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Sampling the form of inner experience in three adults with Asperger syndrome

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SYNOPSIS Three adults with Asperger syndrome were invited to talk about their inner experiences, using an experience sampling and interview technique. They reported thoughts primarily or solely in the form of images. By contrast, normal adults previously tested with this technique reported inner experiences of a variety of forms. The present report suggests the feasibility and potential interest of the experience sampling method with high-functioning individuals with autistic disorder.

INTRODUCTION

In the present study, a first attempt was made to investigate the inner world of three people with autistic disorder. Recent research has provided evidence for a specific and unique impairment in the ability of autistic subjects to attribute mental states – a lack of 'theory of mind' (Baron-Cohen *et al.* 1985; Leslie, 1987; Frith, 1989; Perner *et al.* 1989). Other psychological theories of autism have suggested alternative primary impairments, for example in executive functions (e.g. Ozonoff *et al.* 1991), or interpersonal relatedness (e.g. Hobson, 1989). At present each of these theories has much to offer for our understanding of the spectrum of autistic disorders. As regards the question of inner experience, however, the theory of mind account of autism makes the clearest predictions. One implication of the theory would seem to be that autistic people who fail theory of mind tasks should have little access to their own mental states and be relatively poor at introspecting about their own thoughts. The ability to represent mental states is necessary not only for understanding the behaviour of others in terms of their beliefs and desires, but also for thinking about one's own thoughts. The strictest interpretation, then, might lead us to expect that a study of introspection in autism would be impossible.

However, not all subjects with autistic disorder have the same degree of theory of mind deficit (Baron-Cohen, 1989; Ozonoff *et al.* 1991; Happé, 1991*a*; Bowler, 1992). It has been established that a talented minority exists who manifest some ability to think about mental states in theory of mind tasks (Happé & Frith, 1994). These subjects might be expected to have rather better access to their own inner experience. At present, this question is unexplored. Some autobiographical writings by exceptionally able people with autism suggest a peculiar experience of the world, but these writings are relatively hard to interpret as data (Happé, 1991*b*).

The present subjects were relatively high-functioning and verbally fluent, and suffered from the type of autism that is increasingly receiving the label 'Asperger syndrome' (Frith, 1991). All passed at least the simplest tests of theory of mind, and were able to attribute a false belief to a story character in a test passed by normal 4-year-olds but failed by most autistic subjects. A study of introspection in autistic subjects seemed to have most chance of success with these unusually able individuals. Not only did our subjects possess sufficient verbal ability to participate in the experience-sampling technique, but their relatively good performance on standard theory of mind tasks suggested that they had at least some awareness of mental states.

THE DESCRIPTIVE EXPERIENCE SAMPLING METHOD

The study of introspection has recently been revived by means of the descriptive experience

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sampling method. This technique, which is described in detail in Hurlburt (1990; 1993), has been used successfully with normal subjects as well as with subjects with a range of clinical conditions ranging from anxiety, depression, and eating disorders to schizophrenia. It involves the subject wearing a small device that produces a beep at random intervals, which the subject hears through an earphone. The subject is instructed that his task is immediately to 'freeze the contents of his awareness' at the moment when the beep began and then to write down some notes about the details of that experience. The subject is later interviewed about this beeped moment, using his notes as a memory aid. Several practice trials are usually needed before both interviewer and subject feel comfortable and confident that they have some mutual understanding of the types of questions to be asked and answered. We realize that of course we do not have direct access to inner experience itself, but only to the subjects' reports about it. However, great pains are taken to help subjects to give descriptions of their experience which feel accurate to them.

At the outset it should be noted that because the descriptive experience sampling method is new, its strengths and weaknesses still remain to be established. A carefully-drawn description of the characteristics of normal experience based on a large random sample does not exist. Instead, we must rely on a tentative characterization of normal experience based on Hurlburt's (1990 and unpublished data) use of the descriptive sampling technique with about 40 normal (not psychiatrically diagnosable) individuals. In their reported inner experience, four major categories were found: verbal inner experience; visual images; unsymbolized thinking; and feelings.

Verbal inner experience

This occurred in between 7 and 80% of the samples that Hurlburt's subjects describe. Most of this verbal thinking was clearly expressed in well-formed inner words and sentences, i.e. inner speech. These internally spoken words were generally reported to have the same characteristics as external speaking: same rate of production, same tone of voice, same inflection, same hesitations, etc. While most verbal thought was experienced as being spoken in the subject's own voice, words were occasionally reported to be heard as if spoken by another voice, for example, the voice of a friend. Sometimes, inner words seemed to function as directors of activity, but verbal thought could also be apparently unrelated to other inner or outer activity.

