer performance on delayed spatial memory tasks and on tests of executive functioning. For example, a study by Suhr (1997) assessed a group of

students using measures of schizotypy, the WAIS, and a battery of measures of executive functioning, including the WCST, the Stroop Colour and Word Test, and the Tower of Hanoi test (which assesses forward planning). Her results showed that there were no differences between the high schizotypy students and the healthy controls in terms of IQ but that the high schizotypy students showed significantly poorer performance on the battery of executive functioning tests, most prominently in terms of inhibitory control.

There is also research evidence to support the assertion that individuals who show high scores on measures of schizotypy are at greater risk of developing schizophrenic illness. Chapman, Chapman, Kwapil, Eckblad, and Zinser (1994) conducted a longitudinal investigation in which they followed 508 college students who had completed measures of schizotypy over a ten year period, and found that those whose scores were high at baseline, (as measured by perceptual aberrations, magical ideation, and social anhedonia) were more likely to experience a psychotic illness during the course of the study than those whose scores were low. These kinds of findings have prompted the commission of a body of research in which healthy individuals assessed for schizotypy have been used to investigate psychological models of psychosis. The usefulness of studying individuals who show high scores on measure of schizotypy, is that they enable the researcher to bypass the confounding effects of institutionalisation, medication and so on that affect a clinical population.

Re-visiting Frith: Schizotypy research

Research which has investigated Frith's theory using a schizotypy paradigm, again, provides an inconclusive view. Most of the studies using schizotypes have tended to concentrate on his ideas about monitoring the mental states of others. There are an increasing number of studies examining the presence of executive deficits in schizotypy, and two such studies will be described here in order to illustrate that there is some support for Frith's assertion that negative symptoms are related to a disorder of willed action. There appears to be no research relating to the ability to self-monitor in schizotypy which precludes a review.

Schizotypy and disorders of willed action

Earlier in this chapter it was explained that schizophrenia patients show impaired performance on the WCST, which requires the participant to employ many of the executive skills which are required to generate willed actions. The results of studies examining WCST performance in schizotypy are more mixed, and some have not found a correlation between high schizotypy and poor performance (i.e. Lenzenweger & Gold, 2000, cited in Dinn, Harris, Aycicegi, Greene, & Andover, 2002). However, it has been argued that this is because Lenzenweger and Gold measured schizotypy using the Perceptual Abberation Scale, which is taps the positive dimensions of schizotypy such as the presence of perceptual distortions. Studies which have examined the relationship between the negative dimensions of schizotypy and WCST performance have tended to find clearer evidence of deficits.

Laurent et al. (2001) compared schizophrenic patients, their first-degree relatives, and non-psychiatric controls on the WCST and when they examined the groups as a whole, they found no difference between the performance of the relatives, and that of the controls. However, when they divided the relatives into subgroups based on the different dimensions of schizotypy they found that perseverations were clearly linked to high scores on measures of anhedonia. There remained no link between test performance and the positive dimensions of schizotypy.

Dinn et al. (2002) examined executive performance and personality traits amongst students who had been screened for schizotypy, using a battery of tests that included the Stroop colour and word test, and verbal fluency tests. They found distinct positive and negative profiles, with negative schizotypy showing the strongest associations with deficits on measures of executive functioning, and positive schizotypy being more strongly associated with disinhibition, impulsivity and antisocial personality. Taken together, these results suggest that schizotypes who score highly on the negative symptoms do show the kinds of executive dysfunctions which might lead to a disorder of willed action.

Schizotypy and the ability to monitor the mental states of others

Langdon and Coltheart (1999) used a schizotypy paradigm to return to the suggestion that ToM deficits are merely the result of the chronic asociality inherent in general psychiatric illness. In Langdon's (1997) study it was found that the patients whose illness was of the longest duration, exhibited the poorest mentalising skills. They investigated this hypothesis using forty healthy undergraduate students who testified to having *no history of psychiatric illness* and who were divided into high and low schizotypes on the basis of the SPQ questionnaire (Raine, 1991).

Students were tested for mentalising ability via an examination of their performance in sequencing three kinds of stories. 'Mechanical stories' involved simple cause and effect relationships between phenomena, and tested the participant's capacity to infer causal relations. 'Social script stories' described everyday routines and evaluate a subject's ability to use social script knowledge. 'False belief' stories involved testing a subject's ability to infer false beliefs, and to correctly predict that a character would act on the basis of misinformation. Langdon and Coltheart reasoned that if high schizotypy individuals do evidence a selective ToM deficit, then they should show selective impairment on the false belief stories *only*. Their results showed that the subjects who showed high scores on the measure of schizotypy made more errors on the false belief stories relative to the low schizotypes, and relative to the other story types, suggesting support for Frith's model. In this first experiment they found that the poorest scores in terms of ToM were exhibited by subjects whose schizotypy scores were analogous to the negative symptoms of schizophrenia, again, consistent with Frith's theory.

Langdon and Coltheart (1999) then conducted a second experiment which aimed to replicate their own finding, but also to include control tasks to try to take account of three alternative explanations for the results they achieved. One possibility was that the high schizotypy individuals were simply more strongly affected by the increasing difficulty of the tasks. In addition, they considered Russell's (1998) suggestion that schizophrenic patients do not have defective theory of mind, simply they are 'captured' by misleading pieces of information inherent in a scenario, and their inability to inhibit these irrelevant details leads them to misinterpret what is happening. As such, Langdon and Coltheart again presented participants with three kinds of picture completion tasks, containing 'mechanical', 'false belief', and 'social

script' stories, but this time they additionally included an extra 'capture' story, in which the story illustrated contained some extra, but misleading details, and which was also pitched at a higher level of difficulty than the other stories. Finally, they considered Currie (1995) and Harris (1995) assertions that schizophrenic patients do not have selective mentalising deficits, simply they have a general inability to entertain future hypothetical states. To control for this possibility they included a 'Tower of London' planning task, (Shallice, 1982) in which subjects had to mentally map out a sequence of moves in order to transfer coloured balls from one location to another. Langdon and Coltheart reasoned that if a selective mentalising deficit were responsible for the results found in their first experiment, high schizotypy individuals should still show their worst performance relative to the low schizotypes on the false belief stories, they should not be impaired on the capture stories, or on the Tower of London test. Once again, Langdon and Coltheart's data supported their hypotheses and they concluded that their study demonstrated strong evidence in favour of Frith's (1992) model and against competing accounts of mentalising deficits. However, there was one inconsistency in their findings, in that in experiment two, poor mentalisers were more likely to rate highly on the positive symptoms of schizophrenia, rather than the negative symptoms, as found in experiment one (and in contrast to Frith's hypotheses).

Pickup (2000) attempted to replicate Langdon and Coltheart's finding that higher measures of schizotypy are associated with poorer ToM, but failed to do so. He screened healthy volunteers for schizotypy using the STA (Claridge, and Broks, 1984) and the O-life (Mason, Claridge & Jackson 1995) and invited them to complete a task using eight theory of mind stories and eight 'physical' stories; both types of stories required the participant to comprehend the information presented,

and to draw inferences beyond the information presented, but only the ToM stories required the attribution of mental states. The physical stories acted as a control for the hypothesis that poor performance on these tests was a result of generalised defects in reasoning, or that the subjects have problems imagining hypothetical states of affairs (Harris, 1995; Currie, 1996). On the basis of Frith's theory, it was hypothesised that subjects who scored highest in terms of schizotypy, would show the lowest scores on the ToM stories, but that both groups would perform equally well on the physical stories. It was also hypothesised that the poorest ToM scores would be found amongst those whose schizotypy scores were analogous to the behavioural signs (that is to say, scoring highly on the 'Cognitive disorganisation' 'Impulsive Non-Conformity' and 'Introvertive Anhedonia' sub-scales' of the O-Life, (Mason et al. 1995). However, neither of these predictions were supported by Pickup's data. In fact, there was a non-significant trend for highly schizotypal subjects to demonstrate a worse performance on *both* the ToM *and* the physical stories, and there was no significant effect of schizotypy group on story score. In fact, the only correlation which approached significance was amongst subjects scoring highly on the UE (unusual experiences) dimension of schizotypy – analogous to the *positive symptoms* of the disorder, and ToM scores. As such, the relationship between schizotypy and ToM is still unclear.

Pickup (2000) considers several reasons why his results may have differed from those found by Langdon and Coltheart (1999). He rules out the possibility that his sample size was too small, since he had 62 participants, and Langdon and Coltheart found their significant result with forty participants in the first experiment, and twenty eight in the second. However, he notes two crucial differences between their studies. Firstly, Langdon and Coltheart measured schizotypy using the SPQ (Raine,

1991). Pickup notes that the SPQ has a stronger leaning toward the traits associated with the *positive* symptoms of schizophrenia, in contrast to the O-life, in which the 'unusual experiences' dimension, comprises only around 25% of the items measured. In addition, he comments that the 'interpersonal' dimension of the SPQ focuses more on few friends, and flat affect, in contrast to the lack of enjoyment, which is essential to the 'introvertive anhedonia' scale of the O-life. As such the two scales are to some extent, measuring slightly separate things. Pickup reflects that it may well be that the 'lack of friends' and 'flat affect' measured by the SPQ are more closely associated with impairments in ToM, and he recommends that in future research of this kind, participants complete both measurements, to clarify this issue.

The study presented in this thesis aims to further investigate Frith's ideas using individuals who have been found to have high or low schizotypy traits, using tasks designed to assess ability to monitor the self and others, and to generate willed action. The research will employ a new task – a variant on the pre-pulse inhibition paradigm (PPI). The PPI paradigm has been adapted in order to consider whether high schizotypy individuals can startle themselves. If high schizotypy individuals can startle themselves and low schizotypy individuals cannot, this would provide support for Frith's assertions that high schizotypy individuals have a defect in their ability to self-monitor. To provide a context for introducing this novel task, the pre-pulse inhibition literature will be reviewed first.

