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Creativity and Imagination in Autism and Asperger Syndrome

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Three studies are reported that address the often described impoverished creativity in autism. Using the Torrance Creativity Tests, Experiment 1 found that children with autism and Asperger syndrome (AS) showed impairments. Experiment 2 tested two explanations of these results: the executive dysfunction and the imagination deficit hypotheses. Results supported both hypotheses. Children with autism and AS could generate possible novel changes to an object, though they generated fewer of these relative to controls. Furthermore, these were all reality-based, rather than imaginative. Experiment 3 extended this using a test of imaginative fluency. Children with autism and AS generated fewer suggestions involving attribution of animacy to foam shapes, compared to controls, instead generating reality-based suggestions of what the shapes could be. Although this is evidence of executive dysfunction, it does not directly account for why imaginative creativity is more difficult than reality-based creativity.

KEY WORDS: Creativity; autism; imagination; Asperger syndrome.

INTRODUCTION

The diagnosis of autism includes a symptom that has received relatively little research attention: a lack of normal creativity (DSM-IV; American Psychiatric Association [APA], 1994; ICD-10; World Health Organization [WHO], 1994). Although aspects of the imagination deficit in autism have been investigated (Scott & Baron-Cohen, 1996; Scott, Baron-Cohen, and Leslie, in press), including a possible developmental precursor, pretend play (Baron-Cohen, 1987; Jarrold, Boucher, & Smith, 1993; Wing, Gould, Yeats, & Briefly, 1977), there have been almost no experimental studies of creativity in autism. The exception to this is Frith's (1972) study of pattern imposition in autism. She found that when given the freedom to create patterns using different colored rubber stamps or xylophone notes, children with autism produced less *varied* patterns, relative to controls. That is, they were indeed less creative. A similar conclusion was reached by Lewis and Boucher (1991) when examining the drawings produced by children with autism. The content of the drawings was simply less varied, implying a lack of creativity.

The studies reported here aimed to extend our knowledge of creativity in autism. But this begs the question: What do we mean by creativity? Creativity has been defined by contrasting it with conformity (Crutchfield, 1962; Wilson, 1956). Flowers and Garbin (1989) emphasized the role of imagination in the creative process. They suggest that creativity involves the generation, manipulation, and transformation of images to generate novel representations. Many people would, however, still find this definition of creativity difficult to operationalize.

To overcome this, Experiment 1 administered some *standardized* tests of creativity to children with autism, since such tests have the advantage of referring

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to normative data on what counts as a novel response. For example, such tests can identify if a response is a statistically rare response, which is a quantitative measure of novelty. To this end, we used the Torrance Tests of Creative Thinking (Torrance, 1974). The Torrance tests represent, "one of the most popular and frequently used procedures for assessing creative thinking" (Rosenthal, DeMers, Sidwell, Graybeal, & Zins, 1983). Our second aim was to test whether any deficits found in children with autism also applied to children with Asperger syndrome (AS). In Experiments 2 and 3 we aimed to test reality-based creativity versus imaginative creativity.

Participants

Four groups of children took part in the study. The first was a group of 15 children with autism, all of whom met the standard diagnostic criteria (DSM-IV; APA, 1994). The second was a group of 15 children with AS. AS was defined following ICD-10 (WHO, 1994) as meeting the criteria for autism but with no history of general cognitive or language delay.[3] Children in both groups were diagnosed by independent, experienced clinicians and were attending special schools in Merseyside or Cambridgeshire, UK. The third group comprised 15 children with moderate learning difficulties (MLD), attending a special school in Peterborough, UK. Finally the fourth group was comprised normally developing children, all attending a primary school in Merseyside.

The autism group and MLD group were matched on verbal mental age (VMA), calculated using the Test of Reception of Grammar (TROG; Bishop, 1983). This test assesses syntax as well as vocabulary comprehension. Details of the participants are summarized in Table I. The AS group was matched with the autism group on chronological age (CA) and was included so as to test if the findings from the autism group were unique to that group or not. Inevitably, because AS by definition includes no history of language delay, the group with AS had a higher VMA than the autism group.