Visual images

These occurred with frequencies ranging from 0 to over 50% of samples across subjects. Images were usually in colour and occasionally included moving figures. The typical inner image was experienced in much the same way as external visual perception: the thing seen is in front of the subject; the centre is more clearly focused and detailed, the periphery fades to indistinctness, etc. These images were sometimes accurate reconstructions of previous visual experiences, but sometimes creations of things not previously seen, for example, views from impossible perspectives (such as a person seeing himself from behind) or of non-actual scenes. Occasionally subjects reported a sense of looking at something internally without experiencing a visual image. Sometimes, the visual images served useful or problem-solving functions, e.g. visualizing the result of some action. In many cases, visual images were accompanied by emotions.

Unsymbolized thinking

This occurred at frequencies from 0 to over 50%. Unsymbolized thoughts were clearly-apprehended, differentiated thoughts that occurred with no experience of words, images, or other symbols that might carry the meaning. Subjects sometimes referred to this phenomenon as 'pure thought'. In such samples the subjects could, in their sampling interviews, say clearly what they had been thinking about at the moment of the beep, and thus could put the thought into words, but insisted that neither those words nor any other words or symbols were available to awareness at the moment of the beep, even though the thought itself was easily apprehended at that moment.

Feelings

Emotional experience at the moment of the beep, occurred with frequencies ranging from 0 to over 50% in normal subjects. Feelings were generally experienced to take place in the body,

usually in the chest, but most subjects found it difficult to be precise in giving a bodily location to feelings.

Normal subjects tended to report examples of all of these types of inner experience, singly or together. For example, a subject might report speaking certain words in an inner voice, while at the same time thinking in unsymbolized thought about something rather different. In addition, they reported that actions were sometimes being undertaken at the time of the beep without any inner experience of which they were aware. In these cases, subjects talked of 'just doing' something. At the other extreme, it was striking that the great majority of subjects at the time of the beep were focused on some inner event or events, with no direct awareness of outside events at that moment. Simple perceiving of the world was rarely reported as the content of experience.

Hurlburt and his colleagues have also used the descriptive sampling technique with subjects diagnosed as schizophrenic, depressed, hypomanic, anxious, bulimic, and borderline personality (Hurlburt, 1993). Although the descriptive experience sampling technique has only been used with small numbers of subjects from any one diagnostic group, Hurlburt argues that these preliminary findings suggest clear differences between the reports of inner experience from these different populations. For example, schizophrenic subjects when in acute states reported a high frequency of inner visual experience, occurring in about half of their samples (Hurlburt, 1990). The images appeared to be more concrete than those of normal subjects – having more the characteristics of a photograph – but were often said to be 'goofed up', for example, were bent or twisted, or had black 'ink' spattered randomly on them (Hurlburt & Melancon, 1987). Depressed individuals, on the other hand, showed a predominance of unsymbolized thought.

THE INNER EXPERIENCES OF THREE ADULTS WITH ASPERGER SYNDROME

Three adults, Robert, Nelson and Peter, who had been independently diagnosed as suffering from Asperger syndrome, volunteered to take part in this study. The names used are fictitious and chosen by the subjects themselves. They all exhibited the diagnostic features required by Gillberg (1991), Tantam (1991) and Wing (1991); specifically social impairment, narrow interests, and difficulties in verbal and non-verbal communication. All had normal intelligence, as measured by the WAIS (Wechsler, 1981). None of the three young men lived or worked independently. None was able to make friends, despite a desire to do so. Each had absorbing special interests. All three had a developmental history of autistic behaviours.

The subjects were given a battery of theory of mind tasks: first-order theory of mind tasks which necessitate understanding that a protagonist can have a mistaken belief about a real state of affairs (passed by normally developing children of 4 or 5 years), and second-order theory of mind tasks which require the ability to recognize one character's false belief about what another character thinks (passed by 7-year-olds). All three passed the first-order tasks, and two also passed second-order tasks.

The same general procedure was followed with all three subjects: they were given the beeping device and instructed in its use during the first session. The following day (or perhaps a few days later if a weekend or some other scheduling difficulty intervened) they collected samples (that is, they responded to the beep) throughout a period of several hours of their normal waking activities. That same day (or perhaps the following morning) we met with the subject for several hours to discuss their samples in detail following the procedure described by Hurlburt (1990). This interview session served both as data gathering and as a training exercise for subsequent sampling days. The following day (or a few days later as scheduling permitted) the subject collected another series of sampled experiences and again met with the authors for detailed discussions. This sample/discussion procedure was repeated for each subject for a total of about 5 sampling days, and produced between 12 and 16 samples (1 to 6 per day).

Case 1: Robert

Robert was a 25-year-old man who had attained a WAIS Verbal IQ of 94, a Performance IQ of 86, and a Full Scale IQ of 90. On theory of mind tasks he

showed himself capable of attributing mental states, to at least the 7-year-old level. He had been diagnosed in adulthood as suffering from Asperger syndrome on the basis of his developmental history and current functioning, by an independent psychiatrist.

