

Socioeconomic status and imitation on language acquisition in a sample of preschool children

Status socioeconomico e imitazione dell'acquisizione linguistica in un campione di bambini in età prescolare

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SUMMARY. Aim. This study examines the effects of socioeconomic status (SES) on language acquisition in preschool children. It also evaluates the differences between the development of spontaneous imitation and language skills in verbal and nonverbal children. **Methods.** New Reynell Developmental Language Scales (NRDLS) was administered to a sample of 60 children aged from 3 years to 5 years and 11 months, with apparently normal language development. The NRDLS were administered in a public nursery school in a poor area of Bari and to a private nursery school in the "Noicattaro" residential district, in order to differentiate SES. The NRDLS identified 19 nonverbal children and 41 verbal children. **Results.** SES does not affect the process of language acquisition, although the mother's schooldegree improves the child's language capacity. Analysis of mean scores on the NRDLS imitation items revealed a statistically significant difference between the verbal and nonverbal group with more impairment/higher scores in nonverbal than the verbal group. These results suggest that 19 nonverbal children have specifically impaired imitation. These results are further discussed.

KEY WORDS: socioeconomic status, verbal child, nonverbal child, imitation capacity.

RIASSUNTO. Lo studio esamina gli effetti dello status socioeconomico (SES) e l'imitazione dell'acquisizione linguistica di bambini in età prescolare. Valuta anche le differenze tra lo sviluppo dell'imitazione spontanea e le abilità linguistiche nei bambini verbali e non verbali. **Metodi.** La nuova Reynell Developmental Scales Language (NRDLS) è stata somministrata a un campione di 60 bambini di età compresa tra i 3 e i 5 anni e 11 mesi, con sviluppo del linguaggio apparentemente normale. La NRDLS è stata somministrata in una scuola materna pubblica in una zona povera di Bari e in una scuola materna privata nel quartiere residenziale "Noicattaro", al fine di differenziare il SES. La NRDLS ha identificato 19 bambini non verbali e 41 bambini verbali. **Risultati.** Il SES non influisce sul processo di acquisizione del linguaggio, sebbene il livello scolastico della madre migliori la capacità linguistica del bambino. L'analisi dei punteggi medi degli item di imitazione della NRDLS ha rivelato una differenza statisticamente significativa tra il gruppo verbale e quello non verbale con più compromissione/punteggi più alti nel gruppo non verbale rispetto al gruppo verbale. Questi risultati suggeriscono che 19 bambini non verbali hanno un'imitazione specificamente compromessa. Questi risultati devono essere ulteriormente discussi.

PAROLE CHIAVE: status socioeconomico, bambino verbale, bambino non verbale, capacità di imitazione.

INTRODUCTION

Several studies have provided strong evidence of influence between socioeconomic status (SES) and language acquisition, but no study has explored the possible connection between failure of development of spontaneous imitation of actions and poor language abilities.

Numerous studies¹⁻⁵ have reported how socioeconomic disparities profoundly affect physical health, mental well-being and cognitive development^{3,6}. Hackman et al.⁷ discovered that the most intellectual abilities influenced by SES are the linguistic areas of the left hemisphere and the prefrontal cortex in the frontal brain.

No differences were found for total cerebral volume or parietal and temporal lobes in children by SES⁸. Disadvantaged children tend to experience less linguistic, social and cognitive stimulation from their caregivers and home environments compared to children from higher SES homes^{9,10}.

Imitation plays a central role in the development of motor control, speech/language/ communication, and social life¹¹. Imitation is one of the most common ways for children to acquire motor or speech/language skills.