Design and Procedure

The children were seen individually in a quiet, plain room in their school, or in a similar room in the Section of Developmental Psychiatry in Cambridge. The order of tasks was counterbalanced in order to control for possible order effects. All participants took part in all four experiments reported here. In the following section, methods and results for each experiment are described in turn.

Table I. Participants' Verbal Mental and Chronologial Ages (in Years: Months)

	Chronological age		Verbal mental age	
Group	*M*	*SD*	*M*	*SD*
Autism	12:9	3:1	6:9	2:2
Asperger	12:9	2:6	9:10	2:5
MLD	12:4	2:4	6:9	1:8
Normal	5:2	2:7	—	—

EXPERIMENT 1: FIGURE COMPLETION

This experiment utilized two conditions from the Torrance Tests of Creative Thinking: Condition 1 (lines) in which all of the stimuli are the same, but a different response is required for each; and Condition 2 (squiggles), in which each of the stimuli are different, and a different response is required for each. Conventional instructions were modified to make them simpler.

Method

Condition 1. The experimenter presented the participant with a sheet containing 30 pairs of parallel lines (see Figure 1) and said, "I want you to make some pictures by adding to these lines. Try and make lots of different things." No time restrictions were imposed. After the participant had finished drawing on each pair of

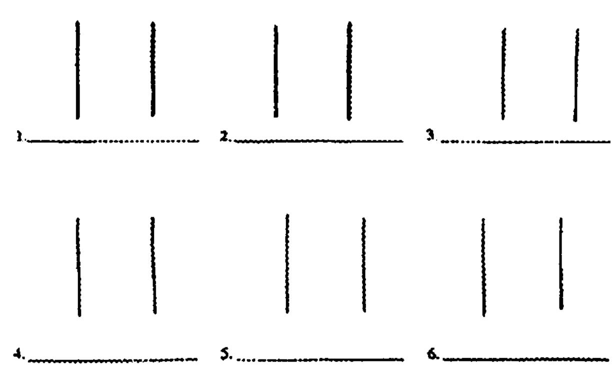

Fig. 1. Stimuli for Condition 1, Experiment 1.

[3] This lack of any general cognitive or language delay had to be true at the time of diagnosis. It is noteworthy however, that on tests of current functioning, some of the children with an AS diagnosis had a verbal MA lower than their CA.

lines the experimenter asked if the child had finished and asked what the picture was. The child's words were written under the picture in each case. This procedure was repeated for each pair with lots of encouragement and reminders to draw something "completely different this time," until the participant said that they could not do any more.

Condition 2. The experimenter showed the participant a booklet containing 10 incomplete figures or squiggles. The figures are variable in that each is different (see Figure 2). The experimenter then used the same verbal instructions as with Condition 1.

Scoring

Torrance (1974) specified that the test should be scored for three dimensions of creativity: fluency (the number of responses, minus repetitions); flexibility (the number of different categories the responses cover) and originality (the statistical rarity of the responses based on standardized norms). However, Heausler and Thompson (1988), after factor analysis, suggested that since these subscores tend to be highly correlated, that an overall score should be used. With this in mind, a total score was used.

Results

Mean scores of each group on each condition are shown in Table II. A repeated-measures ANOVA showed an effect of condition, $F(1, 56) = 4.08, p < .05$;

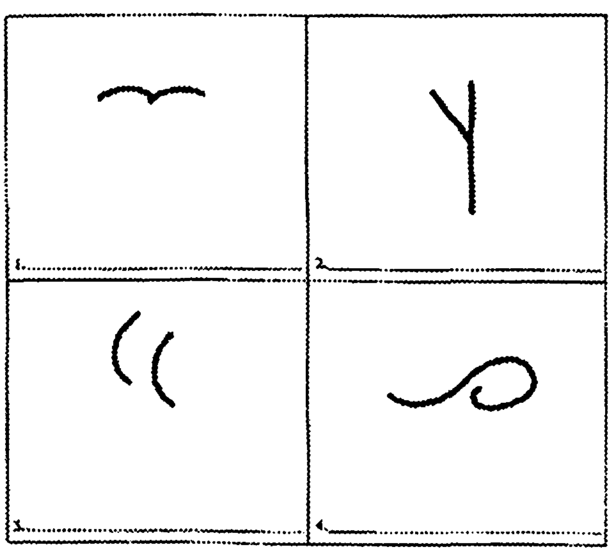

Fig. 2. Stimuli for Condition 2, Experiment 1.

