

## School readiness of moderately preterm children at preschool age

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Received: 18 June 2012 / Revised: 7 November 2012 / Accepted: 26 November 2012 /  
Published online: 21 December 2012

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**Abstract** The study investigates the preschool readiness of moderately preterm children and, in particular, the likely presence of learning disabilities at preschool age. Its theoretical model detects linguistic comprehension and expression; memory-related metacognition and cognition skills; orientation and motor coordination skills; premathematics and preliteracy ones. The research project involved an experimental group made up of 55 moderately preterm children (mean age=62 months, mean gestational age=34.6 weeks), without any clinical neonatal complications, and low birth weight ( $M=2,100$  g,  $SD=350$  g); a control group made up of 55 full-term children without pre- and perinatal complications. The children's primary school reference teachers were given a questionnaire (Observative Questionnaire for Early Identification of Learning Disabilities), which was aimed at identifying any likely social and cognitive skill deficits at preschool age. The data, submitted to nonparametric univariate variance, show how scores of moderately preterm children in the metacognition [ $U_{(n1\ en2=55)}=35$ ,  $p=0.04$ ,  $r=0.49$ ] are statistically lower, other cognitive skills (memory, orientation, and visual–motor coordination) [ $U_{(n1\ en2=55)}=32$ ,  $p=0.02$ ,  $r=0.45$ ], premathematics [ $U_{(n1\ en2=55)}=32$ ,  $p=0.02$ ,  $r=0.44$ ], and the total score [ $U_{(n1\ en2=55)}=31$ ,  $p=0.02$ ,  $r=0.12$ ]. Such data would seem to suggest the need for hypothesizing preventive training and educational paths as a prerequisite for the development of the school abilities.

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**Keywords** Moderately preterm children · Learning disabilities · School readiness · Preschool age

## Introduction

European and international literature dealing with severely preterm birth (gestational age, <28 weeks or low birth weight <1,500 g; Taylor et al. 2000; Bhutta et al. 2002; McGrath & Sullivan 2002; O’Keeffe et al. 2003; Marlow 2004; Mulder et al. 2009; Biasini et al. 2012) and moderately preterm birth (gestational age, <34/5 weeks and weight <2,500/>1,500 g; Chyi et al. 2008; Huddy et al. 2001; Van Baar et al. 2009; Heinonen et al. 2010) have defined a specific background of the likely configurations of disadaptive functioning with regards to cognitive, emotional, and behavioral fields, which characterize the developmental paths of preterm children. The probability that such configurations could be detected at preschool age as precursors of real learning disabilities and school failure has already been claimed by the authors of this article in a previous research project (Perricone & Morales 2011a; Perricone et al. 2012a, b).

To be more precise, studies on the communication and linguistic development of a preterm child’s earliest years (Sansavini et al. 2004) have shown lower performances in terms of accuracy and expressive language complexity. Moreover, further studies on psychological functioning of preterm children at school age (Cherkes-Julkowski 1998; Caravale et al. 2005; Chyi et al. 2008; Pritchard et al. 2009; Van Baar et al. 2009) have shown that even moderately preterm children display poor school performance—usually math delayed (Johnson & Breslau 1999; Litt et al. 2005; Saigal et al. 2000)—have reading and writing difficulties (Chyi et al. 2008; Pritchard et al. 2009), as well as learning disabilities at school age (Winchester et al. 2009). Preterm children, in fact (32–34 week gestational age), are infants born without any medical or neurological morbidity and are a healthy perinatal group. Since this is a recent phenomenon, the research project evidence on long-term developmental outcomes is still evolving. Preliminary reports suggest that preschoolers had delays in school readiness (Adams-Chapman 2006) and at elementary school age, they displayed poor school performance including language development (Chyi et al. 2008; Magill-Evans et al. 2002) and visual–spatial skills delays (Magill-Evans et al. 2002), calling for individual education plans and the use of school services in grades 3–5 (Chyi et al. 2008).

