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Why Asian children outperform students from other countries? Linguistic and parental influences comparing Chinese and Italian children in Preschool Education

Benedetto Di Paola[a]

[a]Università degli Studi di Palermo, Dipartimento di Matematica e Informatica, ITALY

ABSTRACT

This paper focusing on the complex situation of the Italian multiculturalism and trying to reply to why Asian children mathematically outperform students from other countries, discusses from the epistemological point of view, Chinese children's skills before to start their formal education in Italian educational school context. A review of the literature, comparing pre-schoolers competences of Asian and Western students, reveals two important influenced factors: linguistic and parental stimuli. In particular many researchers showed that the structure of the Chinese language provides in children a head start in basic math skills, for example to discover, since preschool activities, a pre-algebraic structures of writing. An example with numbers is shown in the paper.

Other studies also show that Asian parents, compared to the Western cultures ones, tend to promote in a strong way the development of good basic mathematics skills and a stronger epistemological discipline foundation.

A general framework on these two important aspects for the education context is presented with the aim to help teacher and researchers to better understand Chinese and Italian possible different cognitive styles in mathematics learning just from Preschool.

KEYWORDS
Education, Multiculturalism, Preschool, Chinese and Italian students, Chinese written language

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A general overview of multiculturalism in Italy: the case of Chinese students

Multiculturalism in mathematics classroom is one of the more emerging themes of educational studies related to the teaching/learning processes. The Italian case could be a relevant example with a national average of students with non Italian citizenship at 8,8% (786,630 units, but near an half born in Italy from alien parents, from more than an hundred of countries) (Ongini & Santagati, 2015) and an uncountable plurality of heritages and "home tongues" different from the main Italian culture, like dialects speaking students (especially in small towns, mountains, rural context or in the islands, and in the whole southern and north-eastern Italy) or minorities like Arbëreshë, Catalan, Croatian, French, Franco-Provençal, Friulian, German (two types), Greek, Ladin, Occitan, Sardinian (two types), Slovenian, and Roma, Sinti and Travellers. So an Italian classroom could be a complex blending of habits, expectations, values and feelings about the sense, meaning and characteristics of mathematics itself, about interesting or useful topics, about school practices and ways to learn and teach mathematics, about languages and communicational channel. As a community with teachers, students and families, values and expectations of each in those fields could be explicit or lay in background, but always with some weight in daily school life and effective influence on the results of learning/teaching processes.

36.043 Chinese students (mostly from Wēnzhōu (温州) and other districts of Zhèjiāng (浙江) province) form the fourth non Italian citizen group (4,6% of non Italian students) after Romanian, Albanian and Moroccan. If the immigration of Romanian, Albanian and Moroccan are nowadays quite common for the Italian School, the Chinese presence at Italian schools is more complex. It is in fact quickly increasing as a "new" reality of the Italian School system and, in many cases, teacher doesn't know what sorts of experience Chinese students bring with them from everyday life into the classrooms, which kind of knowledge they posses, which kind of feelings they have, and so on (Spagnolo & Di Paola, 2010). In many cases Chinese pupils and their cultural elements remain invisible to teacher and their schoolmates! But in spite of great initial linguistic difficulties and an uneasy dialogue between schools and families, they are very respectful and good, especially in mathematics. Their good results expressed by Italian teachers and researchers in many scientific subjects are coherent with international assessments like PISA or TIMMS, which assign to students from countries in the Far East, especially Singapore, China, Korea and Japan, very high scores (OECD, 2013). The problem is that the large majority of Italian teachers don't know "why" Chinese students (in K-12) are good in Mathematics.

Siegler & Mu (2008) and Perry (2000) showed that there are many possible factors that contribute to the Chinese exceptional mathematics performance in PISA or TIMMS however most evidences have concentrated on particular educational factors such as the school time allocating in China by teacher to mathematics, a deeper explanations of mathematics procedures and algorithms, and a earlier starting point to learn Mathematics in a formal or informal ways.