Children use imitation to learn new motor skills and communicative actions and to facilitate comprehension of other individuals' behavior¹². Neurophysiological studies discovered mirror neurons in macaque monkey and similar system

of “mirror neurons” in humans. It is plausible that the mirror neuron system may be involved in imitation in typically developing individuals and also provide the neurological basis for imitation deficit in the specific language disorder. The location of these neurons in the equivalent of Broca’s area, suggested that shared meaning form the basis of communicative movements, gesture and speech, that all originate from the firing of these mirror neurons¹³ supporting a close relationship between movement and language. Based on his work on imitation Marshall and Meltzoff have developed the “like me” hypothesis of infant development: there is an intrinsic connection in the infant mind between observed acts and similar executed acts¹⁴. Infants project their own internal experiences onto others performing similar acts. As a result, infants begin to acquire an understanding of other minds and their mental states (desires, language, visual perception and basic emotions, for instance). This hypothesis suggests imitation is inborn, and the understanding of other’s mental states is a consequence. Later research has included the investigation of memory¹⁵, communications development, and intention¹⁶. In collaboration with neuroscientist Jean Decety, Meltzoff has started to investigate the neural mechanisms underpinning imitation^{17,18}, empathy¹⁹ and gaze-following. Other research has shown that gestures help the child in constructing the meanings of words. Child used functions: pointing, with conventional gestures such as “yes”, “no”, “good”, “hello”, which imitate gestures of specific representation of objects, actions or events²⁰.

The goal of the present study is to explore how SES may affect develop of language and the possible connection between failure to develop spontaneous imitation of actions and poor language abilities in a random sample of normal children.

MATERIALS AND METHODS

Two indicative measures of SES are used in this study: index of multiple deprivation (IMD) and maternal education status. IMD is a composite measure of deprivation and it is based on information from seven domains (income, employment, health and disability, education, skills and training, housing and service, crime and living environment). Maternal education is clearly a reflection of human capital (not material influences), while IMD measures of income and employment reflect financial capital (basic needs as food and clothes). Information on years of maternal education and IMD scores was collected by means of parental surveys (questionnaires). The maternal education factor is divided into three groups: statutory minimum numbers of years leaving full-time education (high school), further education, higher education to degree level. Social capital is reflected in IMD measures of housing and services, crime and living environment⁷.

Our study focused on 60 children (30 males, 30 females) aged from 3 years to 5 years and 11 months (mean age 4 years and 6 months) with apparently normal language development. No child had certified diagnosis of the disorder. Information was collected by administering specific surveys during the 2014-2016 school year in a public nursery school of a poor area in Bari and in a private nursery school of Noicattaro. The tool used for the linguistic analysis was the NRDLS test (Italian version), administered by clinicians to all 60 children.

The IMD factor is divided into two groups: one presents the NRDLS test scores obtained from children in a public nursery

school of Bari, the other group presents the children’s scores on the test selected in private school of the residential district of Noicattaro. Children attend a public school located in the Libertà neighborhood in downtown Bari. This neighborhood is a multi-cultural environment subjected to urban pollution with few gardens²¹ and with a high crime rate²². Every child had 10 toys, lived in a family with a middle-income <15.000 euros income tax 2014²³, played with family members for less than two days a week and did not practice extracurricular activities. Instead, children in the other group lived in Noicattaro, a residential district with large green areas and gardens to play in, with little pollution^{22,23} and with a lower crime rate. Every child had more than 10 toys on average, lived in a household with a higher income >20.000 euros income tax 2014²² played with family members for more than two days a week and practiced extracurricular activities.

The tool used for the linguistic analysis was the NRDLS test²⁴. It was administered in Italian language to all 60 children by clinicians. The NRDLS test contains 72 items for comprehensions, divided into seven sections, 64 items for productions divided into seven sections. It is administered using objects, toy animals and picture books. Sections in both scales cover early vocabulary nouns and verbs, relating two objects, simple sentences, grammatical inflections and complex sentences. The comprehension scale also has sections on pronouns and inferencing and the production scale includes a section testing grammaticality judgement.

Three sections of NRDLS test are used to study imitation with 28 items. The NRDLS imitation test scores and spontaneous observation scores were added to get a total score. The NRDLS imitation items are 21 and the spontaneous observation items are 7: total items 28. The maximum score is 56, two points for each item (Table 1).