Pre- pulse inhibition

The pre-pulse inhibition paradigm evolved from research examining deficits in selective allocation of attentional resources and information processing amongst schizophrenic patients (Braff & Geyer, 1990, cited Braff, Geyer & Swerdlow, 2001).

The research shows a pattern whereby these patients lack the ability to filter out and ignore trivial or meaningless stimuli, and it has been hypothesised that this leads to over stimulation and cognitive overload, both of which contribute toward psychotic symptoms. This ability to automatically screen out unnecessary information is termed 'perceptual gating'. The prepulse inhibition method of measuring perceptual gating processes was first described by Graham in 1975 (cited in Braff et al. 2001). Graham outlined an experiment in which a weak warning stimulus was played (the prepulse) followed by a louder, startle inducing stimulus. The startle reflex in humans consists of a rapid contraction of the skeletal and facial muscles, in response to a sudden and quite intense stimulus. In humans this is typically measured by using electromyography (EMG) of the orbicularis oculi muscle of the eye. When the interval between the prepulse and the startling stimulus is short, i.e. between 30 and 500 milli-seconds, normal subjects show an *inhibition* of the blink reflex component of their startle reaction, in comparison with the response that is generated to the startling stimulus alone. With subsequent presentation of the pulse and prepulse, onset latency of the startle response is decreased.

It has been suggested that this phenomena exists because the prepulse inhibits or 'gates' the response to the startling stimulus by activating brain processes which 'protect' processing of the information provided by the first stimulus, so that it can be adequately processed without interference from subsequent events (including the emission of the startling stimulus). As such, during the very brief period following the presentation of the warning stimulus, responses to further stimuli are blunted (Blumenthal, 1996, cited in Braff et al. 2001, Swerdlow, Geyer, Blumenthal & Hartman, 1999, cited in Braff et al. 2001). It has been further suggested that in evolutionary terms, this is functional to the organism, since it facilitates the

negotiation of a world in which we are all constantly bombarded by a stimuli in every modality; this protective 'gating' response helps to prevent sensory overload (Swerdlow, 1996, cited in Braff et al. 2001).

The prepulse inhibition phenomena is now much replicated, and the paradigm provides a robust and ubiquitous measure of sensori-motor gating. It occurs across sensory modalities, whether tactile, auditory, or visual, and occurs even when the prepulse and startling stimulus are in different sensory modalities. It occurs in all mammals as well as humans and does not appear to be a result of conditioning, since the phenomena occurs on first presentation of the prepulse and pulse (Blumenthal, Schicatano, Chapman, Norris & Ergenzinger, 1996, cited in Braff et al. 2001).

However, research involving schizophrenic patients suggests that they do not use these automatic filtering processes in the same way as healthy controls - a number of studies have shown that they show reduced prepulse inhibition. For example Braff et al. (1978) compared the differences in the prepulse inhibition of the startle response of schizophrenic patients and healthy controls, and found that the schizophrenic patients exhibited less startle inhibition than the healthy participants. Braff et al. surmised that the pre-attentive filtering processes operated by the healthy subjects were defective amongst the schizophrenic patients and that their results support the hypothesis that schizophrenia is characterised by an inability to filter information effectively.

Parwani et al. (2000) compared the prepulse inhibition of a group of clinically stable schizophrenic outpatients, acute schizophrenic inpatients and normal controls. Their results confirmed that schizophrenic patients demonstrated reduced sensori-motor

gating in comparison with controls, as measured by the PPI of their acoustic startle response, but in addition, they found no significant differences between the pattern of response between the stable outpatients and the acute inpatients. This finding suggests that sensori-motor gating deficits may be a trait marker for schizophrenia, rather than a state dependent phenomena caused by the disruption of information processing during a psychotic episode. Further support for this theory comes from studies finding similar inhibitory deficits amongst the first degree relatives of schizophrenic probands and subjects with schizotypal personality disorder (Cadenhead, Swerdlow, Shafer, Diaz, & Braff, 2000).

As previously discussed, the use of individuals who are high in schizotypy to investigate the cognitive mechanisms underlying schizophrenia provides an opportunity to circumvent the confounding effects of medication and institutionalisation that dog research with patients. Simons and Giardina (1992) invited college students to complete measures of schizotypal traits and then complete a passive attention task (i.e. participants were not instructed specifically to attend to any of the sounds that they heard) in which their startle response was measured. They found that those showing high scores on measures of 'anhedonia' did not differ significantly from controls, but subjects whose scores indicated high levels of 'perceptual abberation' did demonstrate impaired PPI at 120ms lead interval. Cadenhead et al. (1993) found abnormal patterns of PPI amongst patients diagnosed with schizotypal personality disorder (again, in a passive attention condition). Schell et al. (1995) identified individuals who were high in schizotypy and administered both active and passive attention tasks. They found that there were no differences between the two groups in the passive attention task, but in the active attention

condition the high schizotypy individuals failed to show the normal pattern of response inhibition.

Other research suggests quite different findings. Blumenthal et al. (1994) examined response amplitude, response latency and response probability in college students demonstrating high scores on psychosis-proneness measures, and found no difference between the pattern of responses of these high schizotypy subjects and their healthy controls. They concluded:

'We believe that college students who produce high scores on these scales may not provide a good model for the perceptual gating deficits which have been demonstrated in schizophrenic patients, at least with regard to measures of automatic non-attentional processing. Although these psychosis prone subjects are similar to schizophrenics in many ways, these similarities do not include automatic perceptual filtering deficits as indicated by the startle response' (p354).

Schafer and Marcus (1973) used an auditory average evoked potential (AEP) paradigm to consider the ability of schizophrenics to process information when the triggering of the stimuli has been *self-initiated.* They noted that when an individual triggers a stimulus to himself, the resulting AEP is of shorter latency, and decreased amplitude, in comparison to the AEP produced by randomly triggered stimuli. They speculated that this indicates that the brain is especially primed to give less attention to self-initiated stimuli, since the survival of the organism is more likely to be achieved by special attention to novel or unexpected stimuli. However they noted with interest, that when they induced a increase in the time period between the participant triggering the stimuli, and the stimuli arrival, that in normal subjects AEP amplitude *actually increased,* arguably because of participant uncertainty as to what

had happened to the stimuli that they were expecting. Braff et al. (1977) hypothesised that if schizophrenic patients have a deficit in their short term information processing, then their AEP patterns would show the *reverse* pattern to that outlined by Schafer and Marcus: as the time increases between the participant triggering the stimuli and the stimuli arrival, AEP would decrease, because the knowledge that a stimuli is due to arrive would decay. In an experiment comparing ten patient controls with the performance of ten schizophrenic patients this is precisely what they found. They concluded that this is further evidence that schizophrenic patients have deficits in the part of the information processing system that they labelled Very Short Term Memory, (VSTM) meaning the moment to moment scanning of incoming information which allows the individual to make instantaneous decisions about what information to attend to or to disregard.

This thesis: Hypotheses and tasks

This thesis aims to further inform the debate surrounding the role of poor mentalising in schizophrenic symptomatology. It will compare individuals who *either* manifest high *or* low levels of schizotypy, in their ability to self-monitor, to monitor the mental states of others, and to generate willed action. Results which indicate that high schizotypy individuals show a selective deficit in mentalising ability, relative to low schizotypy individuals, will provide support for Frith's theory. Participants will be allocated to either a high or a low schizotypy group on the basis of the O-life questionnaire. They will also complete the SPQ in order to address Pickup's (2000) suggestion that this measure addresses the 'lack of friends' dimension which is less prominent in the O-life. The study will employ the experimental tasks detailed below:

1) The triangles task, (Castelli, Happé, and Frith, 2000)

Abell, Happé and Frith (2000) comment that although researchers still most commonly use false belief tasks to assess mentalising ability, there are some problems associated with these tasks, not least the suggestion that they fail to capture the 'real life' demands associated with understanding mental states. This might explain the reason why a number of high functioning autistic people can perform well when presented with such tasks in a laboratory, despite ongoing difficulties in interpreting what others think and feel in their every day lives. As such, Castelli et al. (2000) sought to develop a new task that would more accurately discriminate autistic and non-autistic participants in terms of mentalising ability. They took as their starting point a piece of research undertaken by Heider and Simmel, back in 1944. Heider and Simmel presented healthy participants with footage of two triangles and a circle moving within and around a rectangle, and found that when asked to describe what they thought was taking place, the participants showed a strong inclination to provide accounts which denoted intentional action. Castelli et al. speculated that such a task which was based on the movement of animated shapes only, might be more successful in discriminating between autistic and non-autistic people, since it would eliminate facial and vocal cues that autistic people may be using to some how 'deduce' what is taking place. Consequently, they developed the 'Triangles' task, a series of 12 short animations, featuring two triangles which participants are asked to view, and then describe what they think is taking place. The task features three different types of animation which are presented in a pseudo-random order –

- Random animations – in which the triangles simply move around the screen with no purpose, floating or bouncing at tangents to each other. Here, the triangles merely act, and no attribution of mental states is required in order to interpret what is going on,

- Goal directed animations – in which the triangles act on the basis of each other's behaviour, for example they are seen chasing or fighting each other, but there is still no requirement for the observer to imbue mental states in order to appreciate what is going on,
- Theory of mind animations – in these animations the triangles are seen to act in a way which is meant to influence what the other one 'thinks', for example one hides and then surprises the other. In another sequence of this type one is trapped by the other and must trick his captor in order to escape. Unlike the previous types of animations, the viewer must now apply mentalising ability in order to provide an accurate description of what is going on.

In Abell et al.'s (2000) own research the triangles task was used to compare the mentalising skills of a group of highly functioning autistic children, with normally developing children and a group of children with moderate learning disabilities who had been matched for verbal mental age. They found that their sample of autistic children demonstrated equal ability to negotiate traditional false belief tasks, but when presented with the ToM animations on the triangles task they were less likely than the normally developing children to use mentalising language, and were more likely to refer to a mental state that was inappropriate to the animation.