Such studies hypothesize that even moderately preterm children might show cognitive and behavioral difficulties, although these are less detectable at preschool age and less serious than those shown by severely preterm children, they could lead to real learning disabilities (Als et al. 2003; Cherkes-Julkowski 1998; Pritchard et al. 2009) and/or school failure at school age (Chyi et al. 2008; Delobel-Ayoub et al. 2009; Saigal et al. 2003; Taylor et al. 2000).

As an extension of such studies, the survey focuses on preschool readiness of moderately preterm children and precursors of learning disabilities. It explores the likely precursors of learning disabilities in moderately preterm children, through a theoretical model dealing with general skills related to “learning aptitude” (Terreni et al. 2002) in terms of linguistic, metacognitive, attentive, memory, logical–mathematic reasoning, and preliteracy skills. To be more precise, the model focuses on the precursors of likely difficulties related to the ability of linguistic comprehension and verbal exposition, whose lack is often detected in case of severe prematurity (Sansavini et al. 2004); it also focuses on precursors of visual–motor orientation, general coordination of movements and fine motor skills impairments, which preterm children usually show from preschool age (Hemgren & Persson 2006). Moreover, the model focuses on the likely precursors of awareness, control of cognitive

processes (metacognition), and memory impairments, which are frequently detected in preterm children (Marlow 2004; Mulder et al. 2009; Caravale et al. 2005).

## Methods

### Objectives and hypothesis of the research project

The aim of the study is to investigate the presence, or lack, of social and cognitive skills as precursors of school readiness in moderately preterm children at preschool age. It wants to verify the presence of statistically significative differences among the indicators of general and specific skills as precursors of school learning.

### Subjects

The group involved in the research project (Table 1) was made up of 110 children at the average age of 5 years and 2 months. They were attending the last year of Italian preschool (the English equivalent for the first year of primary school) at schools in Palermo and the provinces.

The reference study group included a group of children selected in 2008/2009 and involved in an earlier research project (“birth year 2004” cohort; Perricone & Morales 2011a) and a further group of children involved in a later research project in 2009/2010 (“birth year 2005” cohort).

Before involving the research group children, the official authorities had approved the proposed path in terms of correctness and ethics. Then the children’s parents were asked to sign the declaration of informed consent according to the D.LGS. 196/2003 art.13 related to their personal and other people’s data protection. Professionals working in the field have followed the official path respecting the criteria that regulate the main codes of ethics of the

**Table 1** Characteristics of the sample by term and preterm birth

| Variable  | Children moderately preterm (=55) <sup>a</sup> |     |             | Children full term (=55) |     |             | <i>p</i> value |
|---|--|-----|-------------|--------------------------|-----|-------------|----------------|
|   | Mean   | SD  | Range       | Mean                     | SD  | Range       |                |
| Clinical characteristics  |  |     |             |                          |     |             |                |
| Child age (months)  | 62   | 4   | 57–67       | 64                       | 2.5 | 61–66       | n.s.           |
| Birth gestational age   | 34.6   | 1.5 | 31–35       | 40                       | 2   | 38–42       | <0.05          |
| Birth weight (g)  | 2,100  | 350 | 1,750–2,450 | 3,200                    | 400 | 2,800–3,550 | <0.05          |
| Days of hospitalization   | 15   | 8   | 8–23        | 2                        | 1.5 | 2–3         | <0.05          |
| Family’s socioeconomic status and social background characteristics | Mean   | SD  | Range       | Mean                     | SD  | Range       |                |
| Household income  | 1  | 1   | 1–2         | 1                        | 1   | 1–2         | n.s.           |
| Number of working parents   | 1  | 1   | 1–2         | 1                        | 1   | 1–2         | n.s.           |
| Education level of mother (years) (sociocultural level)             | 13   | 8   | 8–23        | 12                       | 8   | 8–22        | n.s.           |
| Mother’s age (years)  | 31.6   | 6   | 24–37       | 32.6                     | 5   | 26–38       | n.s.           |
| Number of children  | 2  | 1.5 | 1–3         | 2                        | 1.5 | 1–4         | n.s.           |
| Parents’ Italian nationality %                                      | 98 %   |     |             | 99 %                     |     |             | n.s.           |

<sup>a</sup> Healthy preterm (HPT), no medical/neurological complications

study, according to a wide research project of the Unit of Research in Paediatric Psychology conducted by the Psychology Department of the University of Palermo.