In the last ten years researchers from all over the world developed a lot of works on the "comparison" of students performance in mathematics. We refer to the work of Bartolini Bussi et al., 2013, César & Favilli, 2005; Cai & Hwang, 2002; Cai & Silver, 1995; Favilli et al., 2013; Huang & Bao, 2006; Leung, 2001; 2002a; 2002b; Ramploud & Di Paola, 2013; Spagnolo & Di Paola, 2010. Mostly of all these work, taking in account US, European and far-eastern countries students such as Chinese, Japanese, and Korean, are focused in didactical context starting from Elementary level; few works on this subject are focused at Preschool.

According to the data collected by ISMU (2016), the phenomenon of first inclusion of Chinese pre-scholars in the Italian education system and, in general, the related study of little children's learning skills coming out from their parents, is quite new.

Since many years, the G.R.I.M. (Research Group In Mathematics Education) of Palermo is working to understand the "reasons" for this excellence and despite this, to understand the complexity of teaching mathematics (Battaglia & Di Paola, 2015; Di Paola et al., 2016; Battaglia et al. 2016, Fazio et al. 2012) in such multicultural situation in classroom. Analysing some aspects of East Asian cultures (Chinese one in particular) as for example language, historical mathematic traditions (Bishop 1988; Hofstede, 1980), different teaching practices and classroom life (Hui & Triandis, 1986; Wang & Murphy, 2004) we are building a general framework useful for teacher and researchers. In this paper we briefly present some key points of our paradigm with the aim to help teachers and researchers to observe and interpret, just in pre-schoolers, possible different cognitive styles of Eastern (Chinese) and Western (Italian) learners in mathematics foundation (Paik et al., 2011). Skills coming out from cultural under layers that join and influence, in direct or indirect way, the learning processes, just from the beginning, at Preschool.

Referring to the studied of Paik et al. (2011), considering pre-schooler Chinese immigrants learners, is it possible to explicit two important factors that explain why the Chinese advantage on the Western counterparts occurs just from a young age and also in non Chinese educational contexts as the Italian one: the first one is related to language, the second to the parental influences on learning process. In this paper we focus our attention to these two aspect comparing Chinese and Italian pre-schoolers in Italian Preschool.

Language influences

Dowker et al. (2008) discussed the influence of Asian languages (Chinese in particular) on mathematics performance suggesting that it is one of the important influences on the exceptional mathematics performance of students especially for the first approach (at Preschool) to informal mathematics competence with numbers. Gerofsky (2015) revealed that there are several advantages that Asian languages confer on early number learning; in particular the author referred to the use of Chinese number words. Spagnolo & Di Paola (2010), particularly referring to the written Chinese language, discussed also the role of natural language in mathematics thinking.

If we look the grammar of the Chinese written language, the different characters (dendograms) are defined and classified in various categories or according to some "meta-rules" of composition based on "part-whole" relation of each written signs. Needham (1981) reports this classification in six classes and he discusses them in this way:

a) Xiàngxíng (象形) "Forms of imagines, pictograms": tree 木; sun 日 ; moon 月 ; mountain 山; horse 马; bird 鸟.

b) Zhǐshì (指 事), "Indicators of situation, indirect symbols".

c) Huìyì (会意), "Union of ideas, composition by association or logic composition".

80% of the ideograms are of the associative kind (Needman, 1981). They represent a sort of mental equations (Needham, 1981, pp. 35-36, vol. I) as semantic combinations of two or more characters that are composed by association. We could find different examples for this: 男 [*nán*] man= 田 [*tián*] "field" + 力 [*lì*] "strength; 林 [*lín*] (森林 *sēnlín*) forest = tree 木 + tree 木 (plus 木). Two 木 [*mù*] trees side by side; 休 [*xiū*] stop, rest = 亻 (人 *rén*) + 木 [*mù*] tree. A person stopping to rest under a tree.

d) *Zhuǎnzhù* (转 注), "Transferable sense, symbols that it is possible to interpret reciprocally".

e) *Jiǎjiè* (假借), "Language or sound". These characters are defined in a determinate general manner: the radical is associated to a phonetic sign to indicate the category in which we have to find the meaning of the word. So a lot of words with the same sound are written without confusion. (Needham, 1981, p. 38). Example: 园 [*yuán*] garden = 囗 (*wéi*) "surround", suggesting a garden fence, and (full form) 袁 *yuán* phonetic or (simple form:) 元 *yuán* phonetic; 袁 [*yuán*] or (simple form:) 元 [*yuán*] phonetic, and辶(辵*chuò*) "go" (to go far) = "far".

f) *Xíngshēng* (形 声), "Loan, rented phonetics character". The formation is very similar to the preceding case, but the way to construct the character is different.