Robert was very cooperative throughout the sampling procedure, arriving on time or as much as an hour early for the meetings. He sampled for a period of 5 days, coming to be interviewed each day. With the exception of relatively little apparent interest in or curiosity about the social aspects of the interview situation, his behaviour in the interviews was not particularly unusual. He seemed to accept that it was possible to talk about what he was 'thinking about' at a particular moment in time. We discussed 16 samples with Robert, ranging from 1 sample to 6 per session.

Images

The characteristics of all Robert's 16 samples were strikingly uniform. All 16 involved visual images, with no other aspects of experience reliably available to be reported – no feelings, no inner speech, no bodily sensations, etc. All Robert's images were seen clearly and in accurate colour, with the centre of the image being most clear and losing focus at the periphery, apparently exactly the same as his real-world visual perception. Most of the images were in accurate motion, although two were like still photographs. That is, Robert's images were quite similar in form to those reported by normal subjects. Most of the images were directly related to what he was doing or intending to do. Robert himself appeared in 8 of the 16 images. In 6 of these 8, he saw himself from the back; the remaining two had perspectives from the top looking down and from the side, obliquely, seen from slightly forward of a direct profile.

For example, at sample no. 3 Robert reported that he was 'thinking about' what he had to do today. This 'thinking about' involved a series of images of the tasks he had set for himself. At the moment of the beep, he was trying to figure out how to find his way to the Cognitive Development Unit, where he had his appointment with us. This 'trying to figure out' was an image of himself walking down the street near Euston station. This image was of precisely what he was doing at the moment of the beep: he saw himself from the back, walking away from the point of perspective. There was full, accurate colour and motion in the image, and there seemed to be a normal fading of focus at the periphery of the image. Robert reported that this image seemed to be located inside his head, oriented as if he were looking forwards at it, but he could not give additional details of this phenomenon. There were no other aspects of experience reportable at this beep.

Two of Robert's images had an 'X-ray' quality about them, allowing him to see simultaneously both the inside and outside of some apparatus whose incorrect functioning he was trying to diagnose. For example, at sample no. 13 Robert was sitting at the railway station waiting for a train. While waiting, he was 'trying to figure out' why a key that he had recently had made did not work. This figuring-out involved picturing an image of the key in the door lock, with his left hand holding and turning the key. This image was in full, accurate colour and motion. The lock itself was seen both from the outside (that is, he could see the face of the lock and the keyhole) and from the inside (he could see the levers inside the lock move as the blades of the key pushed them along). This simultaneous outside/inside viewing was impossible to describe adequately. It was as if he had an X-ray view of the lock superimposed on the exterior view of the lock. Robert recognized the physical impossibility of this perspective; he knew he was seeing parts of the lock face that would actually be obscured by his hand, and also parts of the inner workings of the lock that would actually be obscured by the lock cover, but he was confident that those aspects were somehow being seen simultaneously in their naturally occurring physical orientations. Besides this image, there were no other aspects of experience present to Robert at this moment.

Almost invariably Robert's first description of a sample was that he was 'thinking about' something; subsequent questioning led him to say that this thinking-about involved seeing an image. We enquired whether, during our conversations, he 'saw' the same images he had seen at the beep. He consistently said 'yes,' although sometimes the during-the-conversation image was said to be not as clear as the beeped image. From his behaviour and responses during the conversations we were quite persuaded that he was, indeed, seeing an image during our conversations.

Images were experienced to be inside his head, but he was not sure exactly where. Some images were experienced as being larger than others, as large as 'A4' (metric standard letter paper size, about 21 by 30 cm). The contradiction between being inside his head and being of A4 size was noted by Robert with a smile, but he did not waver from either facet of the description.

The absence of other forms of inner experience

Robert's samples were marked by the absence of any characteristics of inner experience except images. Except for the imagined sensation of a cat scratch on the back of his hand in one sample of an image of a cat, no samples included inner speech, feelings, bodily sensations, or other features of inner experience that have been reported by other subjects. Robert clearly had adequate ability to describe such features, and on

occasion we specifically enquired whether such features were present, so as to rule out the possibility that they were simply being overlooked. Our conclusion was that they simply did not occur to Robert as aspects of experience at any of the sampled moments.

Because the lack of non-image forms of inner experience was so striking, we structured exercises during the interviews to explore the way in which Robert experienced unambiguous strong bodily sensations. For example, with Robert's consent one of the authors (R.H.) leaned him forward and sideways to very tilted body positions; his inner experience (seeing a recalled image) remained constant, and a bodily awareness did not occur to him. In another such experiment, R.H. twisted the skin of Robert's wrist in opposite directions, creating what in most people would be a moderately painful experience. The wrist sensation did not create its own image or disturb the image that was present in his real-time inner experience: the image that he had been describing to us remained constant. Robert said he could feel the skin twisting but insisted it was not painful.

The reliability of Robert's reports

As with all our subjects, we attempted to ascertain whether Robert's reports were accurate descriptions of events occurring at the moment of the beep, or constructions based on events other than that moment. For example, we occasionally (purposefully or accidentally) asked leading questions of him to find out whether he would simply answer according to our demands; he did not follow those leads, making us more confident that he was reporting some aspect of his own inner experience rather than merely acceding to our influence.

