MENTAL SYNTHESIS AND CREATIVE THINKING IN CHILDREN WITH SOCIO-CULTURAL DISADVANTAGE IN LEARNING PROCESSES

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Abstract - The aim of this study was to analyze the influence of mental synthesis on creativity in 60 Italian children (aged 8-12) with socio-cultural disadvantages and to verify the differences on mental synthesis and creative performances between children with socio-cultural disadvantages and children without these disadvantages, randomly chosen from classes of State Primary Schools in Catania, Italy. The Creative Mental Synthesis task (Antonietti, 1999) and the Test of Creative Thinking (Williams, 1994) were used (rotation, dimension, superimposition, and inclusion) (fluency, flexibility, originality, and elaboration). The results showed that the more children with socio-cultural disadvantages were able in superimposition of visual forms, the better they performed in originality and elaboration but not in flexibility; they were less able in mental synthesis and, specifically, in rotation, dimension, and inclusion of visual forms than control group. No significant differences for creative performances were found between the two groups. The present investigation suggests the necessity to deepen the effects of mental imagery on creative thinking and to realize school programs specialized on strategies for strengthening the processes related to mental imagery in children with socio-cultural disadvantages.

Key words: Creative thinking, socio-cultural disadvantages, mental synthesis tasks.

1. INTRODUCTION

Mental imagery and creativity are considered two important psychological dimensions in the cognitive processes and in everyday life. According to the classic definition proposed by Finke, mental imagery is "the mental invention or recreation of an experience that in at least some respects resembles the experience of actually perceiving an object or an event, either in conjunction with, or in absence of, direct sensory stimulation" (Finke, 1989, 2). Also, Stevick (1996) defines mental imagery as "a composite that we perceive (more or less vividly) as a result of the interaction between what we have in storage and what is going on at the moment" (1996, 16).

Mental imagery includes different dimensions as mental rotation and transformation, scanning, visual images, and mental synthesis. With reference to the last aspect, it has been referred to "a process by which an individual mentally manipulates and transforms visual mental images in order to produce new configurations or to discover novel emergent properties" (Pearson and Logie, 2004, 183) and, more recently, it has been considered as "an active voluntary process of synthesizing a never-before-seen image from several images generated from memory" (Vyshedskiy, 2008, 23).

Mental synthesis has been included in the *Geneplore Model*, elaborated by Finke and his colleagues (1992) and it has been defined as a component of the generative process of cognitive structures, which included several dimensions, such as memory retrieval and visualization (Smith, 1995; Ward, 1995; Sternberg and Lubart, 1991), association (Mednick, 1962), and mental and physical transformation or rotation (Shepard and Meltzer, 1971; Marmor, 1977; Finke, 1989; Vederhus and Krekling, 1996). In *Geneplore Model*, the authors reported that, in the generative phase of creative process, persons construct the preinventive structures containing a variety of emergent characteristics; these are useful to support the creative discovery in the exploratory phase, in which individuals understand the initial mental representations in meaningful ways (Finke, 1992). If initial exploration produced a satisfactory solution, the preinventive structures (that is, internal precursors to the externalized creative products, linked to the ability of creative visualization which is different from the arbitrary interpretation of forms in a creative way) may lead directly to creative product. As reported by Finke, "people can mentally synthesize simple visual forms to make unexpected and creative discoveries" (1992, 15). According to this perspective, one can often discover properties in an image that one was not aware of at the time the image was initially formed (Pinker and Finke, 1980; Roskos-Ewoldsen, Intons-Peterson, and Anderson, 1993).

An example of this process is the discovery of emergent features in mentally synthesized forms: it has been empirically studied by Finke and Slayton (1988), Finke, Pinker, and Farah (1989), and recently used also by Durling (2003) with designers, Kokotovich and Purcell (2000) with design and law students, and by Heylighen et al. (2007) with architecture students. The authors demonstrated that subjects can often take into consideration simple patterns such as letters, numbers, and geometric forms, and imagine to combine them in novel ways, and then discover creative patterns and symbols that result from their combinations. In a typical experiment (Finke, 1989), subjects were given three of object parts, which were selected at random and designated by name. The subjects were instructed to imagine combining the parts to make an interesting form. They could vary the size, position, and orientation of any part and combine them in any way. The subjects were given the name of a general object category (e.g. toys and games, transportation) and were asked to try to interpret the created forms as representing some kind of practical object belonging to that category. They described their products and these were rated both for originality and practicality.