More specifically, the children involved were subdivided into two groups (see Table 1), depending on the presence of the variable “preterm birth”:

- An experimental group, so defined according to the “preterm birth” variable, was made up of 55 moderately preterm children (gestational age=32–34/5 weeks and birth weight: 1,500–2,500 g) without any medical neonatal complications and low birth weight (mean gestational age=34.6 weeks, SD=1.5, and mean birth weight=2,100 g). They were selected according to the following criteria: gestational age, <35 weeks; birth weight, 1,500–2,500 g; absence of any neurological, sensorial, and genetic pathologies; and absence of any malformative syndrome.
- The control group was made up of 55 healthy full-term children (mean gestational age=40 weeks, without any pre- and perinatal complications). The selection criteria of the control group were the following: birth at about 40th postconceptional week (range=39–41 weeks of gestation); birth weight, >2,500 g; absence of pre- and perinatal complications, neurological pathology, sensorial deficit, and genetic pathology or malformative syndrome.

In relation to the family’s socioeconomic status and the sociofamily background of the research group (Table 1), the children of the two groups do not differ in a significative way and are therefore interchangeable. In fact, the two groups that were compared seem to overlap as shown in certain statistical tests (test  $t$ ,  $\chi^2$ ).

To be more precise, the full-term and preterm children belong to Italian families, 90 % of them have siblings (on average of two children per family), whose mother (on average of 32 years old) belongs to a social middle class (one-income family), on average with secondary school education. The subjects of the two groups were chosen by means of a survey on birth carried out in the classroom. The children, together with their parents, were asked to answer some simple questions about their birth (“I was born on....; I was born in....; I was/not born prematurely....; my birth weight was...; I was hospitalized for ....”). After having compared the information regarding the medical and birth records of children, which the parents had provided the researchers with, the children were divided into two groups (experimental and control ones), and the research was carried out.

### Procedures and instruments

The Questionnaire Observative Questionnaire for Early Identification of Learning Disabilities (IPDA; Terreni et al. 2002) has been used to investigate the focus areas (learning competence). This questionnaire, dealing with the prerequisites for school learning of children at preschool age, was given to the reference teachers who were asked to assess how frequently they had noticed some abilities and behavior displayed by children in classroom, using a Likert-type scale four-response levels (0=not at all/never, 1=rarely/sometimes, 2=quite frequently/most of the time, very frequently/always).

The reference teachers (two per classroom) were asked to observe the way children behaved at school, before filling in the questionnaire. The teachers agreed on the level of assessment. Both, observation and questionnaire had been performed before the preterm children were identified to guarantee an impartial observation.

The questionnaire, which was standardized and validated in an Italian sample (Terreni et al. 2002), is characterized by high internal reliability ( $r$  of Pearson=0.72,  $p<0.01$ ) and high levels of accuracy (concurrent and predictive validity). The standardization sample of the

questionnaire was made up of 1991 healthy children (966 males and 995 females) attending the last year of an Italian (North-central Italy) maternal school. The average age of the children was 64 months, and 20 % of them showed precursors of learning difficulties at preschool age (total scale score  $< 113$ ) that were later confirmed at school age.

It is made up of 43 items and split into two sections. The first section concerns the scale of behavioral aspects (items 1–9) related to the adjustment to rules, control, collaboration, and work on his/her own abilities, meant as precursors of social competence at school age (Schaffer 1996; Caprara 2001). With regard to the learning competence, the scale of motor skills (items 10–11) assesses the quality of general movements coordination and fine motor skills; the scales of linguistic comprehension (items 12–14) and oral expression (items 15–19) focus on the ability of paying attention to, listening to others and on expositive and descriptive clarity; the scale of metacognition (items 20–23) investigates the children's skills of being aware and knowing how to control their own cognitive processes, namely the ability of using strategies to understand better, sustain a task, recognize the sources of distraction. Finally, the scale on other cognitive skills (items 24–33) investigates abilities of memory, orientation in space, and visual–motor coordination.