Frith's research suggests that schizophrenic patients also show a selective deficit in their ability to monitor the mental states of others. In this thesis, it is therefore hypothesised that high schizotypy participants will show selective deficits in their ability to interpret the ToM animations relative to the low schizotypy group, since accurate interpretation of these animations requires the application of mentalising skills. It is hypothesised that both groups will perform with equal accuracy when

interpreting the 'random' and 'goal directed' animations where no mentalising skills are required.

2) The Hayling test and Go/No go.

The Hayling Test (Heaton, 1981) is a sentence completion task, in which the participant is required to inhibit their immediate response in order to provide a word which does not fit at the end of the sentence which has been read to them. This test has been administered in order to further assess whether high schizotypes demonstrate the kinds of executive deficits which might lead to a disorder of willed action. It was hypothesised in this study that the performance of the high schizotypy individuals would not fall into the clinically impaired range (given that they are not patients but healthy volunteers) but that they would show a poorer performance than the low schizotypes in terms of time taken to complete the task and number of errors made.

The go/No go task is a computer-based task, in which a sequence of letters is quickly flashed up on screen, one after the other. Participants are instructed to respond as quickly as possible to the presentation of a letter, by pressing a 'V' key on the pad, *except* in response to two specified letters. Participants are instructed that when they see these two letters they should make no response at all. Since participants are required to respond to the majority of letters that they see, they quickly develop a 'cognitive set' in which they repeatedly press the button after viewing each letter. But in order to comply with the instructions, participants need to be able to shift from this cognitive set at will, and inhibit their own response. There are two parts to the test, in part 1 participants are requested to inhibit their responses to the letters 'L' and 'C', in part two they are requested to inhibit their responses to the letters 'Q' and 'N'.

As such, part two is a reversal of part one and participants must inhibit responses which were previously acceptable, and vice versa. This task was used in Weisbrod et al.'s (2002) study in which they found that schizophrenic patients' ability to inhibit their own response was markedly poorer than that of healthy controls. Frith accounts for such results by asserting that amongst patients with negative behavioural signs, there exists a defect in self-monitoring, such that the patient lacks awareness of his/her own goals. When required to generate spontaneous action or speech they instead perseverate, or provide inappropriate responses to environmental stimuli. As such it is hypothesised in this study that high and low schizotypy participants will respond with equal accuracy in the 'go' condition, where they must respond to the letter presented, but high schizotypy individuals will show poorer ability to inhibit their response in the 'No go' condition.

3) Me-pulse

The present study will employ a new task that is a variant on the prepulse inhibition paradigm. In this task the startling stimulus will be one that is *triggered by the participant*, a 'me-pulse', rather than prepulse. The research will attempt to address existing controversies related to the idea that perceptual gating deficits only appear in schizophrenia patients *versus* the suggestion that in fact perceptual gating deficits appear in healthy volunteers who are high in schizotypy, and as such represent a trait marker for schizophrenic illness. It will build upon the research of Schafer and Marcus (1973) who have used self-initiated startle stimuli to indicate that ordinarily, when an individual triggers stimuli himself, the resulting response is of lesser amplitude than one produced by random stimuli because in-tact gating mechanisms lead the individual to reserve their attention to novel or unexpected stimuli. On the basis of this, it is hypothesised in this study that individuals who are low in

schizotypy will show the predicted decrease in response to self-triggered stimuli, but individuals who are high in schizotypy will *not* show a decrease in amplitude of response. If indeed high schizotypy individuals show a startle response to self-triggered stimuli which is just as great as that shown in response to randomly generated stimuli, then it can be said that they show the propensity to startle themselves, and this would provide further support for Frith's theory that these individuals exhibit defective self-monitoring.

Table 2 summarises Frith's account of the relationship between ToM deficits, and schizophrenic symptomatology. It also indicates which tests will be used in this study to assess his hypotheses.

Table 2: Summary of Frith's hypotheses and tests used in this study.

Schizophrenic presentation	**Disorder of self-monitoring?**	**Disorder of other monitoring?**	**Friths account?**	**Assessed by?**
Positive symptoms				
Passivity phenomena, Auditory Hallucinations	Yes	No	Route B impaired. Disorder of awareness of own intentions	Me-pulse
Paranoid delusions	No	Yes	Inability to monitor intentions of others.	Triangles task
Schizophrenic speech	Yes	Yes	Inability to monitor own and others intentions	Triangles task
Negative signs				
Apathy, withdrawal, poverty of speech	Yes	No	Route B impaired. Lack of awareness of own goals. Inability to generate willed action.	Go/No go +Hayling

Chapter Two – Methods.

Participants and Design

An independent group design was used to compare individuals who had high schizotypy scores with individuals who had low schizotypy scores. Participants were recruited from University College London, either through advertising or by contacting people whose names were held on a database of volunteers for psychological research. Inclusion criteria required participants to be aged between 18 and 50 years, to have no serious mental illness or history of one, and to have no history of head injury. Participants were required to be fluent in spoken English and to have an IQ that fell within at least the average range. Since all participants were university students, it was assumed that their IQ was adequate, and as such IQ was not tested. Previous research (Langdon & Coltheart, 1999) has found that significant group differences can be obtained with a total sample of 40 participants.

Ethics

Ethical approval to undertake this study was obtained from the UCL ethics committee on non NHS human research and all participants provided written, informed consent (Appendix 1). Participants were assured that any information that they gave would remain confidential. After the experiment had finished, all participants had the opportunity to discuss whether any aspect of the experimental procedure had been in any way distressing.

Procedure

Potential participants completed the O-life questionnaire to determine their level of schizotypy. Only those whose total STA score fell *either* below 10 points *or* above 24 points were recruited. As the PPI response of women fluctuates over the menstrual cycle, female participants did the experiment during the first four days of their period (see Swerdlow, Hartman & Auerbach, 1997, cited in Braff et al. 2001). The entire experimental procedure took around one hour, and participants were paid £10 for their time.

Measures of schizotypy -The O-life Questionnaire (Mason, Claridge & Jackson, 1995).

This 159 item self-report questionnaire yields a total score (STA) and scores on four dimensions of schizotypy, (as identified by Claridge et al., 1996) as follows:

Unusual experiences - unusual perceptual events, hallucinatory experiences, and magical thinking, examples include:

'Have you ever felt you have special, almost magical powers?'

' Are your thoughts almost so strong you can sometimes hear them?'

Cognitive Disorganisation - difficulties in sustaining attention and concentration, as well as moodiness and social anxiety, examples include:

'No matter how hard you try to concentrate, do unrelated thoughts always creep into your mind?'

'Do you frequently have difficulty starting to do things?'

Introvertive Anhedonia - difficulties gaining enjoyment from social, or other sources, a lack of enjoyment of physical and emotional intimacy, and a preference for

spending time alone. These items are thought to relate particularly to the 'negative signs' of schizophrenia, examples include:

'Are you much too independent to really get involved with people?'

'Are people better off if they stay aloof from emotional involvement's with people?'

Impulsive Nonconformity - asocial behaviours, impulsivity and non-conformity. Examples include:

'Do you ever have the urge to break or smash things?'

'Do you often feel like doing the opposite of what people suggest, even though you know they are right?'

In addition to providing separate scores for each of the four factors, analysis of the O-life also generates a composite 'schizotypy' score (STA score). The questionnaire also contains items relating to extraversion as 'filler' items, in order to tone down what could be considered a 'pathologising' tone to the instrument. The items are presented in random order, though care has been taken not to place the questions relating to more extreme behaviours near to the beginning, and as such the ordering is perhaps more appropriately referred to as 'quasi-random'. The scales have adequate internal consistency (0.72-0.89) and test re-test reliability (0.77 – 0.93).

The Schizotypal Personality Questionnaire (Raine 1991)

This is a 74 item self-report questionnaire. Items are based on DSM-111-R criteria for schizotypal personality disorder. There are sub-scales relating to all nine schizotypal personality traits which can be further collapsed into three factors – 'Interpersonal', 'disorganised' and 'cognitive perceptual'. Some of the sub-scales clearly overlap with those of the O-life; for example there are clear similarities between the O-life 'unusual perceptual experiences' dimension and the SPQ

'Unusual perceptions' factor. However, the SPQ also contains a sub-scale 'no close friends' which may be more helpful than the O-life for understanding inability to represent the mental states of others. Pickup (2000) suggested that future research should consider using both the O-life *and* the SPQ in order to shed light on the discrepancy between his findings (which did not provide support for Frith's ideas) and those of Langdon and Coltheart (which did). The SPQ shows high internal validity (0.91), and high test-retest reliability (0.82). There are also appropriate levels of discriminant validity (0.63) and criterion validity (0.68).

Experimental Tasks

1) Ability to monitor the mental states of others – The triangles task

Participants will then be assessed on their ability to represent the mental states of others using the 'Triangles' task developed by Castelli, Happé and Frith (2000). This task consists of the presentation of a series of animations on a computer screen. The animations involve one large red triangle, and one smaller blue triangle, moving around silently, on a white background. The basic visual characteristics of each animation are as similar as possible, in terms of shape, speed of movement, and orientation changes. Each sequence lasts between 34 and 45 seconds. Before the test begins, participants are shown two practice animations to ensure that they understand what the test requires. Each participant then views 12 further animations. After viewing each animation in turn participants are asked to describe what they think is going on. At no stage is any feedback given. Participant's answers are tape recorded for later transcription and analysis.

There are three different types of animations which are shown in a semi-random order in order to prevent fatigue and practice effects. The three types of animation are:

- 1) *'Theory of Mind'* animations: the actions of the triangles imply complex mental states; the triangles are seen to be mocking, seducing, coaxing and surprising one another. Crucially, the actions of one triangle are determined by what the other triangle *'thinks'*.
- 2) *'Goal directed'* animations: the triangles interact on a simple purposeful level, they are seen chasing, dancing, fighting and leading one another. Here, the actions of one character are determined by what the other character *'does'*
- 3) *'Random'* animations: the two characters do not interact with each other, but simply bounce off the edges of the screen, or drift about in movements resembling billiard balls. Here, the two characters actions are *not contingent.*

Each animation requires the comprehension of information, and the drawing of inferences, but only the 'ToM' animations require the attribution of mental states. Each of the three animations is of equal difficulty, to control for the possibility that participants might fail on the 'ToM' animations because they are simply the hardest of the three. The 'Goal directed' and 'Random' animations also control for the possibility of generally poor reasoning ability by the participant, since if that were to be the case, they should score poorly on each of the three animations.

