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The relationship between emotion comprehension and mental synthesis in developmental age

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Abstract

The purpose of this study was to explore the relationship between emotion understanding and mental synthesis in a group of Italian children (6-11 years), using the Test of Emotion Comprehension (Albanese & Molina, 2008) and Creative Mental Synthesis Task (Antonietti, 1999). Results showed that emotion understanding and mental synthesis ability increased with age and that there was a reciprocal relationship between the two processes. Future investigations could be carried out in order to analyze the presence of this relationship in preschoolers.

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1. Introduction

The scientific debate in psychological and developmental research about the correlation between cognition and emotions is still open and suggests the necessity to clarify whether the first process has effects on the latter or vice versa. For example, in relation to one of the most important cognitive abilities such as the theory of mind, as recently reported by O'Brien et al. (2011), the understanding of emotions comes “on line” early during development and informs children’s understanding of others’ thinking; on the contrary, as verified by Harwood and Farrar (2006), the basic understanding of others’ mind allows children to learn emotion comprehension. A third alternative, suggested by Cutting and Dunn (1999), states that emotion comprehension and mentalistic competence are separate aspects of the children’s social-cognitive skills. On the one hand, with reference to cognition, we decided to investigate one of several abilities linked to mental imagery, that is, mental synthesis in developmental age; on the other hand, in relation to emotions, we chose to analyze the components of emotion understanding according to Pons’ perspective (2004).

1.1. Mental synthesis

Mental synthesis was defined by Finke (1990) as “the invention or recreation of an experience that, at least in some respects, resembles the experience of actually perceiving an object or an event, either in conjunction with, or in absence of, direct sensory stimulation”. Specifically, mental synthesis refers to a process by which an individual mentally manipulates and transforms visual mental images in order to produce new configurations and it has been

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considered part of the creative process of thinking, the “generative process of cognitive structures”, which included memory retrieval and visualization (Smith, 1995; Ward, 1995), association, mental and physical transformation or rotation (Mednick, 1962; Finke, 1990), and so on. As reported by Finke, Ward and Smith (1992), people can mentally synthesize simple visual forms to make unexpected and creative discoveries. According to this perspective, one can often discover in an image properties that one was not aware of at the time the image was initially formed.

An example of this process is the discovery of emergent features in mentally synthesized forms. Finke and Slayton (1988) proposed that subjects can often take into consideration letters, numbers, and geometric forms, and imagine combining them in novel ways, and then discover creative patterns and symbols that result from their combination. In this respect, Finke (1990) used a procedure similar to previous ones in order to discover creative inventions through the mental synthesis of visualized forms. Subjects were given three parts of an object, 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. They described their inventions and these were rated both for originality and practicality.

The experimental paradigm of Finke has been recently used in Italian children by De Caroli and Sagone (2010) in the Italian adaptation proposed by Antonietti (1999).

1.2. Emotion comprehension

Emotion comprehension is considered a central component of children’s socio-emotional competence (Denham, 1998), theory of mind (O’Brien et al., 2011), prosocial behaviour (Denham, 1986) from infancy to adolescence (Denham & Couchoud, 1990; Dunn, 2000; Hughes & Dunn, 1998). During the infancy, children increasingly show to understand that certain situations evoke particular emotions, facial expressions are related to particular emotions, and emotions influence others’ behaviour (Bartsch & Wellman, 1995; Brown & Dunn, 1991; Harris, 1994; Lagattuta, Wellman, & Flavell, 1997).

In Pons, Harris and de Rosnay’s model (2004), emotion comprehension develops through three hierarchical phases from 3 to 10 years. In the first phase, called “external level”, children start to acquire the initial components of emotion understanding: recognition of the basic facial expressions (happiness, sadness, fear, and anger), influence of external circumstances on emotions (e.g., receiving a gift is linked to the happiness), and understanding of the role of desire in emotions. In the second phase, named “mental level”, children develop the mastery of the role of beliefs in emotions, the impact of reminders, and the discrepancy between felt and externally expressed emotions; they understand that individuals can internally experience emotions that differ from those they intentionally display (Harris et al., 1986). Finally, in the third phase, defined “reflexive level”, children mature the understanding of morality, the regulation of emotions with control strategies, and the simultaneous presence of ambivalent or mixed emotions in a given situation.