Occasionally (three times) conversations about a sample would include references back to previous samples taken as much as a week before. All of these three recollections involved seeing an image at the time of recall. Of these three recalled images, one was identical (including colours, perspective, degree of clarity of particular parts of the image, etc.) to the original image as far as our notes allowed us to ascertain; one was identical except for one detail; the third image was reported to be somewhat blurry on recollection.

Case 2: Nelson

Nelson was a 24-year-old man who was studying part-time at a College of Further Education. He was rather fluently verbal, polite and eager to please, with wide-ranging artistic and cultural interests. With the exception of a few stereotypies in speech patterns (for example, he repeatedly addressed all the interviewers by name, saying things like 'I'd be happy to tell you that, Russell, Uta and Francesca', and 'That's exactly right, Uta, Francesca and Russell'), and the fact that he smiled almost constantly, he might not be identified by the lay person as having any disorder. However, he had been diagnosed by two separate clinicians as suffering from Asperger syndrome on the basis of current social impairments and abnormal developmental history. From the outset he was very interested in the sampling task. Nevertheless, like Robert, he never asked about the general aims of our project, or how his own responses compared with those of other subjects.

Apart from the sampling interviews, Nelson was given the WAIS as well as a battery of theory of mind tasks. Nelson had a VIQ of 110, a PIQ of 108 and FIQ of 110. On the theory of mind tasks, he passed those tests of false belief that normal 7-year-olds pass (second-order theory of mind tasks) but failed to understand cases of double bluff that normal subjects comprehend at the same age.

Nelson's sampling consisted of six interviews (an initial orientation and five sampling days) over a period of about 2 weeks; each interview lasted approximately 90 min or more, during which Nelson's attention did not waver. He typically brought two or three samples to the interview, generally obtained within the few hours immediately preceding the interview, often on the train en route. The beeper was set to an average interval of about 20 min.

We discussed twelve samples in detail. Nelson's ability to perform the sampling task changed remarkably over the sampling period. During the first day, it seemed to be difficult or impossible for Nelson to understand what we meant by our requests for him to report inner experience or thoughts. He did not differentiate easily between perceiving an object in external reality, seeing an image of that object, and thinking about the object. For example, at the first beep he was looking at some trees. He could not clarify whether that 'looking at' involved a real or imaginary seeing. In another early sample he said he was thinking, 'It's a lovely picture', and told us he was both saying those words and seeing them in black capital letters written in his head. We did not believe the details of his descriptions of the first few sampled moments; in his eagerness to please he seemed to be making up rather than remembering portions of his accounts. It had apparently never occurred to him to think about his inner experience. Subjects frequently do not adequately understand the sampling task on the first day or two of sampling. It might be noted, however, that Nelson seemed much further from such understanding than most subjects; in fact on the first day it seemed quite probable that he might never be able adequately to respond to the beep.

By the fifth sampling day, however, we had become quite convinced that he understood what our

questions meant and that he was able to implement his understanding at the moment of subsequent beeps. He was now differentiating in the notes he wrote immediately after the beep between 'actual' and 'visualized' phenomena, and his accounts contained the kind of detail we have come to expect of individuals who have actually experienced the phenomenon under discussion. His fourth- and fifth-day sampling descriptions were delivered with considerable and unshakable confidence and credibility. He still contradicted himself about some of the minor details of his experience, but his apprehension of the central characteristics of his experience seemed secure. When we did not understand something, we could ask Nelson about it from many different directions, and while he sometimes had difficulty finding the words to express to us what he was experiencing, that experience itself seemed quite clearly available to him and very resistant to being modified by our questioning, even when we asked leading questions.

The 10 useable samples were remarkably uniform in their general characteristics: all included a visual image, and that image was the sole aspect of inner experience at the moment of the beep. Occasionally there was also a simultaneous awareness of external perception, and sometimes there was little differentiation between external and imaginal perception, but there were in general no other aspects of inner experience (that is, no inner speech or inner hearing, no unsymbolized thinking, etc.). On occasion, slight feelings were reported as being ongoing at the moment of the beep; in general, these feelings were indistinct and nearly impossible for Nelson to describe.

Images

All of Nelson's ten samples included a visual image as the dominant (or only) feature of his experience. These were all in colour, half were in motion, and elements within the images varied as to degree of clarity or vagueness, with central features generally reported as being clear.