Scoring is based on two separate dimensions (as used by Abell et al. 2000)

1) the *accuracy* of the response in terms of how clearly the participant appears to understand what took place. Responses which describe the sequence with complete accuracy will be awarded 2 points. Responses which are partially accurate but which are incomplete or relate to the actions of one triangle only will be awarded 1 point, O points will be awarded for responses which are clearly wrong or focus on minor, inconsequential details of the actions depicted.

2) the *type* of description provided. An appropriate response to a random animation should elicit a response containing a simple 'action' statement, with no mention of interaction or mentalising (for example. 'bouncing / floating'). An appropriate response to a goal directed animation should elicit a response containing an 'interaction' statement, (for example 'dancing / fighting'), again with no reference to mentalising. However an appropriate response to a ToM animation should contain a *mentalising* description, with explicit reference to psychological terms or mental states (for example, 'seducing / surprising'). Each appropriate type of description is awarded 1 point.

Ability to monitor own actions – Me-pulse

Self-generated startle responses were used to assess self-monitoring of actions. The eyeblink component of the acoustic startle was measured by electromyographic (EMG) recordings from the right orbicularis oculi and forehead using three silver/silver chloride disk electrodes filled with electrolyte gel to the skin. The startle system (Psylab, UK) recorded band pass filter EMG activity at between 30 – 400 Hz for 250ms from the onset of the startle stimulus. Startle magnitude was measured using analogue to digital units, and peak latency to response in milliseconds. Acoustic stimuli consisted of 40ms bursts of 116db (A) broadband noise with an instantaneous rise time over continuous background noise of 70db (A) presented biurnally through headphones. The prepulses were 20ms duration noise bursts of 80db (A), i.e. 10db (A) above background noise. The visual stimulus used to generate self-startle trials was given on a VDU as a green square presented centrally. After a five minute acclimatisation period with the background noise the first block of six 116db (A) 40ms noise bursts was presented (pulse alone). These pulse alone trials were followed by 36 trials, consisting of three blocks of 12 trials. Each of the

blocks consisted of four pulse alone trials, 4 trials with 30ms prepulse to pulse and 4 self-generated trials. The final block was identical to the first, consisting of six pulse alone noise bursts. The total session included 48 trials. Participants were seated throughout testing and asked to fixate upon the computer screen and press a button on a pad when they see a green square on the screen. If responses fell outside the physiological range for a reflex blink (20ms or beyond 90ms) they were discarded. Responses were recorded as startle magnitudes, peak latencies and MPI/PPI.

Generating own actions: The go/No go task

This task tapped response inhibition and response reversal. The task consisted of three blocks, the first consisted of 40 stimuli and the second two blocks of 100 stimuli. Stimuli were 16 characters of the alphabet organised into two sets of 8. For the first block participants were instructed to respond, by pressing a designated key on the computer keyboard as quickly as possible, to each letter on the screen. In the second block participants were presented with 100 stimuli, matched for frequency across versions, and were instructed to respond by the same designated key press to all but two of the eight letters. These two letters constituted the 'No go' trials. Each letter appeared for 0.8 seconds followed by an inter-stimulus interval of 0.5 seconds. The proportion of 'Go' stimuli was 75% and that of the 'No go' stimuli was 25%. Participants were then given a short break and were then presented with the third block, another 100 stimuli, and were then instructed not to respond to a different two of the eight letters. This required participants to respond to the two letters for which responses were inhibited in the previous block, thus tapping response reversal. Scores were recorded in terms of errors and reaction times.

Response inhibition -the Hayling test (Heaton, 1981)

The Hayling test was given in the standard format. It is divided into two parts, each containing a series of sentences that have the last word missing (for example, *'The old house will be torn...?')* The examiner reads the incomplete sentence to the participant, who is required to give a verbal response. In section one, the participant is simply required to provide a word which would appropriately complete the sentence (For example, 'The old house will be torn? ... *'down').* However, in section two, the participant is instructed to answer with a word *which is unconnected to the sentence in every way.* For example 'London is a very busy... *'banana'.* A participant's response here, indicates his or her ability to inhibit the response which they would ordinarily give. Scores are based on time taken to provide a response in section 1 and 2, plus the number of errors made in section 2. Category A errors are made when the participant provides an answer which fits perfectly with the rest of the sentence, Category B errors are made when the participant provides an answer which is closely associated with the word which would complete the sentence.

The test-retest reliability rating of the Hayling test is comparable with that of other commonly used tools such as Ravens Advanced Progressive Matrices, Set 1, (Raven, 1943) and are as follows: Hayling 1 time 0.62 ($p<0.001$), *Hayling 2time0.78($p<0.001$), Hayling errors 0.52 ($p<0.01$).*

Data Analysis

Data was analysed using the computer package SPSS version 10.1. Group differences on the triangles task were measured using independent samples t-tests,

(or Mann-Whitney U-test when the data was not normally distributed). The go/No go data was analysed using repeated measures ANOVA. The α level was set at $p \leq .05$.

Chapter Three – Results

Participants

Approximately one thousand e-mails were sent to potential participants. These explained the purpose of the research and had an O-life questionnaire attached. One hundred and three people (approximately 10%) responded by returning their questionnaires. Of those, 48 met the inclusion criteria and had scores within the cut off points delineating high/low schizotypes. Forty people completed the study.

Of the 40 participants that were recruited, 11 (27.5%) were males, 29 (72.5%) were females. There were 5 males and 18 females in the low schizotypy group, and 6 males and 11 females in the high schizotypy group. A Chi-squared test showed no significant group difference in gender, χ^2 (1) = .90, p = .34.

Participants' ages ranged from 18 to 49 years, with a mean age of 25.0 $\pm$ 6.5 years (Table 1). There was no significant group difference in age, t (38) = .34, p = .73. Thirty-six (90%) participants stated that they had no mental health problems, 3 (37.5%) said they were depressed, (2 from the high group, 1 from the low group). 1 person in the high schizotypy group stated that they were anxious. No participant had any history of psychosis. At the time of testing, 3 people were taking antidepressants, 3 used oral contraceptives and 2 used medication to combat asthma. Thirty-five participants stated that they did not use any illegal drugs, 5 reported using cannabis (two of these people were in the low schizotypy group, three were in the high schizotypy group). Thirty-two participants were non-smokers, 6 smoked less than 10 cigarettes per day, 2 smoked more than 10 per day. The low schizotypy group contained 3 smokers, (13%) the high schizotypy group contained 5 smokers (29%).

1. Questionnaire measures

1) The O-Life

Twenty-three participants had a total STA score of < 10 points and were entered into the low schizotypy group, 17 had a total STA score of > 24 points, and were entered into the high schizotypy group. The low schizotypy group had significantly lower scores than the high schizotypy group, t (25.53) = -21.05, p = .001.

Table 1: Age, gender and mean STA scores for high and low schizotypy groups

	Age (SD)	Gender (m/f)	Mean STA Score	Mean SPQ Score
Group 1	24.7 (4.60)	5/18	6.52 (2.19)	9.04 (6.41)
Group 2	25.4 (8.51)	6/11	26.41 (3.41)	39.2 (14.98)

The low schizotypy group also had lower SPQ scores than the high group, t (17.73) = -7.37, p = .001.

Dimensions of schizotypy

Within the high schizotypy group 10 (58.8%) participants had scores which were above the 75th percentile on the 'cognitive disorganisation' (cogdis) factor, 15 (88.2%) had scores which fell above the 75th percentile on the 'unusual experiences' (unex) factor, 9 (52.9%) met the same criteria for the 'impulsive non-conformity' (impnon) factor, and 10 (58.8%) met this criteria for the 'introvertive anhedonia' (intan) factor.

2: The Triangles Task

Table 4: Means (Standard deviations) for each group on the triangles task.

	High Schizotypy Group	Low Schizotypy Group	
Random Animations			
Accuracy score	6.13 (2.45)	8.0	(0)
Description score	3.19 (1.22)	4.0	(0)
Goal Directed Animations			
Accuracy score	6.06 (1.29)	6.5	(1.06)
Description score	3.67 (.4 9)	3.61	(.49)
ToM Animations			
Accuracy score	4.93 (1.33)	5.09	(2.07)
Description score	2.25 (1.48)	3.04	(1.07)

Accuracy of description: Random animations

The two groups were first compared on the accuracy of their responses to the random animations. A box plot indicated that the low schizotypy group contained six outliers (<8 points), and so these scores were excluded from the analysis. There was a ceiling effect on accuracy scores in the low schizotypy group. There was a significant group difference in the accuracy of responses to the random animations, U score = 68 ($z = -3.26$) $p = .01$, with the high schizotypy group showing less accuracy (Table 4).

Accuracy scores - Goal directed sequences.

There was one outlying score (<4 points) in the low schizotypy group; this was excluded from the analysis. The scores of the two groups showed no significant difference, $t(36) = 1.15$, $p = .26$.

Accuracy score – Theory of Mind animations

There was no significant group difference in accuracy score on ToM animations, U score = 119.50 (z = -.65) p = .51.

Type of description

Participant's responses were rated according to the degree of *mentalising* implicit in the language used.

Type of description: Random animations

A box plot revealed that there were 5 outlying scores (<3 points) in the low schizotypy group, and so these scores were excluded from the analysis. The low schizotypy group were performing at ceiling and better than the high group, U score = 90 (z = -.280) p = .01.

Type of description: Goal directed animations

Box plots revealed that there was one outlying score within the high group (<1) and so this was excluded from the analysis. There was no significant group difference in type of description given for goal directed animations, U score = 162.50 (z = -.36) p = .72.