Some studies, focused on the association between theory of mind and emotion understanding (Hughes & Dunn, 1998; Cutting & Dunn, 1999; Dunn, 2000), discussed the influence of understanding of mental states on emotion comprehension: preschool children who were able to correctly solve false belief tasks were able to recognize the facial expression of emotions, external circumstances, and to link desire and emotions. In addition, comprehension of emotional-state language (Ornaghi & Grazzani, 2012), nonverbal intelligence (Albanese et al., 2010), and working memory (Morra, Parrella & Camba, 2011) were significantly correlated with the development of emotion understanding.

Findings related to the relationship existing between mental synthesis and emotion understanding (according to Pons, Harris and de Rosnay’s model) were scarcely detectable and this constituted the rationale of the current investigation in Italian school context. We hypothesized that children will be more able to understand emotions with the increase of age (H_1), as previously found in Pons et al.’ study (2004) and Albanese and Molina’s researches (2008); children will improve the mental synthesis ability with age (H_2); the more the children will be competent in emotion understanding the more they will be able in mental synthesis tasks and vice versa (H_3).

2. Methodology

2.1. Participants

The sample was composed by 72 typically developed Italian children (34 boy and 38 girls) aged between 6 and 11 years ($M=8.4$, $sd=1.4$) and divided in three equally balanced age groups (24 for each group: 6-7 years, 8-9 years, and 10-11 years). Participants were recruited from their classes in Public Primary Schools in Catania, Sicily (Italy) and parental consent for participation to this study was obtained.

2.2. Measures and procedure

Test of Emotion Comprehension (TEC). This test, developed by Pons and Harris (2000), was used in the Italian version of Albanese and Molina (2008) to analyze the nine components of emotion comprehension (recognition, external causes, desire, beliefs, reminders, regulation, hiding, mixed emotions, and morality), grouped in three main hierarchical levels (external, mental, and reflexive level: see Pons, Harris & de Rosnay, 2004). Children were administered a set of 23 cartoon scenarios placed at the top of each page of a picture book. The bottom part of each page showed four possible emotional outcomes portrayed by facial expressions. The researcher read a short story while children looked at the cartoon scenarios. Children were asked to point to the facial expression (chosen among scared, angry, happy, sad, and just alright) that fitted best with the emotion of characters (boys for male story and girls for female story). Scores were computed in relation to responses provided by children to each component, with one point for the correct responses and zero point for the wrong responses. The nine components were presented in fixed order of difficulty, each associated with different numbers of cartoon scenarios:

- (I) *Recognition* measured the capacity to recognize and name emotions on the basis of expressive cues: for example, "Let's look at these four pictures and point to the boy (or girl) who feels angry".
- (II) *External causes* understanding was the awareness that emotions may be caused by external situations: for example, "This boy (or girl) is getting a birthday present. How is this boy (or girl) feeling?".
- (III) *Desire* understanding was the capacity to recognize that two individuals can feel different emotions about the same situation because they have different desires: for example, "Christian likes Coca-cola while John hates Coca-cola. They found out that there is a bottle of Coca-cola in a box. How is Christian feeling? Is he happy, sad, just alright, or scared? And how is John feeling? Is he happy, sad, just alright, or scared?".
- (IV) *Belief* measured the awareness that individuals' beliefs can influence their emotional reactions to a situation: e.g. "This is Alice's rabbit and this is a fox willing to eat the rabbit. The fox is hidden behind the bushes by means of the flap; does Alice's rabbit know that the fox is hiding behind the bushes? How is the rabbit feeling? Is he happy, just alright, angry or scared?".
- (V) *Reminder* was the awareness of the role of memories in emotional experience: e.g. "Alice is very sad because her rabbit was eaten by the fox. In the next day, Alice is looking at a photo of her friend. How is Alice feeling? Is she happy, sad, just alright, or scared? And now Alice is looking at the photo of her rabbit. How is Alice feeling? Is she happy, sad, just alright, or scared?".
- (VI) *Regulation* understanding valued the awareness that emotions could be regulated by the use of psychological strategies; e.g. "Alice is sad for the loss of her rabbit. What is the best way to stop sadness?".
- (VII) *Hiding* was the comprehension of discrepancy between felt and expressed emotions; e.g. "Tom has lots of toys while Daniel doesn't have any. Daniel is smiling because he doesn't want to show Tom how he is feeling inside. How is Daniel feeling really inside? Is he happy, just alright, angry, or scared?".
- (VIII) *Mixed emotions* was the awareness that individuals can have contradictory emotional responses to a given situation: e.g. "Mary is looking at her new bicycle, but she thinks that she might hurt herself because she never rode a bicycle before. How is Mary feeling? Is she happy, sad and scared, happy and scared, or only scared?".
- (IX) *Morality* analyzed the awareness that negative emotions derived from morally unacceptable behaviors and, vice versa, positive emotions from morally laudable actions: for example, "George took chocolate biscuits