Mental synthesis can be considered a relevant part of creative processes studied in terms of divergent thinking (Guilford, 1950) involved in cognition. According to Guilford, creativity was an individual characteristic associated with novel ideas which may emerge in the form of

tangible products and within the frame of reference of the thinking person. Torrance (1959) believed that it was a process of becoming sensitive to problems, gaps in knowledge, missing elements, and disharmonies. The author elaborated the following factors of creativity: *fluency*, *flexibility*, *originality*, *elaboration*, *resistance to premature closure*, and *abstractness of ideas*. *Fluency* was referred to the ability to produce various ideas concerning the solutions to problems; *flexibility* was related to the capacity to adapt oneself to a change and to use a variety of approaches; *originality* was the ability to generate unfamiliar responses and unconventional associations; *elaboration* was the capacity to redefine and reorganize in new ways what one sees and to transform something well known into a new context; *resistance to premature closure* was the ability to keep an 'open mind' while processing the information and, finally, *abstractness of ideas* was considered the capacity to synthesize processes of thinking.
The framework chosen in the present study for the analysis of creative thinking is focused on Williams' Model (1966; 1970), that integrated the affective aspects of creativity (willingness to take risks, imagination, curiosity, and complexity) with cognitive ones (fluency, flexibility, originality, and elaboration). The set of four cognitive factors consisted of *fluency*, related to the generation of a large number of ideas and production of meaningful responses; *flexibility*, connected to changing ideas passing from one category to a different one; *originality*, linked to the capacity to produce rare and infrequent ideas, and *elaboration*, that is the capacity to develop, embellish, and enrich ideas with details.

1.1 Mental synthesis and creativity

Several studies have investigated on the relationship between mental imagery and creativity in high school students and adults, indicating that the imaging ability (i.e., vividness of visual imagery and mental synthesis) has significant positive effects on problem-solving and factors of creativity, such as fluency, originality, and elaboration (Schmeidler, 1965; Khatena, 1984; Parrot and Strongman, 1985; Finke and Slayton, 1988; Finke et al., 1992; Daniels, 1995; Drake, 1996; González et al., 1997; Kokotovich and Purcell, 2000; LeBoutillier and Marks, 2003). For example, Schmeidler (1965) showed a significant correlation between mental images and creativity: according this author, good imagers tended to have high scores in creativity tasks, while poor imagers had either high or low scores on those tasks, suggesting that mental imagery is an important way to creativity. Forisha (1981) investigated the relationship between vividness and control of imagery and figural and verbal creativity in psychology students. González, Campos, and Pérez (1997) studied the influence of imagery on fluency, originality, elaboration, and resistance to premature closure in high school students. Little evidences of these relations were found in children (e.g. Campos and Pérez, 1989) and this constituted the focus of current study, carried out with children attending to at risk school context and characterized by difficulties in learning processes in relation to environmental variables (desegregated family, low levels of participation to school projects, etc.).

2. Method

2.1 Hypotheses

The aim of the present study was to explore the relationship between mental synthesis and creativity and to verify the differences for sex and age both in mental synthesis and creative performances in socio-culturally disadvantaged children compared to control group in Italian school context. In detail, we predicted that socio-culturally disadvantaged children (at risk) would obtain lower scores on mental synthesis and creative performance than control group (no at risk).

2.2 Sample

The sample consisted of 60 Italian children aged 8-11 (I group: range 8 yrs. to 8 yrs-11 mo.; II group: 9 yrs. to 9 yrs-11 mo.; III group: 10 yrs-0 mo. to 11 yrs.) and divided in two groups, balanced for sex, 30 children with socio-cultural disadvantages (Gr-A) and 30 children without these disadvantages (Gr-B) as control group.

Both the groups were randomly chosen from all classes of State Primary Schools in Eastern Sicily (Italy). Parent consent was requested and obtained prior to each child's participation.

2.3 Materials and procedure

The Creative Mental Synthesis task in the Italian version developed by Antonietti (1999) was used to analyze the mental synthesis of visualized forms and the Test of Creative Thinking by Williams (1994) was used to explore fluency, flexibility, elaboration, and originality. Each task was individually administered to children during school time and in a room specifically set aside for the study.