Type of description: Theory of mind animations

Box plots revealed that there were no outliers. There was no significant difference in the scores of the two groups - U score = 126.50, (z = -1.71) p = .09.

3. The Go/No go task

Data was analysed using a repeated measures analysis of variance (RMANOVA) with part one and two of the task as a within subjects factor, and schizotypy group (high/low) as a between subjects factor.

Total number of hits

The low schizotypy group tended to make more correct hits than the high schizotypy group in both parts of the task, $F(1, 37) = 3.27$, $p = .08$. There was no significant group x part interaction. There was a main effect of part, with both groups scoring more correct hits in part 2 of the test, $F(1, 37) = 5.99$, $p = .02$.

Total number of false alarms

There was a significant group difference in the number of false alarms, $F(1, 35) = 7.92$ $p = .01$. The high schizotypy group made more false alarms than the low schizotypy group. There was no significant group x part interaction, or main effect of part.

Mean reaction time – hits

There was a significant group difference in reaction time to hits, $F(1, 34) = 4.0$ $p = .05$. The high schizotypy group reacted more quickly than the low group in both parts of the test as shown in Table 6 below. There was no significant group x version interaction. There was however a significant effect of part, with both groups reacting more quickly in part 1, $F(1, 34) = 24.52$, $p = .01$.

Mean reaction time – false alarms

There was no significant group difference in reaction time to false alarms $F(1, 35) = 1.02$, $p = .32$.or group x part interaction. There was a significant effect of part, with both groups' false alarms being slower in part 2, $F(1, 35) = 47.20$, $p = .01$.

Table 5: Means (standard deviations) for both groups on the go/No go task.

Total number of hits	**High schizotypes**		**Low schizotypes**	
Part 1	71.56	(2.87)	72.78	(2.29)
Part 2	69.94	(4.29)	71.35	(2.39)
Total number of false alarms				
Part 1	7.12	(4.29)	3.95	(2.06)
Part 2	6.69	(4.67)	4.10	(2.43)
Mean reaction time – hits				
Part 1	395.92	(46.42)	413. 86	(45.59)
Part 2	419.85	(40.83)	453.35	(37.20)
Mean reaction time – false alarms				
Part 1	322.86	(47.55)	352.01	(46.59)
Part 2	414.03	(74.06)	419.39	(74.61)

4: The Hayling test: Overall scores

Overall scores on all sections of the test showed some participants in the 'high average' range, but the majority fell within average norms. Only one participant (high schizotypy group) had an overall score in the 'poor' range. A Chi-squared test indicated that there were no significant group differences in overall Hayling scores, $\chi^2 (5) = 7.92$, $p = .16$.

Table 6: Hayling Test - Means (Standard Deviations)

	Mean time Part 1	**Mean time Part 2**	**Category B Errors**	**Category A errors**
Low Group	2.09 ± 2.23	6.65 ± 6.95	.69 ± .70	.52 ± .59
High Group	4.87 ± 4.49	23.88 ± 18.38	.86 ± .66	.53 ± .64

Time taken to complete part one of the Hayling test showed three outliers. One high schizotype had an extreme outlying score of 60 seconds, two low schizotypes had outlying scores of >15 seconds and so these were excluded from the analysis. The low group completed this first section of the test faster than the high group, t (20.65) = -2.27, p = .03.

On the second part of the test there were three outlying scores in the low group (with times of over 29 seconds) and so these were excluded from the analysis. The high schizotypy group took longer than the low group to complete the task, t (25.98) = -2.62, p = .01.

Category B errors

The two groups were then compared in terms of the number of errors that they made completing the second part of the task. A box plot showed that there were three outlying scores in the high group (> 4 errors). These scores were therefore excluded from the analysis. There was no significant group difference in the number of category B errors, t (35) = .69, p = .49.

Category A errors

An independent samples t-test revealed that there was no significant group difference in the number of category A errors, t (36) = .05, p = .96.

5: The Me-pulse task

For the purpose of this investigation, the main variable of interest was startle amplitude. Data was analysed using a repeated measures analysis of variance (RM ANOVA) with the trial type as a within subjects factor (prepulse, pulse, and me-

pulse) and schizotypy group (high/low) as a between subjects factor. Owing to recording failures much of the data had to be discarded. As such, the effective sample size here is much smaller: 9 participants in the low schizotypy group and 8 in the high schizotypy group.

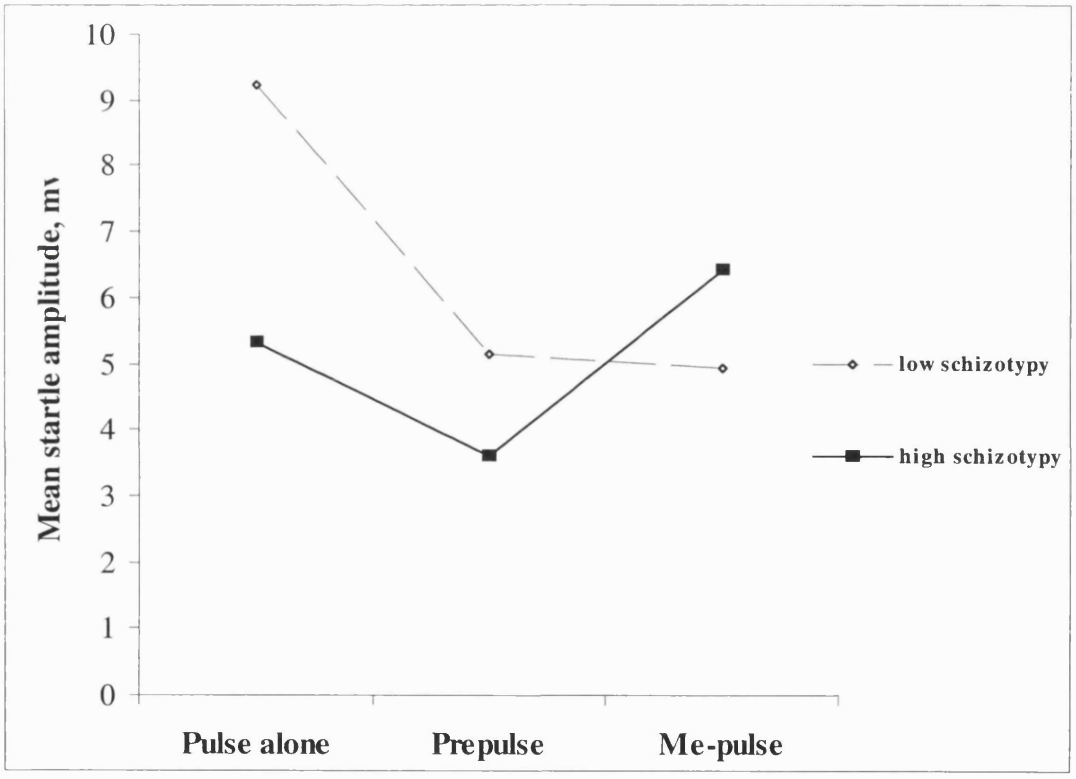
There was a significant trial x group interaction, $F(2, 13) = 5.93$, $p = .02$. There was a significant main effect of trial, $F(2, 13) = 5.93$, $p = .02$ but not of group.

The low schizotypy group showed the greatest startle reaction to the pulse, with a lesser degree of startle to the prepulse, and the smallest reaction to the self-initiated me-pulse. The high schizotypy participants showed a slightly decreased reaction to the pulse, (indicating some prepulse inhibition) but an increased reaction to the self-initiated me-pulse.

Table 7: Mean startle reactions: prepulse, pulse, and me-pulse.

	High schizotypy group (n = 8)	Low schizotypy group (n = 9)
mean startle magnitude per prepulse trial	3.58 (2.14)	5.12 (4.43)
mean startle magnitude per pulse trial	5.30 (4.02)	9.24 (7.17)
mean startle magnitude per me-pulse trial	6.40 (4.46)	4.93 (4.13)

Figure 1: Mean startle amplitude for both groups.



Data was then analysed to assess the percentage of prepulse and me-pulse inhibition across each group using the formula (100 – (100 x magnitude me-pulse / magnitude pulse). As can be seen clearly in Figure 2, there was no group difference in prepulse inhibition but the high schizotypes showed very low me-pulse inhibition in comparison to the low schizotypy group, $F(1, 15) = 5.27$, $p = .04$. There were significant main effects for both type of trial, $F(1,15) = 6.69$, $p = .02$, and group, $F(1, 15) = 5.7$, $p = .03$.

Table 8: Percentage prepulse inhibition and me-pulse inhibition for each group

	High schizotypy group (n = 8)	Low schizotypy group (n = 9)
Percentage prepulse inhibition	55.44 (31.69)	73.47 (16.45)
Percentage me-pulse inhibition	-109.93 (217.16)	63.60 (32.33)

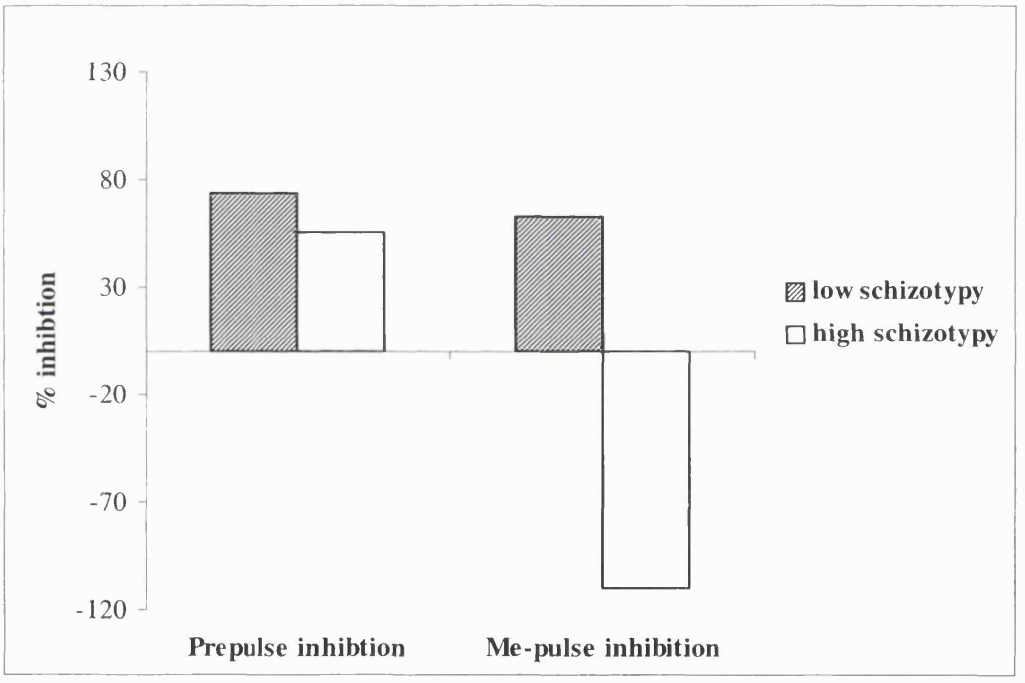


Figure2: Percentage prepulse inhibition and me-pulse inhibition for both groups.