At sample no. 5, Nelson was in an underground train, standing facing the door as it was stopped in the station. At the moment of the beep, he was 'thinking about' an old woman he had seen earlier that day. This thinking-about involved 'picturizing' (Nelson's own term for viewing an image of something) the old woman, seeing an image of her standing in the same orientation (standing across the street) as he had originally seen her that morning. The image was still and in colour: he could see her grey hair, clear-framed glasses, blue eyes, and wrinkled face. The grey of the road and the blue of her coat were also seen but were somewhat vague or out of focus. There was also a feeling of 'sympathy' for this woman, who (when he actually saw her earlier) was having difficulty crossing the street. This feeling seemed to be located in Nelson's head, but he could give no further details of it except to say that perhaps it was 'like a faint thought'. Also visually present but in the background was the actual seeing of the scene Nelson was facing: he was seeing the tube doors and above them an advertisement depicting a Leonardo da Vinci drawing.

'The shape of my thoughts'

During his description of many of his images, Nelson referred to the image as being 'the shape of my thoughts'. For example in sample no. 7 Nelson was looking at the brick wall of a house near his home. At the moment of the beep he was visually focused on three or four of the bricks. His thoughts had 'taken the shape of' the bricks, following the outline of the individual bricks. Nelson described the bricks as 'looking out at him' to capture the fact that the bricks had taken over the focus of his attention for the moment, seemingly of their own accord; that is, he was not aware of directing his own attention towards the bricks. By describing his thoughts as 'taking the shape of' the bricks, Nelson seemed to mean that his field of view and awareness was totally occupied by precisely those particular bricks and nothing more; the surrounding bricks simply were not seen at all. Nelson was feeling a 'little bit sentimental' about the bricks; he had seen them many times before, had grown up with them. He could not describe how this sentimental feeling presented itself, except that he was somehow paying particular attention to the colour of the bricks and this seemed to be a factor in the recognition of the sentiment. On other occasions too, Nelson described aspects of his images, particularly colours, which had affective significance.

Nelson used the phrase 'the shape of my thoughts' repeatedly throughout the interviews. When we asked him a question, he might say, for example, that 'the shape of my answer is...'. To explore this further we set up situations and exercises that might illuminate this phenomenon. In one of these R.H. held a pen in his right hand, about a metre in front of Nelson, and asked him to describe his perception. In reconstructed form, his responses were as follows. 'The pen is the shape of my thoughts.' Can you see the other objects that are in approximately the same direction as the pen, my head, for example? 'No.' R.H. moved his left hand across his own face, which was perhaps 15–20 degrees to the right of the pen. Did you see any movement in the room? 'I know that you moved your other hand, but I didn't see it. I somehow sensed that it moved.' Our interpretation (as a result of this and other similar experiments) is that Nelson did in fact see only the pen, and did not see the movement outside the region of the pen. The ground of Nelson's perception existed in some cognitive sense (he knew a movement took place) but not in a visual sense. Thus, we believe that Nelson was being quite accurate when

he described the pen as being the shape of his thoughts: there was in fact no visual experience beyond the borders of the pen.

Using images for problem-solving

As we explored Nelson's samples, we repeatedly asked him to provide details of his experience for which he had little or no previous experience in communication. As he struggled to find ways to respond to our questions, we occasionally interrupted him and asked him to describe his inner experience right then. Our impression is that these questions always uncovered some kind of visual process that he was engaged in as he attempted to answer.

For instance, Sample no. 10 was an image of a gothic church that stands in the Sussex town of Lancing, seen as if looking up towards its site on a hill top. As he was trying to describe some feature of this church to us, we interrupted him and asked him what was happening right now. He said he had an image of Oxford University as seen from an aerial view, looking down at Corpus Christi College and its surrounding environs. He explained that he was searching the University buildings for one that might have the same visual characteristic as the Lancing church which he was trying to describe. If he had found such a building, he told us, he would have focused in on it and then used what he saw there to illustrate for us the characteristic in question. It is remarkable to note that his perspective on the Lancing church was from below looking upwards, while his perspective on Oxford was from above looking down; that apparently would provide no difficulty for his comparison of shapes.

Interestingly, Nelson's use of visualization to understand the world also emerged in the theory of mind tasks. In response to a set of stories in which the subject is asked to explain the motivation behind a speaker's literally-untrue utterance (Happé, 1994), Nelson showed an idiosyncratic tendency to explain mental states in terms of visual images. For example, one story contains an utterance intended as a joke; a boy sees a woman come out of the hairdresser's with very short hair and says to his friend, 'She must have been in a fight with a lawnmower'. When asked why the boy had said this, Nelson answered, 'Because he's metaphorically describing that she's lost a lot of hair... putting together that a lawnmower cuts grass and scissors cut hair... visualizing, not too seriously, in his mind, not in reality, a lawnmower going over her head'. Similarly, in response to a story in which two boys are pretending an upturned table is a ship, Nelson explained the boy's utterance ('You are standing in the sea!') as follows; 'He's having a great time visualizing the kitchen floor... using a past event of the sea to transfer it in a 3-D way to the kitchen floor'. These answers suggest that Nelson found it useful to think about thoughts as 'pictures in the head' in order to understand instances where reality and mental representation of reality are not identical.