2.3.1 Creative Mental Synthesis task

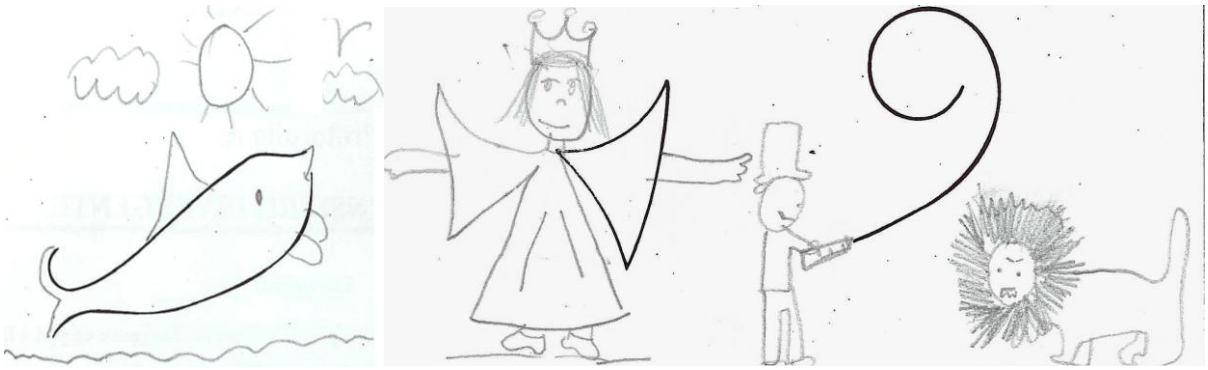
The Creative Mental Synthesis task consisted of a paper-pencil protocol with three stimuli, "**V**" (capital letter V), "□" (square), and "**O**" (circle). Each child was instructed to imagine combining the stimuli to make meaningful objects and was allowed to imagine the stimuli in any size and to combine them in anyway; subjects should not alter or modify the shape of the stimuli. Four scores used to measure the capacity to mental synthesis were computed: 1) rotation; 2) dimension; 3) superimposition; 4) inclusion. The "rotation" score was the total number of rotations applied to the stimuli or parts of them. The "dimension" score was the total number of reduction or enlargement applied to the size of each stimulus. The "superimposition" score was the total number of superimposition of one or two stimuli on the remaining one until to cover a part of the same. The "inclusion" score was the total number of stimuli enclosed into each other.

2.3.2 Test of Creative Thinking

The Test of Creative Thinking was made up of a protocol with 12 frames, containing incomplete graphic stimuli shown to children who were asked to draw a picture. It was used to assess the mean scores of fluency, flexibility, originality, and elaboration.

The "fluency" score was the total number of meaningful pictures created by children (range from 1 to 12 points). The "flexibility" score was the number of changes of ideas from one category to a different one (range from 1 to 11 points). The "originality" score was the total number of pictures drawn inside or outside each incomplete stimulus placed in the frames (range from 1 to 36 points); one point was assigned to each picture drawn outside the stimuli, two points to each picture drawn inside the stimuli, and three points to each picture drawn both inside and outside the incomplete stimuli. The "elaboration" score was the number of asymmetric pictures drawn by children (range from 1 to 36 points): zero points were assigned to the symmetrical pictures, one point to the asymmetric pictures drawn outside the incomplete stimuli, two points to the asymmetric pictures inside the incomplete stimuli, and three points to the asymmetric pictures drawn both inside and outside the stimuli.

Three examples of completed frames by children are reported in the subsequent boxes.



2.4 Data analyses

Statistical analyses were carried out by using SPSS Version 15.0 (Statistical Package for Social Science), with t-test and linear correlations to investigate the differences between control group (no at risk) and socio-cultural disadvantaged children (at risk) both in creative performance and in mental synthesis abilities.

The type of group, sex and age-groups were considered as independent variables and scores obtained in creative and mental synthesis performance as dependent variables.

3. Results

3.1 Mental synthesis

T-tests for type of groups indicated significant differences on rotation, dimension, and inclusion of visual forms between the two groups. As shown in Table I, socio-culturally disadvantaged children were less able in mental synthesis than control group, with exception of the superimposition.