The scales of preliteracy (items 34–40), metalinguistic skills, and premathematics (items 41–44), on reasoning ability and use of quantities and operations, are in the second section since they deal with specific abilities required to face preschool learning successfully.

This questionnaire allows to detect children at risk of learning difficulties on the basis of the total score; however, it also provides the partial scores of each scale to examine the fields which have the lowest score. With regard to reading and interpreting the result, a total score equal to or less than 113 (cutoff score) shows the presence of a likely risk of learning disorders at preschool age. From a descriptive point of view, in relation to reading and interpreting the results, the procedure expects to compare the mean scores of each scale with different normative scores of reference of the test (Table 2). This has allowed to verify whether performances of children of the research group (full-term and preterm children) were at risk of learning difficulties at preschool age.

**Table 2** Learning difficulties in the research group

| IPDA scales  | Normative sample |       | Moderately preterm children |       | Full-term children |       | Statistics                                      |           |                     |
|--|------------------|-------|-----------------------------|-------|--------------------|-------|---|-----------|---------------------|
|  | Mean scores      | SD    | Mean scores                 | SD    | Mean scores        | SD    | Mann–Whitney $U$ test <sub>(n1 = n2 = 55)</sub> | $p$ Value | Effect size ( $r$ ) |
| Behavioral aspect  | 3.12             | 0.76  | 3.00                        | 0.73  | 3.10               | 0.63  | 3,137.5   | 0.20      | 0.07                |
| Motricity  | 3.29             | 0.67  | 3.30                        | 0.77  | 3.40               | 0.57  | 3,231.0   | 0.32      | 0.07                |
| Linguistic comprehension   | 3.23             | 0.75  | 3.30                        | 0.60  | 3.40               | 0.59  | 3,342.5   | 0.51      | 0.08                |
| Metacognition  | 3.00             | 0.78  | 2.00                        | 0.85  | 2.90               | 0.74  | 3,503.0   | 0.04      | 0.49                |
| Other cognitive skills (memory, orientation and visual-motor coordination) | 3.60             | 0.68  | 3.00                        | 0.67  | 3.60               | 0.51  | 3,181.0   | 0.02      | 0.45                |
| Preliteracy  | 3.21             | 0.81  | 3.25                        | 0.82  | 3.30               | 0.70  | 2,994.5   | 0.51      | 0.03                |
| Premathematics   | 3.70             | 0.70  | 3.20                        | 0.80  | 3.90               | 0.63  | 3,181.5   | 0.02      | 0.44                |
| Total score  | 139              | 20.50 | 134                         | 27.10 | 140                | 22.40 | 3,095.0   | 0.02      | 0.12                |

Successively, using the different scales of the test, statistical comparison analysis has been carried out between the experimental (moderately preterm children) and the control group (full-term children).

## Results

### Treatment and statistic analysis of data

The codified data have been analyzed using the statistic program for Social Sciences–SPSS (version 16.0) for Windows. With regard to the survey about the likely differences between moderately preterm (experimental group) and full-term children (control group), skills useful for school learning (behavior, motor and cognitive skills, linguistic comprehension, oral expression, metacognition, prerequisites of reading–writing, and mathematics) a nonparametric analysis has been carried out with a view to compare the two samples by means of Mann–Whitney  $U$  test ( $n_1$  and  $n_2=55$ ), considering the lack of a normal distribution of data. The value  $p=0.05$  has been used for the significance test.

The data show statistically significant differences for the total score gained through the IPDA test, where moderately preterm children have a lower total score than the group of full-term children, the same applied to some scales (see Table 2).

In relation to the total score of IPDA, the experimental group made up of moderately preterm children involved in the research path, has a total score that is statistically lower than that of the full-term children [ $U_{(n_1 n_2=55)}=31, p=0.02, r=0.12$ ] even though the difference is not substantial (small effect size). This datum would not seem to show a lack of the cognitive processes that are useful for learning readiness.