without the permission of his friend's mother and he decided to never confess this misdemeanor. How does George feel about that?"

Creative Mental Synthesis task (Antonietti, 1999; see De Caroli & Sagone, 2010). This task consisted of a paper-pencil protocol with three stimuli, "V" (capital letter V), "o" (square), and "O" (circle). Children were asked to imagine combining the stimuli to make meaningful objects and to combine them in anyway and in any size, without modifying the structural shape of the stimuli. Children were asked to draw the mentally created image in A4 sheets. Four scores to measure mental synthesis were obtained: 1) rotation (the total number of rotations applied to the stimuli or parts of them); 2) dimension (the total number of variations -reduction or enlargement- applied to the size of each stimulus); 3) superimposition (the total number of superimposition of one or two stimuli on the remaining one until to cover a part of the same); 4) inclusion (the total number of stimuli enclosed into each other).

Each measure was individually administered to children during school time and in a room specifically set aside for the investigation.

3. Results

Emotion understanding. All children were able to recognize the facial expression linked to emotions. In relation to other components, statistical analyses confirmed that children displayed a significant improvement with age on external and reflexive levels (Table 1) as predicted by H₁. Post hoc analyses (Bonferroni's method) showed that differences for age groups were all significant for $p < .001$. Specifically, the older children were better at recognizing external causes, beliefs, reminders, mixed emotions, and morality than the younger ones, as found by Tenenbaum et al. (2004), Pons et al. (2004), and Albanese and Molina's researches (2008).

Table 1. Components of emotion comprehension: differences for age groups

Components	Age group	Mean scores	Stand. Deviat.	ANOVA
External levels	6-7 years	2.17	.82	12.66**
	8-9 years	2.92	.28	
	10-11 years	2.79	.41	
Reflexive levels	6-7 years	1.37	.49	22.70**
	8-9 years	1.75	.44	
	10-11 years	2.46	.72	
External causes	6-7 years	.75	.44	4.24*
	8-9 years	.92	.28	
	10-11 years	1.00	.00	
Beliefs	6-7 years	.63	.50	4.73*
	8-9 years	.96	.20	
	10-11 years	.83	.38	
Reminders	6-7 years	.42	.50	14.78**
	8-9 years	1.00	.00	
	10-11 years	.79	.41	
Mixed emotions	6-7 years	.21	.41	16.16**
	8-9 years	.88	.48	
	10-11 years	.67	.34	
Morality	6-7 years	.79	.41	3.11*
	8-9 years	.63	.49	
	10-11 years	.92	.28	

Levels of significance for * $p < .05$ and ** $p < .001$

Linear correlations were found between external and mental levels ($r_{(72)}=.34, p=.003$) and between external and reflexive levels ($r_{(72)}=.47, p<.001$) in total sample. These correlations were affected by age groups: in fact, at 6-7 years, external level was correlated both with mental ($r_{(24)}=.59, p=.002$) and reflexive levels ($r_{(24)}=.48, p=.016$); at 8-9 years, external level was correlated only with reflexive one ($r_{(24)}=.52, p=.009$); at 10-11 years, mental level was correlated with reflexive one ($r_{(24)}=.40, p=.013$).

Mental synthesis. Statistical analyses confirmed that children showed a significant progress with age (Table 2) on three of the four components of mental synthesis (rotation, dimension, and inclusion) as well as predicted by H₂: specifically, the older children were more able in the manipulation and transformation of mental images than the younger ones. Post hoc analyses (Bonferroni's method) showed that differences for age groups were all significant for $p<.05$.