Case 3: Peter

Peter was a 34-year-old man who, like Nelson, was currently unemployed and attending further education classes. He had recently been diagnosed by an independent psychiatrist as suffering from Asperger syndrome, and had received a diagnosis of autism in childhood. On the WAIS he achieved a VIQ of 100, a PIQ of 105 and a FIQ of 102. On a battery of theory of mind tests he showed understanding of only simple false beliefs. That is, he succeeded on first-order theory of mind tasks passed by normal 4-year-olds, but failed those second-order tasks passed by normal 7-year-olds. In this respect, his ability to attribute mental states was less developed than the previous two subjects, although it was still more advanced than the majority of autistic individuals.

The first sampling day was divided into two sessions separated by about an hour. In the first session we described the procedure and its rationale; we then gave Peter the beeper and asked him to use it for an hour and return to discuss the samples. He did so, bringing back three samples. Each subsequent sampling day he brought three samples (15 in total), all taken during the same day on which the sampling conversations took place. We also performed a series of exercises during our sampling interviews that were designed to elucidate some aspects of his experience.

No inner experience

Our understanding of the 15 samples that Peter collected is that there was no reportable inner experience in any of the samples; that is, there were no images, no inner speech, no feelings, etc. that other subjects have reported.

Nevertheless, Peter sometimes used the language of inner experience in his descriptions. For example at the moment of sample no. 4 Peter had just got up from his chair at the table, where he was having porridge, to go into the kitchen. He was already standing but had not yet begun to walk. He said during the discussion of this sample that he 'was thinking about going into the kitchen', but careful questioning convinced us that he was not actually 'thinking' about it in any of the senses that we have used that term: he was not saying to himself in inner speech anything like 'I must go into the kitchen'; he did not have a visual image of himself entering the kitchen; he did not have an unsymbolized thought about going to the kitchen, etc. Instead, he apparently used the word 'thinking' to mean that he was engaged in a behaviour that was in progress and not yet complete, and therefore he 'must have been thinking about it'.

Sample no. 15 also illustrates the difficulty Peter had in distinguishing between mental events and behaviours. He was crossing the street on his way to his sampling interview with us when a beep occurred, and he said about his experience then, that 'it was on my mind to go and see you'. 'What was this on-your-mind like?' we asked, to which he replied 'Well, I wouldn't be here otherwise!'. He could not give perceptual details of this thinking, not even of the kind that has been referred to as unsymbolized thinking. In 9 of Peter's 15 samples he was performing some task or activity, seeing or otherwise sensing some aspect of the real world at the moment of the beep: for example, seeing the TV screen in sample no. 9, seeing the letter lying on the table in sample no. 14.

Peter was capable of remembering and reporting words when they were ongoing at the moments just adjacent to the moment of the beep. For example, at sample no. 14 Peter's mother had just said aloud to him, 'There's no post [mail]', to which Peter was about to reply, 'There is one letter'. The beep occurred after his mother's statement and before his own reply. At the moment of the beep, however, there was no noticeable or reportable inner experience. He was seeing the actual single letter lying on the table, and nothing else was part of his awareness. The fact that Peter could report external words that were being said aloud convinced us that he had the verbal ability to report inner words had they been ongoing at the moment of any beep; apparently, phenomena such as inner speech simply did not occur at any sample.

Directly elicited visual experience

Even though Peter did not report having images during any of his samples, further exploration showed that he was clearly capable of seeing and reporting inner visual phenomena. We asked him, for example, to look at the coffee cup on the desk, and then close his eyes. Could he see an image of the cup or of anything else? Yes he could, he said, and subsequent questioning convinced us that he did in fact 'see' an inner display of the cup, that is, he could provide the kind of visual detail usually obtained from individuals who frequently report images. Furthermore, when he talked about some of his favourite subjects, for example railway trains or the phases of the moon, he used visual language that suggested he was internally seeing the things he was describing.

We sought to explore this inner seeing as it occurred in the interviews with us, even though it did not occur in the samples. That is, we occasionally interrupted our sampling interviews to enquire about his experience at that moment, there in the room with us. These reports were frequently of images, which were always in colour ('I'm not colour blind!' he said, incredulous that we might think that his images could be anything but in colour) and usually seen out in the world around him. For example, when he closed his eyes and visualized a cup, the image of the cup seemed to exist in the same place as the actual cup itself. If he were imaging, for example, the interior of a railway carriage, our detailed questioning established that it seemed to spread out around and in front of him as an actual carriage would.

The relationship of the image to the world

Peter's images sometimes had a fixed position relative to Peter's own body. We asked Peter, for example, to close his eyes and imagine the ballpoint pen that R. H. held in front of him and slightly to his right. We then turned him around, to the left through 90 degrees, and the image of the pen rotated with him; that is, the imaged pen remained in front and slightly to his right.