From a descriptive point, when the mean total score obtained by the group of preterm children is compared with the mean total score of the normative group, the moderately preterm children of the survey, in spite of their total score that is statistically lower than that of the full-term children (see Table 2), does not reach the cutoff score ( $\leq 113$ ) to identify the presence of precursors of learning disabilities at preschool age. Therefore, moderately preterm children are not classified as being at risk in comparison to full-term children. The percentage of the children who are really at risk, is the same of the percentage of the two groups (about 20 %), and is consistent with that of the normative group.

As for the different scales, which is the configuration of the different skills useful for learning readiness (Table 2), preterm children of the experimental group that was researched compared to full-term children, have statistically significant lower scores in metacognition [ $U_{(n_1 n_2=55)}=35, p=0.04, r=0.49$ ], other cognitive skills (memory, orientation, and visual–motor coordination) [ $U_{(n_1 n_2=55)}=32, p=0.02, r=0.45$ ] and premathematics [ $U_{(n_1 n_2=55)}=32, p=0.02, r=0.44$ ]. These differences, which are substantial when are statistically compared with the control group (medium/large effect size—see Table 2), would imply that preterm birth is a factor that may lead to distinct cognitive, rather than general, impairments. As Table 2 shows, considering the items with low scores, preterm children would seem characterized by lower capabilities to perform a task, comprehend his/her own activated cognitive processes, use strategies to better understand and to perform school tasks. They also show lower levels of memory, orientation in space, and logical and mathematical reasoning skills.

The descriptive comparison of the partial scores obtained by preterm children with the normative values of each scale of the questionnaire shows that moderately preterm children gained scores that are below average, with regard to certain fields and that would seem particularly at risk. Such areas are metacognition (mean score normative sample=3.00 vs

mean score moderately preterm children=2.00; 38 % of moderately preterm children < mean score vs 36 % of children control group), cognitive abilities concerning memory and coordination/orientation (mean score normative sample=3.60 vs mean score moderately preterm children=3.20; 48 % of moderately preterm children < mean score vs 40 % of children control group) and premathematics competencies (mean score normative sample=3.70 vs mean score moderately preterm children=3.00; 42 % of moderately preterm children < mean score vs 38 % of children control group) seem to be extremely impaired (Table 2).

Moderately preterm children involved are not statistically significant different from full-term children as for behavior aspect, motor skills, linguistic comprehension, and preliteracy. The descriptive comparison with normative scores shows that moderately preterm children obtained scores higher than those of the normative group with regard to certain areas that may be possible developmental resources related to language sphere, such as linguistic comprehension (mean score normative sample=3.23 vs mean score moderately preterm children=3.30) and to prereading skills (mean score normative sample=3.21 vs mean score moderately preterm children=3.25). These latter, then, may be a real developmental resource at school age and fosters a transformation of disadaptive configurations of school failure, whose low scores related to metacognition, cognitive, and premathematics skills are likely precursors.

Compared with the normative group, the moderately preterm children show low levels of social self-regulation, adjustment to school context rules and changing context situations (behavioral aspect), and low levels of motor skill (motricity); the scores of these two scale are below normative mean (mean score normative sample—behavioral aspect scale=3.12 vs mean score moderately preterm children=3.00; mean score normative sample—motricity scale=3.30 vs mean score moderately preterm children=3.29).

## Discussion

Considering the data of the research project, some distinct areas at risk could be hypothesized in the group of moderately preterm children identified by the study such as metacognitive, memory, visual–spatial coordination, and logical–mathematic reasoning. Unlike previous studies (Cherkes-Julkowski 1998; Caravale et al. 2005; Chyi et al. 2008; Pritchard et al. 2009; Van Baar et al. 2009), no general learning disorders emerge, which were shown at preschool age, but the difficulties of some cognitive skills that may lead to “school failure”.

Specifically, the impairment displayed by the data related to metacognitive, reasoning, memory, and orientation skills, would seem to be highly relevant where moderately preterm children are characterized by a moderate but significant impairment of the self-observation and self-modulation of the individual’s cognitive process skills, capabilities of thinking about an individual’s mental state, controlling, knowing, and managing the individual’s learning processes. The metacognitive difficulties together with the moderate impairment of logical-mathematic reasoning, analysis, synthesizing, organization, classification, comparison, memory, and visual–motor orientation abilities, which have already been highlighted by other studies (Johnson & Breslau 1999; Litt et al. 2005; Saigal et al. 2000), surely is an important risk factor for both, the leading role assumed by children during the process of “building” and the signification of the reality of the whole development path and school failure.