Data analysis

All demographic and clinical variables were subjected to statistical analysis. Descriptive analysis was conducted for socio-demographics featuring two samples. To compare age and gender between the verbal and nonverbal groups, we used respectively the Mann-Whitney U test and the chi-square test. In addition, the chi-square test was used to determine whether there was any difference between the expected and observed values in various categories (Mother’s study title, Income, Toys, Family playing time, Sport, and School type) between verbal and nonverbal groups. The Mann-Whitney U test is a nonparametric test and it was used to examine the difference of the NRDLS (Production, Understanding, and Imitation scales) scores between verbal vs nonverbal groups and public vs private school. A P-value of less than 0.05 was considered as statistically significant. For statistical processing, we used the Statistical Package for Social Science version 20.0.

RESULTS

We studied 60 children (30 males and 30 females) aged from 3 to 5 years and 11 months. The NRDLS Italian version was administered in a public nursery school of Bari and in a private nursery school of the Noicattaro residential district. The mean of the children’s age in the public school was 4 years and 6 months versus 4 years and 7 months in the private school. The analysis of comprehension, production and imitation are not different between children in public and private schools (Table 2).

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Table 1. Imitation Test.

Score 0: imitation present

Score 1: partial imitation

Score 2: imitation absent

Maximum score: 56

Section: Relationship between objects 1

■ **Materials:** teddy bear, rabbit, bed, apple, spoon, box.

■ **Instructions:** manipulate objects while saying the sentence. Explain that the child will have to repeat what the operator says. The operator says:

Are you able to say what I say?

1) The teddy bear is in the box. Now you tell me.

The teddy bear is in the box.

2) Here are the rabbit and the bed. Now you tell me.

Here are the rabbit and the bed.

3) The spoon is in the box.

4) Here are the teddy bear and rabbit.

5) The rabbit is in the box.

6) Here are the apple and the bed.

7) The spoon is on the bed.

Spontaneous observation

1) In section Relationship between objects, does the child manipulate the objects according to the operator's instructions in items?

2) Does the child after each item look at the operator?

3) Does the child try to imitate the words and repeat the sounds?

4) Does the child repeat the actions of the operator?

Section: Relationship between objects 2

■ **Material:** teddy bear, truck, box.

■ **Instructions:** remove the previous objects. Sit next to the baby. The purpose is to get the baby to tell where the teddy bear to see his movements and to analyze his movements. The operator places the teddy bear and says:

Where's the teddy bear?

NB. Truck orientation is important: make sure the front of the truck is facing the child and the operator in each item.

■ **Score:** punctuate as appropriate if the child performs the action of the operator even if the appropriate prepossession/adverb (eg on, in, below) is not used with an appropriate name (eg truck, car, wagon) or a Pronoun (eg this one). Carefully analyze the gestures and actions of the child.

1) The operator places the teddy bear in the box. What does the baby do?

2) The operator places the teddy bear under the box.

3) The operator puts the teddy bear over the truck.

4) ... near the truck. Near/next to / next to the truck (car, wagon, this)

5) ... under the truck. Under the truck (car, wagon, this)

6) ... in front of the truck. In front of the truck (car, wagon, this)

7) ... behind the truck. Behind the truck (car, wagon, this)

Spontaneous observation

1) In this section, does the child manipulate the truck according to the operator's instructions in the various items without speaking?

Does the child repeat the actions of the operator?

2) Does the baby look after the item concerned after each item?

3) Does the child try to imitate the words and repeat the sounds?

Section: verbs

■ **Material:** monkey

■ **Instructions:** use the monkey to perform each action. The goal is to stimulate the production of the verb and to analyze the gestures of the child. Each form of the verb is acceptable (eg jumping, jumping, jumping, jumping). The operator takes action at the monkey and says:

What is the monkey doing?

1) The operator skips the monkey. What does the baby do?

2) the operator does the monkey run the baby. What does he/she do?

3) The operator salutes the monkey. What does he/she do?

4) ... applauding. What does he/she do?

5) ... walk. What does he/she do?

6) ... sit down. What does he/she do?

7) ... fall.

The child fails to produce the corresponding verb but tries to take the monkey from the operator or perform the action himself?