Correlations.

Bivariate correlations were computed within the high schizotypy group to explore relations between schizotypy score (STA, SPQ) and scores on tasks which had shown significant differences. There was a tendency for total SPQ score to correlate with the appropriateness score for random animations (r= -.53, p = .052). Thus the

higher the schizotypy score, the less appropriate the description of random animations. There was also a tendency for total SPQ score to correlate positively with time taken on part 2 of the Hayling test ($r = .48$, $p = .072$). Thus the higher the schizotypy score, the longer it took participants to complete part 2 of the Hayling. Analyses using the 3 sub-scales of the SPQ revealed a significant negative correlation between the SPQ cognitive perceptual factor and the total number of correct action words used in the triangles task ($r = -.703$, $p = .005$), and the appropriateness score for random animations ($r = -.782$, $p = .001$). Thus the higher the score on the SPQ cognitive perceptual factor, the fewer correct action words, and the lower the appropriateness score for the random animations. There was a significant positive correlation between the SPQ interpersonal factor and the raw score for part 2 of the Hayling test ($r = .676$, $p = .006$), indicating that the higher the score on the SPQ interpersonal factor, the longer it took to complete the second part of the Hayling test.

Chapter 4: Discussion

The final chapter of this thesis will discuss the results and the degree to which they provide support for Frith's hypotheses. It will consider the way in which these findings relate to the major debates within the study of mentalising in schizophrenia, including:

- whether any observed deficits in ToM indicate a *conceptual* deficit in mentalising ability (i.e. participants cannot mentalise) or an *application* deficit (i.e. participants can mentalise but in an inaccurate way),
- whether mentalising deficits merely represent the schizophrenic state or constitute a trait marker for the illness.

Main findings

There were very significant group differences on both the O-life and the SPQ and the norms for the four sub-factors of schizotypy were found to be highly similar to those that Mason et al. (1995) discovered in a larger study involving 508 participants. As such the construct of schizotypy is well represented in this study.

Participants completed the triangles task in order to assess their capacity to monitor the mental states of others. There was no significant group difference in accuracy when interpreting the goal directed and ToM animations. However, intriguingly the high schizotypy individuals showed significantly poorer ability to accurately interpret the random animations. The low schizotypy participants showed a clearer understanding that in these animations the triangles were not engaged in any purposeful activity. The high schizotypy participants were significantly more likely

to impute some kind of purposeful interaction between the triangles, and to provide an account of their actions which went above and beyond the mere facts of the triangles moving around the screen. The text box below gives some examples of the descriptions of random animations that were given by high schizotypy participants. There was a trend toward the highest schizotypy scores being correlated with the poorest performance in terms of accurately describing the random animations.

Interviewer – '*What do you think was happening?*'

' *the red and the blue were avoiding each other...*'

'both of them are lost...they are trying to find each other...'

'they were trying to ignore each other...'

'I think the smaller triangle was trying to irritate the bigger triangle...'

In this study participants viewed the animation and were then asked one question only : 'What do you think was happening in that animation?' Future studies might enquire further as to which cues participants used to generate their explanations, since it would be useful to have some understanding as to exactly how they arrive their decisions

The high and low schizotypy groups showed no significant differences in their ability to use appropriate language to describe the goal directed and ToM animations (although there was a trend toward the low schizotypy group using more mentalising language to describe the ToM animations). But again the high schizotypy participants were significantly less likely to simply use action words to describe the random animations (e.g., 'bouncing' or 'floating'). Instead they were significantly more likely to use interaction and mentalising terms to describe what took place. The

results of the triangles task does not illustrate a selective disability in the high schizotypy participants ability to exercise ToM, rather it suggests a *tendency to impute social meaning when none is there*. There was evidence that the high schizotypes who reported the greatest number of unusual cognitive perceptual experiences demonstrated the poorest scores both in terms of accurately describing the random animations, and using appropriate language to do so.

The triangles task aimed to evaluate participants ability to monitor the mental states of others. The results of this task demonstrate that the high schizotypy participants cannot be said to have lacked ability to mentalise, since their accuracy scores on the ToM animations were equivalent to their low schizotypy counterparts. As such, this research does not find support for a *conceptual* deficit in mentalising ability; the data does however, support a deficit in the *application* of mentalising ability. This is in keeping with Frith's suggestion that unlike autistic individuals who lack the ability to mentalise from birth, schizophrenia patients have a fully functioning system of meta-representation, which breaks down when they become ill. As such they can mentalise and indeed continue to try to do so, but they make meta-representational mistakes.

Abu-Akel and Bailey (2000) wrote that schizophrenia patients exhibit a 'hyper-theory of mind'; they continue to have a conceptual understanding of others minds, but this knowledge is applied atypically. Abu-Akel and Bailey argue that these patients over-attribute knowledge to others and their assessment of situations is marred by the unconstrained generation of hypotheses, thereby increasing their likelihood of picking the wrong one in order to explain action. The pattern of results shown on the triangles task is additionally supportive of Bentall, Kaney and Dewey's

(1991) suggestion that paranoid ideation is related to anomalies in the process of generating causal attribution. Patients with persecutory delusions have been shown to over-attribute the causes of *events* to external cues (Kaney & Bentall, 1989) and to the actions of others (Kinderman & Bentall, 1997). Blakemore, Sarfati, Bazin and Decety (2003) set out to discover whether this erroneous pattern of attributing causality might also apply to paranoid patients understanding of the intentions of others. They compared three groups – inpatients with persecutory delusions, psychiatric controls without persecutory delusions and healthy volunteers, on their ability to accurately perceive contingency between two animated shapes. Participants viewed four short films, in half of the films the target shape is *animate*, i.e. self-propelled, it generates its own action. Thus in animation number one, the target shape is seen to act as a direct response to the actions undertaken by the other. In the second animate film, the target shape is seen to act, but this time its actions are not contingent on the actions of the other. In remaining films the target shape acts in a way that is *not animate.* As such, in film three, the target shape moves only because it is 'bumped' off the screen by the other, in the fourth film there is no contact between the two shapes. After viewing the films participants were asked whether there was a relationship between the movements of the two shapes, and to rate the strength of that relationship on a 1- 10 scale.

Blakemore et al. found that the paranoid patients were more likely than the psychiatric and healthy controls to perceive a contingent relationship when the target shape moved in an *animate*, but not an inanimate way. That is to say, that when considering film number one all participants performed equally well, - interpreting the actions of the target shape as clearly contingent on the actions of the other. But when considering film number two, where a correct response would have noted that the actions of the target shapes were *independent*, the paranoid patients were

significantly more likely to perceive contingency in the relationships, and to rate the strength of that relationship as being as strong as the relationship depicted in film number one. Blakemore et al. speculated that their results might indicate that paranoid delusions are influenced by an increased tendency to attribute contingency to other agent's behaviour. They qualified their findings a little by commenting that in their study, patients were required to attribute contingency to others, not to themselves, (whereas in the context of a delusion, paranoia invariably has a self-referent quality). They also add that since their findings relate to patients, it is not clear whether such a tendency indicates a state, or trait marker. However, their results provide an interesting framework in which to consider the results presented in this thesis. Thus the high schizotypy participants could be said to have over-attributed intentionality when none was there. The random movements of each triangle were given a meaning in terms of a relationship between them.

No previous study has used the triangles task to examine the capacity to monitor the mental states of others in schizotypy. As previously outlined in chapter 1, (page 40) Langdon and Coltheart (1999) employed a story completion task and found that the high schizotypy participants exhibited a selective deficit in their ability to interpret the stories which required the appreciation of a false belief, whereas using the same task Pickup (2000) noted the tendency of the high schizotypy participants to perform worse on *both* the false belief *and* the physical stories. Young, Mason and Birchwood (unpublished data) found no significant differences between the high and low schizotypy groups in their performance on the mechanical, social script and false belief stories, but the high schizotypy participants demonstrated a poorer performance on the 'capture' stories, which contained misleading pieces of salient information. The data in this thesis is not directly comparable with any of the above,

since a different task was used which did not involve the appreciation of a false belief. However, this lack of consistency in schizotypy research might indicate that any mentalising deficits that are present in high schizotypy individuals are quite subtle and are moderated by some additional variable (as yet unknown) before they become pronounced.