According to Spagnolo & Di Paola (2010) the use of radicals [*kǒu*] (口) or [*tián*] (田) in the composition of dendograms reveals also the idea of a variable *as a thing that is varying* (Radford, 2000, 2003) and a parametric system within the composition of many characters.

Since the first years of Preschool, Chinese children study written language (abroad from China, their parents have this task) using a "common" strategy to define and write these. In particular they learn that the radicals part of different dendograms assumes the role of parameter and it is useful to link the meaning or the sound of the different Chinese character to other ones. Step by step they learn to construct a map in which all these written word are linked together by using the Chinese practice called "*Variation*", in Chinese language *Bianshi* (變式) where *bian* stands for "changing" and *shi* means "form." (Sun, 2011)

This process is really complex for little child but extremely important for the mathematics point of view because it vehicles, in informal way, a lot of mathematics! According to Needman (1981) maybe more than in of the cases the Chinese written language has a important role in mathematics thinking and in particular in pre-algebraic and algebraic approach (Arzarello, 1998).

According to Gerofsky (2015) it is common that, before to start school Chinese children just acquired good skills in writing and reading; they, thanks to the study of the structure of Chinese language, acquire a sort of a early approach to Algebra that their own age pre-scholar children doesn't have form the same stimuli. An interesting example of Chinese children skills owned by them in Preschool and unusual for same age Italian children is the use of Chinese number up to 10 (we refer to signs and words). In Italian as in almost all languages, the numbers up to 10 involve in fact memorizing unpredictable sign and names; in Chinese language is simpler. The number's characters and words consistently and clearly represent the base-ten number system; if we look for example to the number 11 (十一), the character and the word is analogous to "*ten (十) plus one (一)*". According to the same algorithm 13 is written and verbalized as *ten plus three* " (十三). Using the "same" configuration by *variation* (Sun, 2011) the number 21, is expressed by a mixed multiplicative and addictive structure and so written and verbalised as follow: "*two-tens-one*" (二十一).

Ng & Rao (2010) argued that the clear repeated base-ten pattern makes very easy for children to learn numbers past 10. In contrast, in Italian (as in other language), as we said before, base-ten numbers do not follow the same pattern and results for children more complex, requiring more learning time. In Italian preschool, Chinese children are more frequently able to represent numbers putting in evidence a habit to play discovering possible relation between numbers. Italian pupils have more difficulties to do it at the same level and never with numbers up to 10. This data is confirmed by literature: several studies have in fact shown that the base-ten transparency of Chinese number words reinforces in Chinese children the concept of place value and the relation between numbers (Ng & Rao, 2010). Miura et al. (1994) highlighted also how children of Preschool from East Asian countries (China, Japan, and Korea) and from western countries (France, Sweden, and the United States) represent, for example, in different way large numbers up to 10: the non-Asian children usually represented numbers using unit blocks while the Asian children, since pre-school tend to use a dynamic combination by a *variation* approach of ten and unit blocks. Same typical Chinese teaching activities on this approach are discussed in Baccaglini et al. (2016).

Another advantage of the Chinese language related to numbering is that ordinal number names are also simple and consistent. In Chinese ordinal number words are easy to learn because a prefix is simply added to the cardinal number names (Ng & Rao, 2010). In Italian language (as in English and other languages) is absolutely complex: "*primo/first*" or "*secondo/second*" are different from "*uno/one*" and "*due/two*". Miller et al. (2000) discussed that these differences are evident comparing pre-schoolers from Asian and Western cultures just in Preschool.

An additional advantage of Chinese language is that number words are frequently used due to inherent properties of the language, which promotes the learning of mathematics concepts (Ng & Rao, 2010).

One property (just as an example) is the lack of plural words, which necessitates the use of number words to describe plurality (Gerofsky, 2015). In Italian language it isn't the same, it is absolutely more complex for little children and unhooked from numbers.