Table I – Comparison between two groups on mental synthesis task

Mental synthesis	Group	N	M	SD	t-test	Sig.
rotation	Gr-B	30	2,33	1,4	**2,58**	**.012**
	Gr-A	30	**1,50**	1,1		
dimension	Gr-B	30	2,37	1,5	**3,60**	**.001**
	Gr-A	30	**1,27**	0,7		
superimposition	Gr-B	30	,40	0,7	-,18	ns
	Gr-A	30	,43	0,7		
inclusion	Gr-B	30	2,13	1,6	**3,83**	**<.001**
	Gr-A	30	**,93**	0,6		

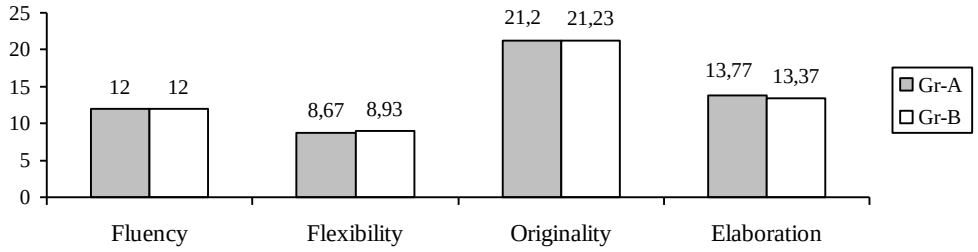
Note: Gr-A (socio-culturally disadvantage children); Gr-B (control group)

No significant differences for sex and age-groups of children in mental synthesis were found. Correlations among elements of mental synthesis were separately analyzed in both groups. For Gr-A, the more children scored high on dimension, the more they were able on superimposition (r=,74, p<.001); for Gr-B, the more children scored high on rotation, the more they were able on dimension (r=,53, p=.002) and the more children scored high on dimension, the more they were competent on inclusion (r=,67, p<.001).

3.2 Factors of creativity

Descriptive analyses for each factor of creativity were reported in fig.1 for Gr-A and for Gr-B. No significant differences for creativity were found between the two groups in sense that socio-culturally disadvantage children obtained the same mean scores of the others.

Fig.1 - Mean scores of factors of creativity - Type of group



Also in this case, correlations among factors of creativity were analyzed separately in the two groups, showing in both groups that the more children scored high on originality, the more they were able on elaboration (Gr-A: r=,63, p<.001; Gr-B: r=,67, p<.001). No differences for sex and age in creativity were noted.

3.3 Relation between mental synthesis and creativity

Linear correlations were carried out between mental synthesis and factors of creativity scores. The results showed that the more children with socio-cultural disadvantages were able in superimposition of visual forms, the more they performed high on originality (r=,42, p=.022) and elaboration (r=,43, p=.019), and low on flexibility (r=-,40, p=.027).

4. Discussion and Conclusion

The findings of the present research highlighted that socio-culturally disadvantaged children were less able in mental synthesis than control group, with exception of the superimposition; in fact, they showed more difficulties in mental processing and visual transformations of stimuli than other children. Instead, they reached the same levels in the production of creative thinking achieved by children without these disadvantages linked to environmental variables. Sex and age-groups didn't affect on mental synthesis and creativity performance in both groups.

The present investigation suggests the necessity to deepen the effects of mental imagery on creative thinking and to realize specialized school programs on strategies for strengthening the processes related to mental imagery in children with socio-cultural disadvantages.

References

Antonietti, A. (1999). Stimolare la scoperta cognitiva attraverso la visualizzazione mentale. In S. Di Nuovo (1999). *Mente e Immaginazione* (pp.173-195). Milano: Franco Angeli.

Campos, A., Pérez M.J. (1989). High and Low Imagers and Their Scores on Creativity. *Perceptual and Motor Skills*, 68, 403-406.

Daniels, S. R. (1995). Images of creativity: The relationship of imagery, everyday cognition, and creative potential among high school students with exceptional abilities in the arts and sciences. *Dissertation Abstracts International*, 56(5), 1708.

Drake, S. M. (1996). Guided imagery and education: Theory, practice and experience. *Journal of Mental Imagery*, 18(1-2).

Durling, D. (2003). Horse or cart? Designer creativity and personality, *Proceedings of Fifth European Academy of Design Conference*. Barcelona, Spain, pp.1-11.

