

Divergent Thinking and Shape Collections in Developmental Age

Maria Elvira DE CAROLI, Orazio LICCIARDELLO, Elisabetta SAGONE

Department of Educational Processes - University of Catania (Italy)

Abstract

Aim of investigation: to verify if creative performances, studied through evaluation of factors of creativity, have been influenced by the production of “shape collections” (Piaget, 1936). Participants: 48 Italian pupils from 6 to 8 years of age. Materials: Test of Divergent Thinking (Williams, 1994) and Logical Operations (task no.13) (Vianello and Marin, 1991). Results: Creative performances have been influenced by ability to produce shape collections, overall for older pupils. Originality, elaboration, and production of titles have been affected by this cognitive competence developed in older pupils. Future research could deepen the role of cognitive development -in terms of quality of thinking- in relation to the divergent thinking.

Keywords: Shape collections, creativity, elaboration, originality

1. Introduction

In recent literature focused on the cognitive aspects of creativity, a reduced attention has been given to relationship between divergent thinking and specific cognitive operations of classification, the so-called “shape collections”, produced in developmental age and analyzed by Piaget (1936).

The shape collections were considered as “creations of a figure whose parts are connected to each other not only for the presence of one or more common characteristics, but also for simple relations of spatial proximity” (see Petter, 1961, 241). Children realize a shape collection with empirical meaning, creating, for example, a house consisted of a triangular roof, two square windows, and a rectangular door, from to 4 geometric shapes (one triangle, two squares, and one rectangle). These performances were analyzed by Piaget in terms of capacity of classification, but it is possible to think of them as products of the ability to reorganize the stimuli using the factor of originality studied as one of the most important factors of creativity (Guilford, 1950, 1968; Torrance, 1962).

The aim of the current study has been focused on the relation between creativity according to Williams’ model and the ability to elaborate “shape collections”, as it was studied by Piaget. With reference to the first, the Williams’ factor model analyzed five factors identified as representative of cognitive aspects of creativity:

- a) “*fluency*”, i.e. the capacity to produce a large number of ideas and generate meaningful responses; this capacity was investigated in previous studies by Guilford (1950) and Torrance (1962) through the following tasks: “use a brick”, “name all the things of square or circle form”, “how a ‘potato’ and ‘carrot’ are alike”;
- b) “*flexibility*”, i.e. the ability to change ideas passing from one category to another; the researchers analyzed this ability using the tasks of “brick uses” and “product improvement” (Guilford, 1950; Torrance, 1974; Runco, 1991, 2007; in Italy, Antonietti, and Cerioli, 1991);

- c) “*originality*”, i.e. the capacity to produce rare, infrequent, and unfamiliar ideas; Guilford (1950), Wallach and Kogan (1965), and Torrance (1974, 2002) explored this ability with the following tasks, “word building and symbol production”, “mosaic construction”, “inkblot”, “production of rhymes”, “gestalt completion”, and “unusual uses”;
- d) “*elaboration*”, i.e. the ability to develop, embellish and enrich ideas with details; this ability was analyzed by the researchers using “block constructions”, “imaginary situations”, “incomplete figures and shape test”, “invention of stories”, and “analogies” (Torrance, 1962; in Italy, Antonietti and Cerioli, 1991);
- e) and, finally, “*production of titles*”, i.e. the verbal ability to generate new and original ideas.

Williams’ model has been widely used in the Italian context with subjects in developmental age and in relation to other psychological processes (psychological androgyny: De Caroli, Licciardello, and Sagone, 2008; personality traits: De Caroli and Sagone, 2009; flexibility on gender stereotypes: De Caroli and Sagone, 2009; disability: De Caroli and Sagone, 2010) and so on. With reference to disabled pupils, the authors analyzed the relationship between creative performances and learning disability, in particular, with the aim to compare children with learning disability and children with typical development, balanced for the same cognitive level (pre-operational, intermediate, and concrete operational levels). The Italian version of Test of Divergent Thinking (Williams, 1994) and Logical Operations Tasks (Vianello and Marin, 1991) were used to measure the cognitive levels of children in areas of seriation, numeration, and classification. Results partially supported the hypotheses: at the pre-operational and concrete operational cognitive level, learning disabled children scored lower on flexibility, originality, elaboration, and production of titles than children with typical development.