On other occasions, the image stayed fixed while Peter moved within it. For example, at one point he was imaging a railway carriage which he was involved in restoring. The image was seen, he said, from the seat where he usually sits in such a carriage – the fifth seat back on the right. The portion of the image that was most clearly seen was the red striped seat just ahead of him in the car. We then asked him to stand up; 'What happened to the image?'. He now saw most centrally the luggage rack that was above the seat in front of him, that is, the portion of the carriage that would be at eye level if he were standing in the railway carriage itself. We asked him if he could image the rear portion of the carriage, and he spontaneously turned around and reported he was now seeing the luggage rack of the seat behind him. This rear-facing image was not as clear as his 'usual' forward-looking one, and he was evidently not as comfortable 'looking backwards'. He quite clearly wanted to turn back around to his usual forward-looking orientation, and was struggling within himself not to do so because of our request. Our interpretation was that the image of the carriage was apparently fixed with respect to the room we were in (rather than fixed relative to his own body as was the pen reported above) and he wanted to take his usual position within it.

It seemed imperative for Peter that his images (as we explored them in our interviews) conform to reality as Peter understood it. For example, we asked him to look at a coffee cup that was on the desk in front of him. Could he form a mental image of it? Yes, he said after a delay of a few seconds, during which time he seemed to be examining portions of the cup rather intently. We then blocked his view of the cup with a white paper screen. Could he still see the cup? Yes, and he accurately described its features: handle to the right, pink stripes near the rim and bottom, etc. His description convinced us that he was actually seeing a visual image of the cup, rather than simply reporting facts about the cup. Furthermore,

the image he saw with his eyes closed seemed to be strongly related to the image he saw with his eyes open. Any change to the real state of affairs, while he was visualizing the object, presented a problem for him.

With the screen blocking his view, we rotated the cup on the desk top, telling him that we were turning it so that the handle faced left. Peter reported that his image also had rotated: now the handle was on the left. We replaced the screen and repeated this manipulation, saying that we were restoring the cup to its original position; this time, however, we did not actually rotate the cup. Peter reported that the handle in his image was now facing to the right. We removed the screen, and Peter reacted to the revealed orientation of the cup with a slight startle that he reported was somewhat unpleasant. We replaced the screen and asked him to report his image, if any, of the cup. Yes, he had an image of the cup, and this image was just as clear as previously. But now, he said, there was no handle on it! It was, he said, as if he were 'waiting to add the handle'; he did not know where it should be, so he simply did not include the handle portion in his image. A similar example was provided when Peter visualized (with his eyes closed) one of us who was sitting down. When, unbeknown to him, the person stood up, Peter was somewhat upset to discover the discrepancy between his image and the real state of affairs. He had to be reassured afterwards that no such 'tricks' would be played in the future.

From childhood, Peter has had a special interest in the moon, and he had developed a scheme of numbering the phases of the moon from 1 to 32. We attempted to explore the formation and use of images by enquiring about this, giving him a series of numbers chosen more or less randomly between 1 and 32 to serve as stimuli for him. On our second such attempt we said '27', to which he immediately responded that that was the phase of the moon that he had seen on the day of the severe hurricane that had struck England a few years before. He was now seeing an image, he said, of the moon in this phase over the roofs of houses that were on the opposite side of the street from where he was standing, but which had subsequently been demolished when the street was widened. He saw the clouds moving rapidly past the moon and could feel the wind against the right side of his body. This was apparently a quite real bodily sensation extending throughout his right side. He also felt somewhat frightened, but he could not give any bodily or mental details of that fright except to say it was as if he were going to be hit by some object. This was one of the very few multi-sensory experiences Peter described to us.

Fascination with the visual

Peter was from the start cooperative, but not particularly enthusiastic, throughout our interviews, and seemed to try to perform all the tasks we set for him. When we discussed his images, however, he became genuinely enthusiastic, laughing frequently and engagingly. He seemed delighted to discuss the details of visualizations, and brought to one session a series of photographs of the train carriage he was restoring. Of the 20 photographs, approximately 8 were of the lights in the ceiling of the carriage. These photographs were all almost identical. He chose two of them and asked us whether we could see any differences between them. 'One is a little better lighted than the other', R.H. said. 'No! That's not it!' 'Well, the luggage rack is slightly more scratched here then there'. 'No!' he said with glee at our inability to see the significant element. We tried several other alternatives to no avail. Triumphantly he pointed to tiny wooden rings around the base of the chrome light fixture. In one of the pictures the rings were absent. These rings were just barely visible, almost indistinguishable from the shadows in the slightly-out-of-focus polaroid photograph.

He explained that the light fixtures had particular significance for him because he used to see them when he was a young boy riding on the train. His description of that youthful seeing-of-the-light-fixtures was as if he had, there on the train, seen objects for the first time, as if the light-fixtures had somehow come into existence, had become real visual presences for him, in a way that no other object had ever visually crystallized for him before, as if out of the dazzle of unconnected visual sensations of flashes and colours an object had presented itself to him. A similar account of seemingly fragmented perception has previously been reported by a young man with autism writing about his childhood (White & White, 1987).