Table II. Mean Creativity Scores in Experiment 1

	Condition 1		Condition 2	
Group	*M*	*SD*	*M*	*SD*
Autism	12.5	15.9	23.5	10.7
Asperger	29.4	24.3	28.0	6.14
MLD	52.3	14.0	33.3	2.5
Normal	43.8	16.5	33.4	2.8

and a significant group effect, $F(3, 56) = 19.31, p < .001$. In addition, a Group × Condition interaction was also significant, $F(3, 56) = 19.3, p < .001$. Subsequent Tukey's analysis revealed that the autism and AS groups scored significantly lower than the other two groups in Condition 1 (at the .05 level). The autism group scored significantly lower than the AS group. In Condition 2, the autism group scored significantly lower than the two control groups. No other significant group effects were found. No effect of condition was found for the AS group, but all other groups scored higher on Condition 1 than on Condition 2.

Discussion of Experiment 1

As would be predicted from the clinical literature, an overall impairment in creativity was found in children with autism and AS. Although in Condition 1 all the stimuli were the same, while in Condition 2 all the stimuli were different, the children with autism showed a deficit in creativity on both forms. The AS group was impaired on Condition 1 but not Condition 2. This finding supports the executive dysfunction theory of autism (Ozonoff, Pennington, & Rogers, 1991; Russell, 1996). Executive function (Baddeley, 1990; Shallice, 1988) is thought to be essential for the generation of novel responses, that is, for overriding routine responses and allowing generativity. That is, children with autism simply produce fewer novel responses, compared to controls. The next two experiments, reported below, tested the executive dysfunction account of this result along with an alternative: the imagination hypothesis.

EXPERIMENT 2: TOY IMPROVEMENT

To test further the executive dysfunction theory of creativity deficits in autism, in Experiment 2 we drew a new distinction, between two types of creativity. The first entails the production of *novel but real-world* events. Examples of this would be coming up with a novel move in a game of chess, or a novel design in clothes fashion, or a novel sequence of notes in a musical composition. The second variety of creativity entails the production of *novel but purely imaginative* events. Examples of this would be telling a story of an event that was impossible, or painting a picture of an object that could never exist. For shorthand, we refer to these two varieties of creativity as *reality-based* versus *imaginative creativity.*

Applying this distinction to the previous literature leads one to conclude that children with autism might be impaired in both kinds of creativity. Frith's (1972) study was effectively a test of reality-based creativity, while the Scott and Baron-Cohen (1996) study was effectively a test of imaginative creativity. In the latter study, children with autism found it difficult to "draw a man that could never exist," or "a house that could never exist," using the Karmiloff-Smith (1989) procedure. The imagination deficit hypothesis predicted that children with autism would be impaired on measures of imaginative creativity, while being unimpaired on measures of reality-based creativity. The generalized executive dysfunction hypothesis, in contrast, predicted an impairment on both types of creativity. This is, in part, based on the neuropsychological evidence showing that frontal lobe patients have deficits in executive function, creativity, and/or generation of novel responses (Shallice, 1988), regardless of whether it involves imaginative or reality-based creative or novel responses.

As with Experiment 1 above, Experiment 2 was based on a part of the Torrance (1974) standardized creativity test. The original test asked children to look at a picture of a toy elephant and to think of ways to make the toy more interesting to play with. The present study used a soft toy elephant since children find such tasks easier with a 3-D stimulus that they can manipulate (Tegano & Moran, 1989).

Participants

All children who took part in Experiment 1 took part in Experiment 2.

Method

Participants were handed a toy elephant and the experimenter said, "I want you to tell me lots of ways to make this elephant more fun to play with. What could you change about it to make it different? What could it do?" The experimenter then noted all the child's responses. Lots of encouragement was given, the children were prompted for more responses, and no time restrictions were imposed.