After the last investigation, we have been interested in deepening of the role of “shape collections”, realized in cognitive tasks of classification, in creative performance produced by Sicilian pupils, and this represents the aim of the current research.

2. Research objectives

We have analyzed if creative performances, studied by means of evaluation of factors of creativity, have been influenced by the production of the so-called “shape collections” realized by pupils (Piaget, 1936). Differences for sex and age groups have been analyzed.

3. Methodology

3.1. Participants

The sample was made up of 48 Italian pupils aged from 6 to 8 (divided in two age groups: 6 yr., 0 mo. to 6 yr., 11 mo.; 7 yr., 0 mo. to 8 yr., 0 mo.). Participants have randomly been chosen among all students attending State elementary schools in Catania (26 boys and 22 girls). Parental consent was obtained prior to each child’s participation at this study.

3.2. Materials

The materials have individually been administered to pupils and were made up of the Italian version of the Test of Divergent Thinking (Williams, 1994) and Piagetian tasks proposed in Logical Operations tasks (Vianello and Marin, 1991).

3.2.1. Test of Divergent Thinking

The Test of Divergent Thinking (Williams, 1969, 1994) was made up of a paper-pencil protocol with 12 frames containing incomplete graphic stimuli from which pupils were

invited to draw a picture for 25 minutes. Five scores were identified as indicators of creative thinking: fluency, flexibility, originality, elaboration, and production of titles.

According to the Manual, the fluency score is the number of meaningful pictures produced by participants (range 1-12 points). The flexibility score is the number of changes of pictures from one category to a different one (range 1-11 points). The originality score is the number of pictures drawn inside or outside each stimulus placed in the frames (range 1-36 points). The elaboration score is the number of asymmetric pictures realized by participants (range 1-36 points). Finally, the production of titles score is the sum of points assigned to each title produced by children (range 1-36 points).

3.2.2. Logical Operations Tasks

The Logical Operations Tasks, proposed by Vianello and Marin (1991), analyzed the cognitive level of pupils by means of 18 tasks, divided into three areas which included, respectively, 6 tasks of seriation, 6 tasks of numeration, and 6 tasks of classification. In each area, the tasks were proposed to participants in order to increase difficulty. In the present study, we only use one of the 6 tasks of classification focused on the construction of the “shape collections” (task no.13), that consisted of the following materials: eight shapes consisted of two red circles, two blue circles, two red squares, and two blue squares (for each pairs, respectively, size: 8cm and 4cm). In this task pupils have been invited to put together the shapes that were similar”; for example, the fulfilment of a toy train with all eight shapes offered to pupils was a “shape collection”.

3.3. Data analysis

Data analyses were carried out with software SPSS 15.0 for Windows (*Statistical Package for Social Science*), using the following tests: t Student, correlations (Pearson’s *r*) and linear regressions. We have divided pupils in two balanced groups according to the fulfilment of shape collections: Group I (24 pupils for YES-collections) and Groups II (24 pupils for NO-collections).

4. Results

4.1. Factors of creativity

After comparing normative scores for each factor of creativity (Figure 1; Table I), participants have obtained scores above the mid-range in fluency ($M=11,4$, $SD=1,1$) and flexibility ($M=7,7$, $SD=2,0$); at the mid-range in originality ($M=23,8$, $SD=5,5$); below the mid-range in elaboration ($M=13,3$, $SD=6,2$), and production of titles ($M=16,7$, $SD=5,7$). This result has shown that pupils were more able to produce a large number of different ideas and to change mental set; on the contrary, they were less able to embellish the ideas and to produce creative titles.