Table 2. Creative mental synthesis task: differences for age groups

Components	Age group	Mean scores	Stand. Deviat.	ANOVA
Rotation	6-7 years	1.67	1.9	4.98*
	8-9 years	3.04	2.1	
	10-11 years	3.08	1.1	
Dimension	6-7 years	3.25	2.5	10.20**
	8-9 years	7.13	3.6	
	10-11 years	8.01	5.1	
Inclusion	6-7 years	1.83	1.5	3.31*
	8-9 years	2.88	2.8	
	10-11 years	3.42	1.9	

Levels of significance for * $p<.05$ and ** $p<.001$

Linear correlations were computed between rotation and dimension ($r_{(72)}=.72, p<.001$), rotation and inclusion ($r_{(72)}=.65, p<.001$), and dimension and inclusion ($r_{(72)}=.45, p<.001$) in total sample. Differences for age groups were found: in fact, at 6-7 years, rotation was correlated with dimension ($r_{(24)}=.77, p<.001$), superimposition ($r_{(24)}=.42, p=.039$), and inclusion ($r_{(24)}=.75, p<.001$), and dimension was correlated with inclusion ($r_{(24)}=.58, p=.003$); at 8-9 years, rotation was correlated with dimension ($r_{(24)}=.89, p<.001$) and inclusion ($r_{(24)}=.80, p<.001$), and dimension was correlated with inclusion ($r_{(24)}=.62, p=.001$); at 10-11 years, rotation was correlated with dimension ($r_{(24)}=.59, p=.002$).

Emotion comprehension and mental synthesis. As predicted by H₃, interesting relationships were found between components of mental synthesis and emotion understanding levels: in fact, rotation was significantly correlated with external ($r_{(72)}=.45, p<.001$) and reflexive levels ($r_{(72)}=.46, p<.001$); dimension was significantly correlated with external ($r_{(72)}=.42, p<.001$), mental ($r_{(72)}=.29, p=.013$), and reflexive levels ($r_{(72)}=.56, p<.001$).

Multiple hierarchical regression analyses were conducted to investigate whether components of mental synthesis predict emotion understanding levels (*model A*) or, vice versa, whether emotion understanding levels predict components of mental synthesis (*model B*), controlling for age groups in both models. Results of *model A* showed that only rotation ($\beta=.39, t=2.26, p=.027$) predicted external level ($R=.50; R^2=.25; F_{(4,71)}=5.68, p=.001$) with significant effects of age groups ($\beta=.27, t=2.46, p=.016$) and increase of variance ($R=.56; R^2=.32; F_{(4,71)}=6.10, p<.001$); in addition, only dimension ($\beta=.33, t=2.70, p=.009$) predicted reflexive level ($R=.59; R^2=.35; F_{(4,71)}=8.90, p<.001$) with significant effects for age groups ($\beta=.47, t=5.27, p<.001$) and relevant increase of variance ($R=.73; R^2=.54; F_{(4,71)}=15.50, p<.001$). Vice versa, results of *model B* showed that reflexive ($\beta=.32, t=2.73, p=.008$) and external level ($\beta=.28, t=2.30, p=.024$) predicted rotation ($R=.54; R^2=.29; F_{(3,71)}=9.19, p<.001$) without significant differences for age groups; additionally, only reflexive level ($\beta=.45, t=4.14, p<.001$) predicted dimension ($R=.60; R^2=.36; F_{(3,71)}=12.98, p<.001$), also in this case without significant differences for age groups.

Our findings demonstrated that the increase of age affected the performances related both to mental synthesis and emotion understanding and this last result confirmed the developmental perspective proposed by Pons and colleagues (2004). Additionally, we predicted the existence of a significant relationship between the cognitive process of mental synthesis and the levels of emotion comprehension and verified the presence of a reciprocal and until today unexplored influence between the two processes in Italian schoolchildren. Future investigations could be carried out in order to analyze the presence of this relationship in preschoolers also.