Scoring

Following Torrance's guidelines, the number of responses, excluding repetitions, was scored. However, to address the two alternative hypotheses, a content analysis was carried out, to identify reality-based vs imaginative creativity.

Results

Table III shows the mean number of responses made, excluding repetitions. A significant group effect was found, using ANOVA, $F(3, 56) = 21.55$, $p < .0001$. Subsequent Tukey analysis revealed that the autism and AS groups differed significantly from the control groups at the .01 level. The types of responses made are reported next.

Content Analysis

The type of responses made were categorized into four types. Using our earlier distinction, the first three types were *reality-based,* and the fourth was *imaginative:* (i) Additions or alterations: e.g., "Give him a hat" or "made his ears bigger"; (ii) Manipulation: e.g., "Cuddle him," or "Take him to the park"; (iii) Movement: e.g., "Flap his ears"; (iv) Imaginative: e.g., "He could fly," or "He could read you bed-time stories."

Mean responses in each category are shown in Table IV. All responses were categorized by two independent raters blind to the identity of individuals and the aims of the study. Interrater agreement was 97%, and disagreements were resolved by discussion. When the types of responses given were analyzed, a significantly larger proportion of the responses given by the children with autism (45.8%) were Manipulation responses. In comparison, only 1% of the transformations made by children with MLD and 4.2% of those made by normally developing children were of this type (Autism × MLD, $\chi^2 = 90.07$, $p < .001$; Autism × Normal, $\chi^2 = 62.09$, $p < .001$). The AS group also produced a high proportion of Manipulation responses, 22.7% of their responses being of this type, and this was significantly more than both control groups (AS × MLD, χ^2

Table III. Mean Number of Category Changes in Experiment 2

Group	*M*	*SD*
Autism	3.93	3.58
Asperger	6.86	4.27
MLD	12.86	3.56
Normal	13.25	4.85

Table IV. Percentage of Responses in Each Category, in Experiment 2

Group	Additions or Alterations	Manipulations	Movement	Imaginative
Normal	29.7	4.2	17.7	48.4
Autism	17	45.4	15	22.6
Asperger	70.1	22.7	2	5.2
MLD	20.8	1.1	12.3	65.8

= 41.72, $p < .001$; AS × Normal, $\chi^2 = 23.72$, $p < .001$.) The difference between the autism and AS groups was also significant (Autism × AS, $\chi^2 = 8.21$, $p < .005$).

A significantly larger proportion of the responses given by the children with AS (70.1%) were Addition/Alteration responses. In comparison, only 17% of the transformations made by children with autism, 20.8% of the transformations made by children with MLD and 29.7% of those made by normally developing children were of this type (AS × Autism, $\chi^2 = 44.08$, $p < .001$; AS × MLD, $\chi^2 = 60.51$, $p < .001$; AS × Normal, $\chi^2 = 42.87$, $p < .001$). No other group differences reached significance.

A significantly smaller proportion of the responses given by the children with AS (2%) were Movement responses. In comparison, 15% of the transformations made by children with autism, 12.3% of the responses made by children with MLD, and 17.7% of those made by normally developing children were of this type (AS × Autism, $\chi^2 = 9.24$, $p < .005$; AS × MLD, $\chi^2 = 8.49$, $p < .005$; AS × Normal, $\chi^2 = 14.46$, $p < .005$).

Significantly fewer of the responses given by the children with AS (5.2%) and the children with autism (22.6%) were Imaginative responses. In comparison, 65.8% of the responses made by children with MLD and 48.4% of those made by normally developing children were of this type (Autism × MLD, $\chi^2 = 31.96$, $p < .001$; Autism × Normal, $\chi^2 = 11.28$, $p < .005$; AS × MLD, $\chi^2 = 53.92$, $p < .001$; AS × Normal, $\chi^2 = 97.24$, $p < .001$). The children with AS also produced significantly fewer imaginative responses than the children with autism (AS × Autism, $\chi^2 = 10.46$, $p < .005$).