Together with risk tendencies, which seem to characterize the condition of moderately preterm children, it has to be considered the data referring to the competencies areas where moderately preterm children are not statistically different from the full-term children of the control group, and that sometimes are possible resources. It has to be considered the presence of some important social and cognitive skills which are related to linguistic comprehension, preliteracy

competencies, and to self-control, social adjustment, contextualization, and respect for rules skills. Children involved in the research project compared to the control group would seem to be characterized by social orientation, collaboration, and interaction abilities, which give them the chance to be extrovert and to activate exchanges and build relationships, which can also assure them the development of the abilities that they lack. These data are consistent with some studies of the field (Davis et al. 2007; Gray et al. 2008; Manjemer et al. 2000; Winchester et al. 2009; Ketharanathan et al. 2011; Perricone & Morales 2011a, b; Perricone et al. 2011; Perricone et al. 2012a, b). These are abilities that can support the social success and scholastic contextualization of preterm children.

The importance of these aspects leads to consider the hypothesis of training and educational paths that can rely on these resources to “work” and promote the development of the abilities characterized by some impairments and deficit of precursors of school success (Perricone Briulotta 2012; Perricone et al. 2012a, b). For instance, metacognitive paths (Cornoldi 1995; Cornoldi et al. 2001) at preschool and school age that, together with planned school paths, can act as a form of prevention of school failure and learning disabilities, even in cases of moderately preterm birth. Such actions promote the development of abilities and competences related to awareness and use of strategies that allow children to learn how to learn, organize, and interpret environmental information and become independent in the process of knowing, learning, being self-confident, and self-regulated (Perricone et al. 2004).

The study highlights the need for a school training that should be planned at preschool age aimed at developing processes of task orientation, evaluation, searching for cause, building bonds among events, people and information, as well as interventions that may develop metacognitive abilities and competences concerning awareness and the use of strategies that allow children to organize and interpret environmental information, and to become autonomous in the process of knowing and learning.

The study claims the need for assessment and screening at preschool age (Fanos 2001; Fanos & Puddu 2009), aiming at an early identification of problematic areas of learning, as well as resources such as the social abilities which mostly characterize preterm children. It is also suggested to screen the skills of cognitive processes such as metacognition, memory, etc. of which the study detected certain difficulties.

Secondly, this survey stresses the importance of the studies that investigated the extent to which educational difficulties may become evident 1 year before school entry, or the likely nature of these difficulties (Resnick et al. 1999; Schneider et al. 2004) for outcomes concerning school readiness and prereading abilities shortly before school entry. Such information is important for the development of effective early identification and intervention strategies aimed at supporting the learning needs of preterm children during their transition to school and to the classroom. While it has been suggested that educational or school-related difficulties may not be apparent in the first year of school, studies showing behavioral and cognitive difficulties among preterm children during the preschool years, alongside the evidence for worsening school performance over time, suggest that these children may be less able to take full advantage of early learning opportunities (Salt & Redshaw 2006). From infancy throughout primary school, pre-emption of school failure would seem to strengthen the child’s social and cognitive skills required by preschool learning and school success (Schaffer 1994, 1995, 1996; Caprara & Pastorelli 1998; Caprara 2001).

**Acknowledgments** We would like to thank all parents and children for their participation. The study was performed in cooperation with the University of Palermo and the preschools “Campofelice di Roccella-Lascari” (PA) and “M. Buonarroti” (PA) Italy. We would also like to thank the school staff involved.



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*Most relevant publications in the field of Psychology of Education:*

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*Current themes of research:*

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*Most relevant publications in the field of Psychology of Education:*

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*Current themes of research:*

Pediatric psychology. Learning disabilities in preterm children. Precursor of ADHD in preterm children. Assessment

*Most relevant publications in the field of Psychology of Education:*

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