As explained in chapter 1, Frith argued that other positive symptoms in schizophrenia, such as auditory hallucinations and delusions of control were caused by a defect in the person's ability to self-monitor. In this study, participants completed the me-pulse task in order to assess this. This task employed a novel variant on the well-established prepulse inhibition paradigm, which has repeatedly demonstrated perceptual gating deficits among schizophrenia patients. It was initially hypothesised that the low schizotypes' startle response would be decreased in amplitude when the startling noise was self generated, relative to when it was generated by the researcher. In contrast, the high schizotypes would not show a similar decrease in response to self-initiated stimuli. This hypothesis was supported. The low schizotypy participants showed a small decrease in startle amplitude between the pulse and the me-pulse. However, the high schizotypy participants actually showed a marked *increase* in startle magnitude when responding to the me-pulse comparative to the pulse. When data was analysed to assess percentage prepulse and me-pulse inhibition the low schizotypy participants showed significantly greater me-pulse inhibition in comparison to the high schizotypes. A re-examination of the me-pulse data in this study illustrated that a few more of the high schizotypy participants were smokers, (3/8, compared to 1/9 in the low schizotypy group), one more of the high compared to low schizotypes were taking medication (2/8, compared with 1/9) and one more high schizotype admitted to

taking illegal drugs (2/8, compared to 1/9 in the low schizotypy group). Although these numbers are small, they might manifest a sample bias and as such the results of the me-pulse experiment are perhaps best viewed as exploratory. Nonetheless, these are exciting findings, given that this is the first time this task has ever been used. They provide support to the growing body of research described in chapter 1,which has discovered that people with schizophrenia (and particularly those with the positive symptoms) show deficits in their ability to self-monitor such that they mis-attribute internally generated speech (Bentall et al.1991, Johns et al. 2001) and fail to identify their own drawings (Stirling et al, 1998). These me-pulse results also provide further support for Frith's more recent work, in which he described the operations of the *'forward model'* – a breakdown in which leads to a mis-match between the predicted sensory consequences of an event and the actual consequences. Frith wrote that this mis-match means that there is no decrease in the attentional response, leading the person to perceive the event as externally generated. The results of the me-pulse experiment provide a tentative indication that the forward model does not operate as it should in those who are high in schizotypy.

Finally, this research sought to assess Frith's notion that schizophrenic people (especially those exhibiting negative behavioural signs) are affected by a defect in willed action such that they are unable to accurately represent their own goals, or select appropriate actions in order to meet their goals. This study employed two different tasks in order to assess the neurocognitive processes which might underpin this - the Hayling test which examines participants capacity to inhibit their own response, and the go /No go test which also assesses a participants ability to inhibit their own response, but also their capacity for 'set shifting'. It was hypothesised that the results of the Hayling test would show a poorer performance amongst the high

schizotypy group compared to the low schizotypy group, but that their results would remain within the norms for the general population (given that all participants were healthy volunteers). This hypothesis was supported. The majority of participants in both groups had scores which fell within the average range of functioning. Only one participant (who was in the high schizotypy group) performed at a level which fell within the weak range of functioning. The high schizotypes were significantly slower to produce a response on both parts of the test. This is an interesting pattern of results given the different demands of the two parts of the task on inhibitory processes. Responses in the first part are thought to relate to relatively automatic and require no inhibition. Responses in the second part require clear inhibition of automatic responses and initiation of non-sensical responses. However, quantitatively it was clear that the high schizotypes had relatively greater difficulty with part 2 of the task. The average group difference in response time to part 1 was 2.8 seconds whereas for part 2 it was 17.2 seconds. There was evidence that the high schizotypy participants who had the highest scores on the SPQ interpersonal factor took the greatest length of time to complete part 2 of the Hayling (though these correlations were carried out on small sub-group numbers and must be interpreted with some caution).

The go /No go task was also used to assess Frith's notion that people with schizophrenia (especially those with negative behavioural signs) are affected by a disorder of willed behaviour resulting from perseveration, or the provision of inappropriate responses to environmental stimuli. This task had already been successfully used to study schizophrenic patients (Weisbrod et al., 2000) setting a precedent for its use here. It was hypothesised that if Frith's assertions were correct, high and low schizotypy participants would demonstrate similar performance on the

'go' condition ('hits') but the high schizotypy participants would demonstrate a significantly poorer ability to inhibit their responses in the 'no/go' condition (more 'false alarms'). This hypothesis was broadly supported by the data. The high schizotypes made significantly more false alarms than the low schizotypes reflecting impaired response inhibition. Although there was no significant difference in the number of correct hits made by the high and low schizotypy groups, the high group showed faster responses in the go condition. These findings applied to both parts of the task which is interesting as the second part involved a response reversal and therefore a higher level of difficulty. This similar pattern of group differences on both parts of the task suggests a global tendency for decreased response inhibition in the high schizotypy group.

To clarify the extent to which our data with high and low schizotypes provide support for Firths theory it would be helpful to repeat these tasks comparing participants who measure highly on the positive signs of schizotypy with those who measure highly on the negative signs, to see whether these kinds of 'disorders of willed action' are most pronounced amongst those exhibiting negative signs. Even so, these results provide support for existing research with schizophrenia patients which has tended to find that they show executive deficits. In a review of recent studies of executive functioning in schizophrenia Donohoe and Robertson (2003) noted that performance on the Wisconsin Card Sorting Test (which assesses ability to shift attentional 'set') has been consistently shown to be impaired amongst schizophrenia patients, and 11 out of 16 of these studies found an association between poor WCST performance and negative symptoms. Studies also show that schizophrenia patients are consistently impaired on their ability to undertake the Stroop task, (Stroop, 1935) which in part assesses participant's capacity to inhibit a response. Donohoe and Robertson report that only six studies have attempted to

correlate Stroop task performance with symptomatology, but all six found an association with negative (or disorganised) symptoms, rather than positives. These findings suggest support for Frith's ideas but given that such small numbers of studies are involved such support is tentative. Whilst executive functioning is by definition a multifaceted concept, research on schizophrenia has tended to 'lump' a number of neurocognitive processes together under this umbrella, and the term executive functioning has come to stand for something of a rag-bag of ideas. This is not especially helpful for understanding which processes might be linked to which particular clinical symptoms and future research would do well to fractionate the concept of executive functioning (Donohoe & Robertson, 2003). This would facilitate the development of intervention programmes which could more specifically target the neurocognitive impairments affecting patients.

Taken altogether, these present results do provide some support for Frith's theory. As discussed in chapter 1, Frith considered the symptoms of schizophrenia to result from a triad of impairments: a disorder of the ability to monitor the intentions of others, a disorder of self-monitoring and a disorder of willed action. He took a symptom focussed approach, which considered monitoring of the self and the actions of other people to be associated with the positive symptoms of schizophrenia, and disorders of willed action to be associated with negative symptoms. Whilst this study did not find support for a selective inability to mentalise amongst individuals who are high in schizotypy, there was clear evidence of anomalies in their understanding of the actions of others, such that they tended to over impute social meaning, and in line with Frith's theory, these anomalies were most pronounced amongst those whose scores were highest on the positive dimensions of schizotypy. It would be useful to repeat the triangles task with schizophrenic patients to see whether those with

positive (especially paranoid) symptoms are most likely to over interpret the random animations.

Frith considered disorders of self-monitoring also to be related to the positive symptoms of schizophrenia. The me-pulse data provides exciting evidence to suggest that high schizotypes lack the ability to monitor their own actions. This is the first time this task has been used, and the sample was too small to draw sweeping conclusions, but this data gives initial indications that people who are high in schizotypy can in fact 'startle themselves'. This has clear implications for the development of positive symptoms. This task has obvious potential for use in future research involving schizophrenic patients at various stages of their illness (during the prodrome, onset of symptoms, and after medication) and with nonpsychiatric relatives in order to establish whether the capacity to self startle indicates a marker for the disorder.

As discussed in chapter one, most of the research evaluating Frith's ideas has focussed on testing his hypotheses regarding positive symptoms and relates to monitoring of the self and others. There has been comparatively little consideration of his thoughts about disorders of willed action and the relationship to negative symptoms (Donohoe & Robertson, 2003). The results of the Hayling and go/No go tasks in this study suggested that high schizotypes did show deficits in the underlying processes that might lead to a disorder of willed behaviour and in line with Frith's theory, this tendency was most pronounced amongst the high schizotypes who showed the greatest scores on the negative dimension of schizotypy.

Methodological Limitations

This is a relatively small-scale study, employing a total of forty participants. However, previous research has used similar sample sizes, for example Langdon and Coltheart's (1999) study of defective mentalising in schizotypy obtained a significant result with forty participants in their first study, and 28 participants in the second. Even the small sub-sample whose data was useable in the me-pulse task is comparable with previous published research in this psychophysiological area. For example, Braff et al. (1977) had 10 participants per group. Future research could involve a larger sample that might be divided into sub-groups, based on the different dimensions of schizotypy. Another question relates to the generalisability of the present findings. The participants are a self–selecting group as only around 10% of those who were invited to participate actually replied. Since participants are university students the study is most likely *over* representative of the middle class, educated and well functioning members of the population. However, both high and low schizotypes were drawn from the same population so as not to bias any group differences found. It seems unlikely that these issues of generalisability affect the validity of the results herein, since if monitoring anomalies can be detected within this educated and well functioning group then it seems likely that such defects might only be magnified in a community sample.

In terms of assessments used, researchers have tended to view false belief tasks as providing the optimal method for assessing a participant's capacity to infer the mental states of others, and as such the triangles task offers quite a different approach. Abell et al. (2000) suggest that false belief tasks have a number of limitations: they tap other abilities such as inhibitory control. Abell et al. suggest that one reason why healthy three year olds might appear to fail the task is because they cannot inhibit a response which is based on reality (rather than because of a failure to

appreciate that the main character labours under a false belief). They also point out that a number of high functioning autistic people succeed on false belief tasks in spite of on going difficulties in understanding the mental states of others in real life. Thus it seems legitimate for researchers to consider other ways of assessing mentalising ability.

However, the triangles task is subject to limitations of it's own. Many of the low schizotypy participants performed at ceiling level and as such it is not clear how well the task as a whole discriminates amongst healthy volunteers (although it proved discriminating on the random animations). Castelli et al. (2002) developed the task using shapes rather than people or faces precisely so as to eliminate the presence of facial or vocal cues which might allow the observer to decipher the mental states involved, rather than using the more automatic mechanisms that healthy normals seem to employ. But in so doing it might be argued that the triangles task sacrifices ecological validity, for it seems likely that in real life we *do* use a combination of cues such as context, personal knowledge of the other individual, facial expression and so on, in order to make inferences about mental state. The very fact that the test takes place in a laboratory perhaps means that participants are trying to 'get it right' in a way that they might not explicitly do in the context of their every day lives.