Originality

The responses were scored for originality using standardized norms (Torrance, 1974). This was a measure of the statistical rarity of responses. The children with autism and AS produced significantly fewer statistically rare responses than did the control groups, $F(3, 55) = 14.108$, $p < .0001$. Subsequent Tukey analysis revealed that the autism and AS groups differed from the control groups at the .01 level. A significant group difference in terms of flexibility was also demonstrated, $F(3, 55) = 30.06$, $p < .0001$. Subsequent Tukey analysis revealed that the autism and AS groups differed from the control groups at the .01 level in producing responses from fewer categories (e.g., addition, movement, sound, color). See Table V.

Discussion

Experiment 2 investigated the responses of children with autism and AS on a standardized creativity test. Consistent with both the imagination deficit and executive function hypotheses, the results confirmed that the children with autism and AS showed less imaginative creativity, and they produced fewer responses overall. The tendency for the children with autism was to produce mainly manipulation type responses, and the children with AS to produce mainly addition/alteration responses. As a final test of these twin deficits, we carried out Experiment 3.

EXPERIMENT 3: IMAGINATIVE FLUENCY

Experiment 3 used a test of "imaginative fluency." This measure contrasts with three other measures of fluency that have been used in previous studies: (a) *verbal fluency* (naming as many words as you can beginning with a particular letter, in 1 minute); (b) *semantic fluency* (naming as many words as you can in a particular category, in a minute); and (c) *design fluency* (as shown in Experiment 1, above). These three measures of fluency are valid tests of executive function (Shal-

Table V. Mean Originality and Flexibility Scores in Experiment 2

	Originality score		Flexibility score	
Group	*M*	*SD*	*M*	*SD*
Autism	2.0	1.58	1.8	1.64
Asperger	3.2	2.68	3.4	1.67
MLD	8.4	3.13	6.8	1.92
Normal	10.0	3.0	6.8	2.17

lice, 1988) because they measure generativity, irrespective of content. From previous work, there is not always an autism-specific deficit on these measures (Rumsey & Hamberger, 1988; Scott & Baron-Cohen, 1996; and Experiment 2 above). However, imaginative fluency measures how many purely imaginative identities a person can attribute to an object.

To examine this ability, in Experiment 3 children were given a 3-D foam shape and asked what it could be. They were asked to generate as many responses as possible. As with the last Experiment, 3-D shapes were used rather than figures as it has been demonstrated that children find such tasks easier with a 3-D stimulus that they can manipulate (Tegano & Moran, 1989).

Participants

The same children as took part in Experiments 1 and 2 took part in this final experiment.

Method

The experimenter handed the child one of six foam shapes. Order of presentation was randomized and examples are shown in Figure 3. The experimenter said, "I want you to tell me lots of things that this could be. What does it look like? It can be anything you like." The intention behind the last statement was to indicate to the child that nonreal responses were acceptable, while avoiding terms such as "pretend," so as not to disadvantage the children with autism, who may not understand such terms (Tager-Flusberg, 1993). The experimenter noted all responses made by the child. No time restrictions were imposed.

Scoring

(a) The number of responses made, and (b) the type of responses made were recorded, in particular the number of *animate* responses made. This measure was taken (rather than attempting to rate responses on a scale of imagination), since saying an artifact could be animate clearly requires imagination—in reality it is impossible.

Results

Table VI shows mean scores on this task. When the number of responses made, excluding repetitions, was analyzed, a significant group effect was found, using ANOVA, $F(3, 56) = 14.38, p < .0001$. Subsequent Tukey analysis revealed that the autism and AS groups differed significantly from the control groups at the .01 level. The types of responses made are reported next.