Finke, R.A. (1989). *Principles of Mental Imagery*. Cambridge, MA: The MIT Press.
Finke, R.A., Pinker, S., and Farah, M.J. (1989). Reinterpreting visual patterns in mental imagery, *Cognitive Science*, 13, 51-78.
Finke, R.A., Slayton, K. (1988). Explorations of Creative Visual Synthesis in Mental Imagery. *Memory and Cognition*, 16, 252-257.
Finke, R.A., Ward, T.B., and Smith, S.M. (1992). *Creative Cognition. Theory, Research, and Application*. Cambridge, MA: The MIT Press.
González, M.A., Campos, A. and Pérez, M.J. (1997). Mental Imagery and Creative Thinking. *The Journal of Psychology*: *Interdisciplinary and Applied*, 131(4), 357-364.
Guilford, J.P. (1950). Creativity. *American Psychologist*, 5(1), 444-454.
Heylighen, A., Deisz, P., and Verstijnen I.M. (2007). Less is more original?. *Design Studies*, 28(5), 499-512.
Khatena, J. (1984). *Imagery and creative imagination*. Buffalo, NY: Bearly Limited.
Kokotovich, V., Purcell, T. (2000). Mental Synthesis and Creativity in Design: An Experimental Examination. *Design Studies*, 21(5), 437-449.
LeBoutillier, N., Marks, D.F. (2003), Mental imagery and creativity: A meta-analytic review study. *British Journal of Psychology*, 94(1), 29-44.
Marmor, G.S. (1977). Mental rotation and number conservation: are they related?. *Developmental Psychology*, 13, 320-325.
Mednick, S.A. (1962). The Associative Basis of the Creative Process. *Psychological Review*, 69(3), 220-232.
Parrot, C.A., Strongman, K.T. (1985). Utilization of visual imagery in creative performance. *Journal of Mental Imagery*, 9, 53-66.
Pearson, D.G., Logie, R.H. (2004). Effects of Stimulus Modality and Working Memory Load on Mental Synthesis Performance. *Imagination, Cognition and Personality*, 23, 183-191.
Pinker, S., Finke, R.A. (1980). Emergent Two-Dimensional Patterns in Images Rotated in Depth. *Journal of Experimental Psychology*: *Human Perception and Performance*, 6, 244-264.
Roskos-Ewoldsen, B., Intons-Peterson, M.J., and Anderson, R.E. (1993). *Imagery, Creativity, and Discovery: A Cognitive Perspective*. Amsterdam: Elsevier.
Schmeidler, G.R. (1965). Visual imagery correlated to a measure of creativity. *Journal of Consulting Psychology*, 29, 78-80.
Shepard, R.N., Meltzer J. (1971). Mental rotation of three-dimensional objects. *Science*, 171, 701-703.
Smith, S.M. (1995). Fixation, incubation, and insight in memory and creative thinking. In S.M. Smith, T.B. Ward, and R.A. Finke (eds.), *The Creative Cognition Approach* (pp.135-156). Cambridge, MA: The MIT Press.
Sternberg, R.J., Lubart, T.I. (1991). An Investment Theory of Creativity and Its Development. *Human Development*, 34(1), 1-31.
Stevick, E.W. (1996). *Memory, Meaning & Method*. Rowley, MA: Newbury House.
Torrance, E. P. (1959). *Explorations in Creative Thinking in the Early School Years: VI. Highly Intelligent and Highly Creative Children in a Laboratory School*. Minneapolis: Bureau of Educational Research, University of Minnesota.
Vederhus, L., Krekling, S. (1996). Sex Differences in Visual Spatial Ability in 9-year-old children. *Intelligence*, 23, 33-43.
Vyshedskiy, A. (2008). *On the Origin of the Human Mind*. Canada: Mobile Reference.
Ward, T.B. (1995). What's Old about New Ideas?. In S.M. Smith, T.B. Ward, and R.A. Finke (eds.), *The Creative Cognition Approach* (pp.157-178). Cambridge, MA: The MIT Press.
Williams, F.E. (1966). *Seminar on Productive Thinking in Education*. Saint Paul, Minnesota: Creativity Project, Macalester College.

Williams, F.E. (1970). *Classroom Ideas for Encouraging Thinking and Feeling*. Buffalo, NY: D.O.K. Publisher.
Williams, F.E. (1994)(ed. it.). *Test della creatività e del pensiero divergente*. Trento: Centro Studi Erickson.

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