The me-pulse task was effectively carried out on a particularly small sample, owing to technical difficulties.However, as mentioned previously, the sample size *is* comparable with that used in other similar published studies. This is particularly complex research to carry out under non-clinical conditions; it seems likely that to achieve optimal results participants should reside in a laboratory almost as 'in-patients' for at least 24 hours before the experiment, such that the researcher can

control for alcohol, nicotine, caffeine and medication consumption, to name but some of the possible confounding variables. Participants were not tested for hearing ability, they were merely asked to declare whether they understood their hearing to be defective or not. It remains unknown whether in fact some participants had hearing impairments that they were either unaware of or did not report. At the same time, any possible hearing impairment would not explain why the groups were similar in prepulse inhibition and different in me-pulse inhibition.

The go/No go and Hayling tasks were used to assess the kinds of executive impairments which might underlie Frith's hypothesised 'disorder of willed action'. It has already been argued that the concept of executive functioning involves the integration of a variety of different cognitive processes, and likewise, the tasks used to evaluate executive abilities are themselves not 'pure', and involve the operation of a number of abilities. The go/No go task was used here to assess response inhibition and set shifting but arguably, success on this task also involves the use of working memory and sustained attention. There is a fairly robust body of research suggesting sustained attention deficits in schizophrenia. Studies have demonstrated that these deficits exist in both active and remitted schizophrenic patients (Asarnow & MacCrimmon, 1978, cited in Rawlings & Goldberg, 2001) and their non-psychiatric relatives (Mirsky, Yardley, Jones, Walsh & Kendler, cited in Rawlings & Goldberg, 2001). The evidence is more equivocal with respect to those who are high in schizotypy; there are studies demonstrating support both for (Chen et al. 1998, cited in Laurent et al. 2000) and against (Franke, Maier, Hardt, Hain & Cornblatt, 1994, cited in Laurent et al. 2000). If the high schizotypy participants in this experiment were more distractible and less able to sustain their attention across the two parts of the go/No go test this might explain their tendency to make more errors overall. As

such, this study found support for the hypothesis that high schizotypy participants show signs of a disorder of willed action similar to that which has been observed in schizophrenia patients but cannot make specific claims about which executive processes underlie this.

Summary

Recent years have seen a shift away from the view of schizophrenia as a categorical illness, toward the idea of psychosis proneness existing on a continuum. The results of the experiments undertaken in this thesis demonstrate quite a different pattern of cognitive processing between the two groups of participants, and provide further support for the concept of schizotypy.

The results obtained provide partial support for Frith's hypotheses that the symptoms of schizophrenia maybe linked to mentalising ability. High schizotypy participants showed deficits in their ability to monitor their own mental states, and those of others. There was additional evidence that high schizotypes showed deficits in the kinds of executive processes which might underlie the 'disorders of willed action' described in schizophrenia patients. This could not be attributed to overall differences in IQ since all participants were university students, and of sound intellectual ability. The fact that anomalies in mentalising ability were found in these healthy volunteers indicates support for the idea that mentalising problems form a *trait* marker for psychotic illness, rather than merely an aspect of the schizophrenic *state*. The results of the triangles task indicated a deficit in the *application* of mentalising ability, rather than a complete conceptual lack of a ToM, in line with Frith's earlier theorising.

Clinical implications

The results of the triangles and me-pulse tasks highlight the existence of deficits in self and other monitoring amongst high schizotypes, which fits in with the research indicating monitoring deficits amongst schizophrenia patients. Taken all together, this body of findings suggests further support for the use of cognitive therapy with schizophrenia patients, since the model promotes the gathering of evidence before evaluating or making attributions – an important lesson for those who are apt to make rapid decisions on the basis of insufficient details.

The finding that high schizotypes show a tendency to impute social meaning when none is required might suggest a greater focus on non-traditional CBT issues, such as the therapeutic relationship. It seems entirely possible that one of the difficulties that schizophrenia patients have in engaging, is that they may be over-interpreting the actions and behaviours of the therapist. Therapeutic ruptures might be successfully avoided through an open discussion of this.

In order that these studies might have beneficial implications for schizophrenia patients, it may be helpful to return to the concept of ToM, and consider in more detail, precisely which skills are necessary in order to successfully mentalise. When high functioning autistic participants begin to show success on ToM tasks that they could not complete before, it would be most helpful to know quite what has changed. Which cues do they learn to use in order to successfully mentalise? An improved understanding might provide clues as to the active ingredients that would be necessary for a successful therapy.

It has been stressed that a lack of research means that our understanding of the kinds of executive deficits which underpin negative symptoms is still in its infancy. However, psychologists are now beginning to try to tailor rehabilitation programmes

to schizophrenic patients to address these deficits with some success (Davalos, Green & Rial, 1999). The results of the Hayling and go/No go tasks indicate that addressing response inhibition and set shifting may be key processes. The results obtained on the Hayling task might suggest that it is important to provide sufficient time for schizophrenic patients to complete the task provided; the high schizotypes took almost four times as long to provide answers in part 2 but they eventually provided appropriate answers, indicating that they could do the task, simply they could not be rushed.

Conclusion

This study began by highlighting the fact that it is almost 100 years since Kraeplin identified the syndrome we now describe as 'schizophrenia' and yet the disorder is still not clearly understood. But as this thesis has shown, there has been a proliferation of research in this area throughout the last century, and greater clarity is beginning to appear. In 1978 The Lancet (cited in Frith 1992) lamented that many of the apparent 'discoveries' in schizophrenia turned out to be mere 'elephant footprints in the sand' i.e. all too quick to fade away! But researchers are now beginning to understand some of the factors which previously clouded our understanding of this area, such as reliance on the use of patients, (who may be floridly unwell), the study of schizophrenia as a unitary concept, and more latterly, the discussion of 'executive functioning' as an umbrella term. It is becoming more accepted that in order to further our understanding of schizophrenia we need to adopt a symptom focussed approach, and be more specific about which kinds of symptoms correlate with which kinds of neurocognitive processes.

This study has found clear support for the concept of schizotypy and it has added to the gathering body of research that is shows support for Frith's idea that the negative symptoms of schizophrenia are underpinned by a disorder of willed action. It has found intriguing evidence of anomalies in the ability of high schizotypes to understand the mental states of others, and opened up the enticing possibility that high schizotypes appear to be able to startle themselves. Far from schizophrenia research once representing the 'graveyard of neuropathology' (Plum, 1962, cited in Frith, 1992) these are exciting times.

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Appendices

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6 June 2003

Ms Celia Morgan
Department of Psychology
University College London

Dear Ms Morgan

Re: Notification of Ethical Approval

Project ID: 0010/004: An Investigation of the Interaction between Schizotypy and Cognitive Monitoring Processes

Following the meeting of the UCL Committee for the Ethics of Non-NHS Human Research on 1 May 2003, I am pleased to inform you that the above research has been granted ethics approval for the duration of the project (1 June 2003 – 1 June 2004) subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://zzz.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

   Reporting Non-Serious Adverse Events.
   For non-serious adverse events you will need to inform Ms Helen Dougal, Ethics Committee Administrator (**h.dougal@ucl.ac.uk**), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Reporting Serious Adverse Events
The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

3. On completion of the research you MUST submit a brief report (maximum of two sides of A4) of your findings to the Committee. Please comment in particular on any ethical issues you might wish to draw to the attention of the Committee. We are particularly interested in comments that may help to inform the ethics of future similar research.

Yours sincerely

J Birch

Sir John Birch
Chair of the UCL Committee for the Ethics of Non-NHS Human Research

Cc: Professor Valerie Curran
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CONFIDENTIAL

CONSENT FORM

Final Version (20/03/03)

Title of study: An investigation of the interaction between schizotypy and cognitive monitoring processes

Investigators: Rachael Lippett, Celia Morgan, H.Valerie Curran

Please complete the following: *delete as neccessary*

1. Have you read the information sheet ? YES / NO

2. Have you had an opportunity to ask questions and discuss this study ? YES / NO

3. Have you received satisfactory answers to all your questions ? YES / NO

4. Have you received enough information about this study ? YES /NO

6. Which investigator have you spoken to about this study ?.....

7. Do you understand that you are free to withdraw from this study:
   * at any time
   * without giving a reason for withdrawing YES / NO

8. Do you agree to take part in this study ? YES / NO

Signed..... Date.....

Name (please print) ..... Investigator.....

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VOLUNTEER INFORMATION SHEET

An investigation of the effects of schizotypy on cognitive monitoring processes
Investigators: Rachael Lippett, Celia Morgan, Prof. H.Valerie Curran

Purpose of the study:

To determine how the personality can affect a person's mental state and ability to process information

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask the investigator if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Background

Different types of people are known to process information in different ways. This study aims to look at the relationship between personality traits and the processing of auditory, verbal and visual information.

What is involved?

The study will involve an initial screening with a questionnaire examining personality traits and volunteers will then be selected at random to take part in the study. On the test day you will come to a quiet room in the Sub-Department of Clinical Health Psychology in UCL. First you will be asked to give written, informed, witnessed consent to take part in the study. Then you will complete some paper and pencil and computer tasks, involving watching some animations, listening to sounds whilst having your blinking recorded by the computer and responding to various letters on the computer screen. You will then be paid for your participation.

The data from this study is completely confidential and only the experimenters above will have access to it. It will be stored on the principal investigator's computer at UCL but your name will not be recorded on computer and any identifiers to link you to the data will be irretrievably removed.

Please ask Rachael Lippett any questions you may have about the study.

You do not have to take part in the study if you do not want to. If you decide to take part, you may withdraw at any time without having to give a reason.

All proposals for research involving human subjects are reviewed by an ethics committee before they can proceed. This proposal was reviewed by the joint UCL/ UCLH Ethics Committee