Fig.1 - Comparison between sample performances and normative trend

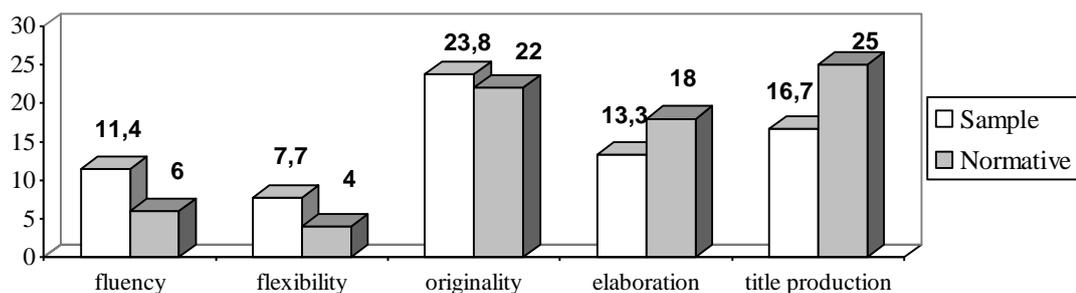


Table I	Scores of creativity	Normative scores for each factor				
		FLU	FLE	ORIG	ELAB	TITLE
I – II – III classes	Talented	9	6	27	24	30
	Above Mid-range	7	5	26	21	26
	Mid-range	6	4	22	18	25
	Below Mid-range	5	3	15	13	22

Pearson product-moment correlations among the factors of creativity have been analyzed (Table II): fluency was positively correlated with flexibility ($r=.38, p=.007$), originality ($r=.38, p=.007$), and production of titles ($r=.42, p=.003$); originality was correlated with elaboration ($r=.71, p<.001$) and production of titles ($r=.42, p=.003$); and, finally, elaboration was positively correlated with production of titles ($r=.37, p=.009$). No significant differences for sex and age groups have been found.

Factors	fluency	flexibility	originality	elaboration	title production
flexibility	.38(**)				
originality	.38(**)	.07			
elaboration	.21	.16	.71(**)		
Title production	.42(**)	.21	.42(**)	.37(**)	
Total creativity	.50(**)	.32(*)	.84(**)	.84(**)	.73(**)

Significance Levels: * $p<.05$; ** $p<.001$

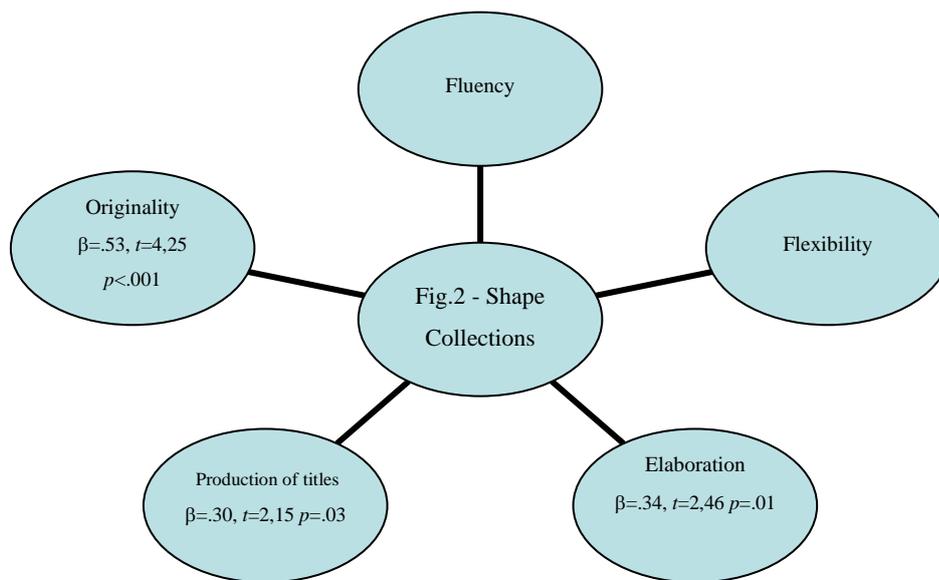
4.2. Factors of creativity and shape collections

Statistical analyses carried out dividing the sample into two sub-groups (YES-collections and NO-collections) have shown that the first were more creative than the latter and, in particular, the first have obtained higher scores in the factors of originality, elaboration, and production of titles than the latter (Table III).