DISCUSSION

A surprising feature of the present study was the enthusiasm with which all three Asperger syndrome adults engaged in the descriptive experience sampling technique as time went by. The subjects seemed genuinely to enjoy the experience, and became better at reporting the form and content of their consciousness. While we had expected a relative inability to think and talk about inner experience, this was true for only one of the subjects, Peter, who was also the least advanced in terms of understanding mental states in the theory of mind battery. The other two subjects appeared to be more competent at the descriptive experience sampling method, after some initial period of familiarisation. The reports of those two subjects were impressively

similar and very different from those of other subjects previously tested (by R. T. H.): thoughts were exclusively reported as images with almost no other features of inner experience. There was another striking difference from normal subjects, our three Asperger syndrome adults showed no interest in or curiosity about how their own inner experiences might differ from those of other subjects.

Particularly in this early stage of descriptive sampling research, it is healthy to maintain considerable scepticism regarding interpretations and conclusions. That being said, it is our opinion, after many hours of the most careful questioning we could manage, that Robert and Nelson were in fact reporting the characteristics of their experiences as they occurred at the moment of the beeper. Thus, our best, and admittedly tentative, conclusion is that for these two subjects, reportable inner experience is predominantly visual. For the third subject, Peter, the beeper method did not elicit reports of inner experience. However, when reports were encouraged in the interview session, Peter too reported inner experience which was predominantly visual.

How should we interpret the finding that our Asperger syndrome subjects described their inner experience in terms of images? The most cynical interpretation might be that the reports we received were merely a response to a totally puzzling request to introspect. We believe that this is unlikely to be the correct interpretation, in view of the consistency both within reports of individuals' samples and across subjects. Furthermore, leading questions about other modes of experience (verbal, unsymbolized) were introduced periodically into the interviews, and had no effect.

Given that we trust our subjects' accounts, at least as much as one trusts the accounts of normal subjects, we suggest two possible interpretations, which we would tentatively extend to other subjects with autistic disorders: thinking in images, and using images as a 'metaphor' for thoughts. The first possibility is that people with autistic disorders do in fact have a predominantly visual style of thinking and that our subjects' reports reflect the real nature of their mental events. Visual thinking has been claimed to be the preferred mode of problem solving for autistic people, by teachers (Schopler *et al.* 1980), parents (Park & Youderian, 1974) and by able autistic people themselves (Grandin, 1992). The relatively superior performance IQ *versus* verbal IQ of autistic children (Prior, 1979; Ohta, 1987; Lincoln *et al.* 1988) and the existence of savant skills in drawing (e.g. Selfe, 1977) might be taken as support for this observation. The visual thinking hypothesis is potentially testable by objective methods, using problem-solving tasks amenable to verbal or visual solutions.

The second possibility is that, while able autistic people do have some sort of accessible inner experience, this experience is not in fact particularly visual. Why the experience should be reported as visual, then, still needs to be explained. It is tempting to suppose that our able subjects had come to some understanding of thoughts as 'pictures in the head', either before the study began or even during the course of the study's focused questioning. Peter, who passed only the very simplest false belief tasks, was the least able of our three subjects to report on his inner experience, while both Nelson and Robert, who understood not only false beliefs but beliefs about beliefs, also showed a greater ability to report inner experience. It is interesting to note that Robert, who passed all the theory of mind tasks, also readily understood the introspection technique, while Nelson, who had some difficulty with the most advanced of the second-order theory of mind tasks also took some time to master the experience sampling method. These differences between the three subjects cannot be explained in terms of IQ differences. Our findings are suggestive, but require further exploration in a larger sample of subjects. It is an exciting possibility that the ability to attribute mental states in experimental theory of mind tests and the ability to introspect on one's own thoughts in the experience sampling task are strongly linked.

If a connection does exist between ability in the two types of task, the question of causal direction will be of interest. Perhaps it is their rather better theory of mind ability that allows our two most able subjects to introspect. This explanation does not illuminate the question of why they reported only visual images. An explanation in terms of the opposite causal direction, however, might shed light on this. It is possible that our subjects' visual images helped them to come to an understanding of the

'representational' nature of thought – that thoughts, like pictures, represent the world as being a certain way, and are separable and distinct from their referent in reality. This may have allowed these autistic subjects to come to an understanding of mental states, such as belief. It has been demonstrated experimentally that autistic individuals have an unimpaired ability to understand photographs and pictures – as representations which can 'misrepresent' the things they depict (Leekam & Perner, 1991; Charman & Baron-Cohen, 1992; Leslie & Thaiss, 1992). These studies have shown that while autistic people have difficulty understanding that beliefs can become out of date, they have no trouble understanding that photographs can be out of date. This raises the possibility that thinking about how pictures (non-mental representations) relate to objects may help autistic people to think about how thoughts (mental state representations) relate to the world.

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