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Creativity and imagination in autism and Asperger syndrome

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Abstract

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. Whilst this is evidence of executive dysfunction, this does not directly account for why imaginative creativity is more difficult than reality-based creativity.

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The diagnosis of autism includes a symptom that has received relatively little research attention: a lack of normal creativity (DSM-IV, 1994; ICD-10, 1994). Whilst aspects of the imagination deficit in autism have been investigated (Scott & Baron-Cohen, 1996), including a possible developmental precursor, pretend play (Baron-Cohen, 1987; Wing, Gould, Yeats & Brierly, 1977; Jarrold, Boucher & Smith, 1993), 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 coloured 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) emphasised 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 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, 1994). The second was a group of 15 children with Asperger Syndrome (AS). AS was defined following ICD-10 as meeting the criteria for autism but with no history of general cognitive or language delay[1]. Children in both of these 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 of 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 summarised in Table 1. The AS group was matched with the autism group on

[1] 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.

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.

insert Table 1 here

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 4 experiments reported here. In the following section, methods and results for each experiment are described in turn.

Experiment 1: Figure completion

This experiment utilised 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 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 ten incomplete figures or 'squiggles'. The figures are variable in that each is different (see Figure 1). The experimenter then used the same verbal instructions as with Condition 1.

insert Figure 1 here

Scoring

Torrance (1974) specifies 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 standardised norms). However, Heausler & Thompson (1988), after factor analysis, suggest that since these sub-scores 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 2. A repeated measures ANOVA showed an effect of condition ($F(1,56) = 4.08$, $p < 0.05$) and a significant group effect ($F(3, 56) = 19.31$, $p < .001$). In addition, a Group by Condition interaction was also significant ($F(3,56) = 19.3$, $p < 0.001$). Subsequent Tukey's analysis revealed that the autism and AS groups scored significantly lower than the other 2 groups in Condition 1 (at the 0.05 level). The autism group scored significantly lower than the AS group. In Condition 2, the autism group scored significantly lower than the 2 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.

insert Table 2 here

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, whilst 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 over-riding 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

In order 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 will 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, whilst the Scott & 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, whilst being unimpaired on measures of reality-based creativity. The generalised 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) standardised 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 3 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.

insert Table 3 here

Content analysis

The type of responses made were categorised into 4 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 4. All responses were categorised by 2 independent raters blind to the identity of individuals and the aims of

the study. Inter-rater agreement was 97%, and disagreements were resolved by discussion. When the types of responses given were analysed, 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 x MLD $\chi^2 = 90.07$, $p < 0.001$; Autism x Normal $\chi^2 = 62.09$, $p < 0.001$). 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 x MLD $\chi^2 = 41.72$, $p < 0.001$; AS x Normal $\chi^2 = 23.72$, $p < 0.001$.) The difference between the autism and AS groups was also significant (Autism x AS $\chi^2 = 8.21$, $p < 0.005$).

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 x autism $\chi^2 = 44.08$, $p < 0.001$; AS x MLD $\chi^2 = 60.51$, $p < 0.001$; AS x Normal $\chi^2 = 42.87$, $p < 0.001$). 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 x autism $\chi^2 = 9.24$, $p < 0.005$; AS x MLD $\chi^2 = 8.49$, $p < 0.005$; AS x Normal $\chi^2 = 14.46$, $p < 0.005$).

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 x MLD $\chi^2 = 31.96$, $p < 0.001$; Autism x Normal $\chi^2 = 11.28$, $p < 0.005$; AS x MLD $\chi^2 = 53.92$, $p < 0.001$; AS x Normal $\chi^2 = 97.24$, $p < 0.001$). The children with AS also produced significantly fewer imaginative responses than the children with autism (AS x autism $\chi^2 = 10.46$, $p < 0.005$).

insert Table 4 here

Originality

The responses were scored for originality using standardised 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, colour). See Table 5.

insert Table 5 here

Discussion

Experiment 2 investigated the responses of children with autism and AS on a standardised 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 3 other measures of fluency that have been used in previous studies: (1) verbal fluency (naming as many words as you can beginning with a particular letter, in one minute); (2) semantic fluency (naming as many words as you can in a particular category, in a minute); and (3) design fluency (as shown in Experiment 1, above). These 3 measures of fluency are valid tests of executive function (Shallice, 1988) because they measure generativity, irrespective of content. From previous work, there is not always an autism-specific deficit on these measures (Rumsey and Hamberger, 1988; Scott and Baron-Cohen, 1996; and Experiment 2 above). However, imaginative fluency measures how many purely imaginative identities a person can attribute to an object.

In order 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 and 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 6 foam shapes. Order of presentation was randomised and examples are shown in the Appendix. 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 non-real responses were acceptable, whilst 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 artefact could be animate clearly requires imagination - in reality it is impossible.

Results

Table 6 shows mean scores on this task. When the number of responses made, excluding repetitions, was analysed, 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.

Response types

When the type of responses made were examined, a significantly smaller percentage of children with autism (33.33%) produced any animate responses at all, whereas 100% of the children with MLD, and 100% of the normally developing children did (Autism x MLD $\chi^2 = 15$, $p < 0.005$; Autism x Normal $\chi^2 = 15$, $p < 0.005$). Also, a significantly small percentage of children with Asperger's Syndrome (53.33%) produced animate responses relative to the control groups (AS x MLD $\chi^2 = 9.12$, $p < 0.005$; AS x Normal $\chi^2 = 9.12$, $p < 0.005$;). No other group differences reached significance.

insert Table 6 here

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, 3 studies are reported which investigate the often described impoverished creativity in autism. Experiment 1, using a standardized measure of creativity (the Torrence 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 Torrence 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, whilst 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 Asperger Syndrome (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 pretence 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.

Table 1. Participants' Verbal Mental and Chronologial Ages (in years and months)

	Mean CA[2]		Mean Verbal MA[3] (sd)	
	X	**sd**	**X**	**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)	--	--

[2] CA = Chronological Age.
[3] MA = Mental Age.

Table 2: Mean creativity scores (and standard deviations) in Experiment 1

	Condition 1		Condition 2	
	X	**sd**	**X**	**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)

Table 3: Mean number of category changes (and standard deviations) in Experiment 2

	X	sd
Autism	3.93	(3.58)
Asperger	6.86	(4.27)
MLD	12.86	(3.56)
Normal	13.25	(4.85)

Table 4: Percentage of responses in each category, in Experiment 2.

Groups	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%

Table 5: Mean originality and flexibility scores (and standard deviations) in Experiment 3

	Originality score		Flexibility score	
	X	**sd**	**X**	**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)

Table 6: Mean number of responses made in Experiment 3

	Number of responses X sd	
Autism	29.93	(14.9)
Asperger	27.4	(13.0)
MLD	52.0	(13.42)
Normal	48.46	(16.36)

Figure Legends

Figure 1A: Stimuli for Condition 1, Experiment 1; Figure 1B: Stimuli for Condition 2, Experiment 1

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