All these aspects promote the idea according to which the Chinese language contribute in direct or indirect way to the enhanced informal mathematics performance of Asian pre-schoolers. (Gerofsky, 2015; Spagnolo & Di Paola, 2010). Of course this is the unique one, other cultural factors are extremely important. Parental influence is another crucial one to study mathematics skills of different cultural children at pre-schoolers level.

Parental influences

Parental influences appear to be particularly significant in Preschool; in fact, at this grade several are the parent-child interactions. As regard the mathematics activities these are due to the little formal teaching typical of pre-school didactical contexts. These decrease in high grades.

Ng & Rao (2010) suggested that Asian parental involvement has a strong effect on their children's mathematics achievement. Huntsinger et al. (1997) in their empirical research with children from Taiwan, China, US and Europe, correlate the high skills of Chinese and Taiwan students, attending preschools with comparable philosophies and approaches, with their diverse parental attitudes and practices. The authors found that East-Asian parents, engaging day by day their children in more formal or informal mathematics activities, are more careful than the US and European parents to the learning process of their pupils. In general is common to find in Chinese parents a particular attention to the learning skills of their sons; this behaviour is due to their cultural values and traditions. For Chinese parents following the Confucian philosophy, Mathematics is in fact one discipline really important for their children in order to succeed. According to this assumption, since Preschool, they are in fact really involved in helping their children especially in Mathematics (Gerofsky, 2015).

In support of this view, Di Paola (2015) highlighted that Chinese parents emphasize, more than Italian ones, hard work to improve in their children Mathematics skills; this imply that they have higher expectation on their son's performance. Chen & Stevenson (1995) had the same result in US. The "informal teaching method" used by chine parents at home, just from the first years of their sons, could be frame as a multi-modal learning approach (Jordan & Baker, 2011). It is referred to the idea of *variation*, the same that we discussed in the section regarding the acquisition of Chinese language skills. According to Gerofsky (2015), for Chinese parents it is common for example to spend quite a lot of time practice counting thought addition/subtraction or multiplication/division algorithms in variation problems with their preschool children (Mellone et al., 2015; Di Paola 2016b). Their aim is to favour, since first years, a better conceptual understanding of numbers and their mutual relation into different problem solving strategies. This approach is typical of the Chinese educational tradition and the related philosophical backgrounds. (Sun, 2011). It is instead atypical for the Italian educational system (Ramploud & Di Paola, 2013). Italian parents, in contrast to the Chinese ones, emphasising a more availability to accept a possible failure, spend less time with their children on mathematics activities. Same resolute were found by Huntsinger et al. (1997) with in other European countries.

Conclusions

This paper trying to reply to why Asian children mathematically outperform pupils from other countries, discusses two important aspect related to the mathematics skills acquisition of Chinese children before to the start their formal education in Italy.

As we argued the structure of the Chinese language provides in children a strong start in basic mathematics skills such as counting, understanding place value, learning ordinal numbers etc. These give, since the first steps of language's learning at pre-school level a strong mathematical foundation that is linked to a pre-algebraic approach useful to write and read word and numbers following a variation approach to sign and related meaning.

Although the influence of language, parental influence are also extremely important, some researchers show that Asian parents, compared to parents from Western cultures, tend to promote in a strong way the development of good basic math skills and a stronger epistemological mathematical foundation. The use of variation approach (the same used in language learning) in the problem solving activities give to Chinese parents an important role to vehicle at home a typical Chinese educational approach and useful for a better conceptual understanding of numbers and their mutual relation into different problem solving strategies.

According to the stimuli coming out from language and parental influences it is not surprising that many research studies find Chinese children "superior" at basic mathematics as in number count or in problem solving activities. Siegler et al., (2008) declare that Chinese pre-schoolers in US context but not only appeared to be about two years ahead with respect to numerical skills. Similar resolute are fond by Hsu (1981).

The reflection discussed in this paper on language and parents influence on learning process and mathematics skills acquisition could be useful to help teacher and researchers to better understand Chinese and Italian possible different cognitive styles in math learning just from Preschool grade. Of course the two cultural references are part of a general framework, more complex, which other different factors are inserted in at a level of pre-schoolers in a variety of cultures background.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Benedetto Di Paola, PhD in Mathematics Education, Researcher in Mathematics Education, Department of Mathematics and Informatics, University of Palermo, Italy.

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