References

- Albanese, O., & Molina, P. (Eds.). *Lo sviluppo della comprensione delle emozioni e la sua valutazione*. Milano: Unicopli, 2008.
- Albanese, O., De Stasio, S., Di Chiacchio, C., Fiorilli, C., & Pons, F. (2010). Emotion comprehension: the impact of nonverbal intelligence. *Journal of Genetic Psychology, 17*, 101-115.
- Antonietti, A. (1999). Simolare la scoperta cognitiva attraverso la visualizzazione mentale. In Di Nuovo S. (1999). *Mente e immaginazione* (pp.173-195). Milano: FrancoAngeli.
- Bartsch, K., & Wellman, H. M. (1995). *Children talk about the mind*. New York: Oxford University Press.
- Brown, J. R., & Dunn, J. (1991). You can cry, mum?: The social and developmental implications of talk about internal states. *British Journal of Developmental Psychology, 9*, 237-256.
- Cutting, A. L., & Dunn, J. (1999). Theory of mind, emotion understanding, language, and family background: Individual differences and interrelation. *Child Development, 70*, 853-865.
- De Caroli, M.E., & Sagone, E. (2010). Mental synthesis and creative thinking in learning disabled children. In G. Perez-Bustamante, K. Phusavat, & F. Ferreira (Eds.). *Proceedings presented to the IASK International Conference on Teaching and Learning 2010* (pp.272-279). Seville, Spain: IASK–International Association for Scientific Knowledge.
- Denham, S. A. (1998). *Emotional development in young children*. New York: Guilford Press.
- Denham, S. A., & Couchoud, E. A. (1990). Young preschoolers' understanding of emotions. *Child Study Journal, 20*, 171-192.
- Denham, S.A. (1986). Social cognition, prosocial behavior, and emotion in preschoolers: Contextual validation. *Child Development, 57*, 194-201.
- Dunn, J. (2000). Mind-reading, emotion understanding, and relationship. *International Journal of Behavioral Development, 24*, 142-144.
- 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., & Smith, S. M. (1992). *Creative cognition: Theory, research, and application*. Cambridge, MA: The MIT Press.
- Finke, R.A. (1990). *Creative imagery: Discoveries and inventions in visualization*. Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.
- Harris, P. L. (1994). The child's understanding of emotion: Developmental change and the family environment. *Journal of Child Psychology and Psychiatry, 35*, 3-28.
- Harris, P. L., Donnelly, K., Guz, G. R., & Pitt-Watson, R. (1986). Children's understanding of the distinction between real and apparent emotion. *Child Development, 57*, 895-909.
- Harwood, M. D., & Farrar, M. J. (2006). Conflicting emotions: The connections between affective perspective taking and theory of mind. *British Journal of Developmental Psychology, 24*, 401-418.
- Hughes, C., & Dunn, J. (1998). Understanding mind and emotion: Longitudinal association with mental-state talk between young friends. *Developmental Psychology, 34*, 1026-1037.
- Lagattuta, K. H., Wellman, H. M., & Flavell, J. H. (1997). Preschoolers' understanding of the link between thinking and feeling: Cognitive cuing and emotional change. *Child Development, 68*, 1081-1104.
- Mednick, S. A. (1962). The associative basis of the creative process. *Psychological Review, 69*, 220-232.
- Morra, S., Parrella, I., & Camba, R. (2011). The role of working memory in the development of emotion comprehension. *British Journal of Developmental Psychology, 29*, 744-764.
- O'Brien, M., Weaver, J. M., Nelson, J. A., Calkins, S., Leerkes, E., & Marcovitch, S. (2011). Longitudinal associations between children's understanding of emotions and theory of mind. *Cognition and Emotion, 25*, 1074-1086.
- Ornaghi, V., & Grazzani, I. (2012). The relationship between emotional-state language and emotion understanding: A study with school-age children. *Cognition and Emotion, 3*, 1-11.
- Pons, F., & Harris, P. L. (2000). *Test of Emotion Comprehension*. Oxford: Oxford University Press.
- Pons, F., Harris, P. L., & de Rosnay, M. (2004). Emotion comprehension between 3 and 11 years: Developmental periods and hierarchical organization. *European Journal of Developmental Psychology, 1*, 127-152.
- Smith, S. M. (1995). Fixation, incubation, and insight in memory and creative thinking. In S. M. Smith, T. B. Ward, & R. A. Finke (Eds.). *The Creative Cognition Approach* (pp.135-156). Cambridge, MA: The MIT Press.
- Tenenbaum, H. R., Visscher, P., Pons, F., & Harris, P. L. (2004). Emotional understanding in Quechua children from an agro-pastoralist village. *International Journal of Behavioral Development, 28*, 471-478.
- Ward, T.B. (1995). What's old about new ideas?. In S. M. Smith, T. B. Ward, & R. A. Finke (Eds.). *The Creative Cognition Approach* (pp.157-178). Cambridge, MA: The MIT Press.