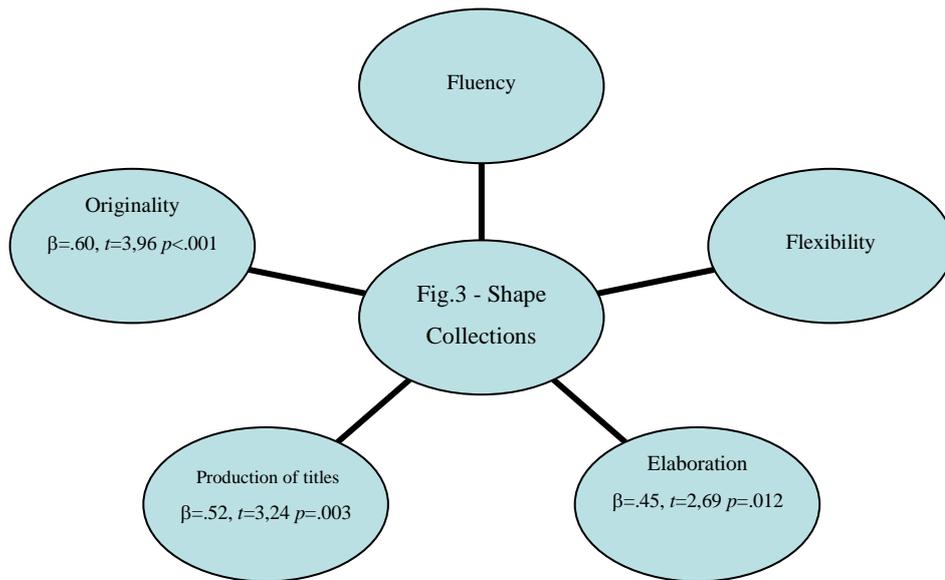
Significant relations between the factors of creativity and shape collections have been found (total creativity: $\beta=.43, t=3,24, p=.002$); the deepening by means of linear regressions showed that originality ($\beta=.53, t=4,25, p<.001$), elaboration ($\beta=.34, t=2,46, p=.01$), and production of titles ($\beta=.30, t=2,15, p=.03$) were affected by the capacity to produce shape collections (Figure 2). The greater was the capacity to realize shape collections the greater were the abilities to produce rare, infrequent, and unfamiliar ideas, to develop, embellish and enrich ideas with details, and to generate verbally new ideas.

Table III – Differences in shape collections and factors of creativity					
Factors of creativity	Group Shape Collections	N	Mean	SD	t Student
fluency	YES	24	11,5	0,8	ns
	NO	24	11,2	1,3	
flexibility	YES	24	7,4	2,3	ns
	NO	24	8,1	1,6	
originality	YES	24	26,7	5,4	4,25*
	NO	24	20,9	4,0	
elaboration	YES	24	15,5	6,7	2,46**
	NO	24	11,2	5,1	
title production	YES	24	18,5	6,1	2,15**
	NO	24	15,1	4,9	
total creativity	YES	24	79,6	15,9	3,24*
	NO	24	66,5	11,7	

Significance Levels: * $p < .001$; ** $p < .05$



This result was affected by age group (Figure 3): linear regressions showed that, only at the 7-8 years of age, originality ($\beta=.60$, $t=3,96$, $p<.001$), elaboration ($\beta=.45$, $t=2,69$, $p=.012$), and production of titles ($\beta=.52$, $t=3,24$, $p=.003$) were influenced by the capacity to produce shape collections. This datum could be explained with the greater capacity to produce shape collections developed by the older pupils than the younger ones.



Conclusion

The current investigation was focused on the hypothesis that creative performances, studied by means of evaluation of factors of creativity, according to Williams' model, were influenced by the production of shape collections, analyzed with reference to Piaget' perspective. As noted, the creative performances were influenced by ability to produce shape collections, overall for older pupils. In particular, originality, elaboration, and production of titles were affected by this cognitive competence developed in older pupils.

For the educational intervention in school context, useful to improve the divergent thinking, the authors believe that it is very important to address curricular programs in every subject towards the precocious development of cognitive abilities to produce the shape collections, using different tasks, i.e. the construction of puzzles, of songs starting by single notes, and of words from single letters.

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