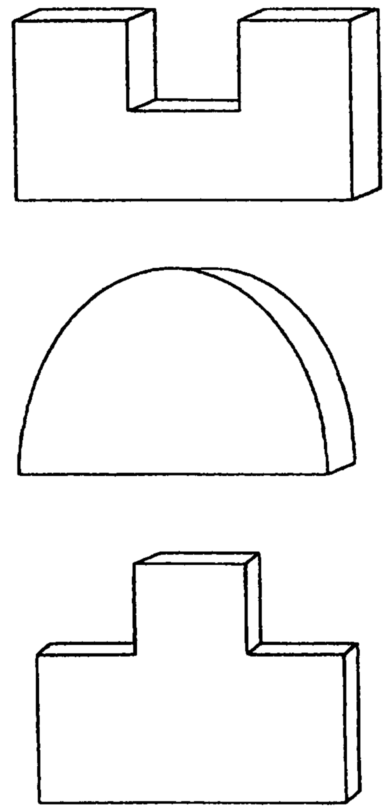

Fig. 3. Examples of foam shapes.

Response Types

When the type of responses made were examined, a significantly smaller percentage of children with autism (33.3%) produced any animate responses at all, whereas 100% of the children with MLD, and 100% of the normally developing children did (Autism × MLD, $\chi^2 = 15, p < .005$; Autism × Normal, $\chi^2 = 15, p < .005$). Also, a significantly small percentage of children with AS (53.3%) produced animate responses relative to the control groups (AS × MLD, $\chi^2 = 9.12, p < .005$; AS

Table VI. Mean Number of Responses Made in Experiment 3

Group	Number of responses *M*	*SD*
Autism	29.93	14.9
Asperger	27.4	13.0
MLD	52.0	13.42
Normal	48.46	16.36

× Normal, $\chi^2 = 9.12$, $p < .005$). No other group differences reached significance.

Discussion of Experiment 3

In this study, the children with autism and AS both produced fewer responses overall. When the types of responses made were examined, significantly fewer of the children with autism or AS produced any animate responses at all. The overall tendency of children in both of these clinical groups was to produce responses that were "real" inanimate things that the shapes closely resembled. In contrast, the control groups produced responses that were less determined by the shape (e.g., animate responses). These results suggest reduced overall fluency as well as reduced imaginative fluency in autism and AS.

GENERAL DISCUSSION

In this paper, three studies are reported which investigate the often described impoverished creativity in autism. Experiment 1, using a standardized measure of creativity (the Torrance Test) found deficits in children with autism and AS. The results of Experiment 1 are broadly in line with the executive dysfunction theory. In Experiment 2, using another Torrance test of creativity, the executive dysfunction and imagination deficit hypotheses were tested. Results supported both hypotheses, in finding that children with autism and AS could generate possible novel changes to an object, but they generated fewer such novel changes overall. Moreover, the novel changes tended to be reality-based rather than imaginative. Experiment 3 confirmed this disproportionate deficit on imaginative creativity using a test of imaginative fluency. Children with autism and AS exhibited reduced overall fluency, as well as generated fewer suggestions on the imaginative fluency measure. Specifically, they attributed animacy to foam shapes less often than controls, instead generating reality-based suggestions of what the shapes could be. Thus, although there is some evidence of executive dysfunction, this does not necessarily fully explain the additional difficulties they showed in imaginative creativity. These patterns were seen in both the children with AS as much as in the children with autism.

The results point to the importance of imagination in normal creativity and the role of imagination deficits in the impoverished creativity seen in autism and AS. But such findings still beg the question: What is causing the abnormalities in the functioning of the imagination? Indeed, what is an imagination deficit? The theory of mind hypothesis (see Baron-Cohen, 1995) might be relevant here. Thus, Leslie (1987) saw pretense as requiring the child's theory of mind, since the child has to represent its own or another person's mental attitude (of pretending) towards a proposition. Specifically, in the tasks above, rather than the child simply accessing representations of objects in memory that have some visual or semantic association with the stimulus (e.g., this pencil line resembles a lamp-post), the child instead represents "I can *pretend* that this line is anything (a rocket, a knife, a walking stick, a house for thin people, etc.)."

If this has any force, this suggests there may be important connections between creativity and theory of mind, via the imagination. It also implies that the deficits in social understanding and communication, which have been linked to a theory of mind abnormality, may turn out to also be connected to the problems in imagination and creativity. Whether this is the correct way to explain this pattern of results, merits further research.

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