Total score:

Table 2. Descriptive sample analysis.

| | Public School Group (30) | | Public School Group (30) | | P |
|---------------|--------------------------|-------|--------------------------|-------|-----------|
| | mean | Sd | mean | Sd | |
| Comprehension | 52.7 | 13.63 | 55.03 | 14.32 | 0.94 (ns) |
| Production | 39.82 | 11.68 | 43.48 | 14.82 | 0.47 (ns) |
| Imitation | 12.07 | 4.14 | 12.07 | 4.14 | 0.25 (ns) |

In the NRDLS test, 19 children had scores below -1DS and are not verbal. 41 children are in a verbal group.

Comparing the NRDLS scores between the verbal and nonverbal group (Table 3) we found statistically significant differences in Production scale ($p<.0001$), Understanding scale ($p<.0001$), Imitation scale ($p<.0001$). Children in the nonverbal group reported more problems in Production, Understanding, and Imitation scales compared with children in verbal group (Table 4).

In addition, we found only different in more mothers with degree in verbal group comparing with non-verbal group ($p=.023$). The mothers of children in the verbal group were characterized by a high degree of academic level, on the contrary mothers of children in nonverbal group are characterized by compulsory education or high school diploma (Table 5).

Table 3. Descriptive sample analysis.

| | Tot (N=60) | Verbal (n=41) | Non-verbal (n=19) | p-value (*) |
|----------------------|----------------------|---------------|-------------------|-------------|
| Gender | Males | 22 | 8 | ns |
| | Females | 19 | 11 | |
| Mother's study title | Compulsory education | 13 | 9 | 0.023 |
| | Diploma | 11 | 9 | |
| | Degree | 17 | 1 | |
| Income | <15000 | 22 | 9 | ns |
| | >15000 | 19 | 10 | |
| Toys | <10 | 22 | 9 | ns |
| | >10 | 19 | 10 | |
| Family playing time | <2gg | 22 | 9 | ns |
| | >2gg | 19 | 10 | |
| Sport | YES | 22 | 9 | ns |
| | NO | 19 | 10 | |
| School | Public | 21 | 9 | ns |
| | Private | 20 | 10 | |

(*) Fisher exact test

Table 4. Statistically significant differences in production, understanding and imitation scales between verbal and non-verbal subjects.

| | Verbal (n=41) | | Non-verbal (n=19) | | p-value (*) |
|---------------------|---------------|-------|-------------------|--------|-------------|
| | Mean | SD | Mean | SD | |
| Production scale | 59.66 | 7.002 | 41.16 | 16.527 | 0.000 |
| Understanding scale | 47.37 | 8.593 | 28.68 | 12.957 | 0.000 |
| Imitation scale | .44 | .743 | 37.58 | 13.451 | 0.000 |

(*) Mann-Whitney test(*) Fisher exact test

Table 5. Statistically significant differences in mother's study title between verbal and non-verbal subjects.

| | Verbal (n=41) | | Non-verbal (n=19) | | p-value (*) |
|----------------------|---------------|----------------|-------------------|----------------|-------------|
| | Count | Expected count | Count | Expected count | |
| Mother's study title | | | | | 0.023 |
| Compulsory education | 13 | 15 | 9 | 7 | 0.000 |
| Diploma | 11 | 13.7 | 9 | 6.3 | 0.000 |
| Degree | 17 | 12.3 | 1 | 5.7 | |
| TOT | 41 | 41 | 19 | 19 | |

(*) Fisher exact test

DISCUSSION

Our study found no effects of SES on language acquisition, but the mother's degree is probably important in language development. Edward et al.²⁴ equally saw an increase of NRDLS scores associated with an increase in years of maternal education. Rowe²⁵ and Sylva et al.²⁶ analyzed a number of features of child's communication and have found also more social skills were present in wealthy families and by the frequency of pre-schools.

Roulstone et al.²⁷ have identified environmental factors that act as mediators in the first learning of language, such as the number of books available for children, the frequency of libraries visited, the teachings of parents and the number of toys available for children. These authors have shown that these factors are more strongly associated with the first language learning compared to broader measures of socioeconomic status.

Letts and Edward's sentences, found within the group of children with uneducated mothers, a number of children with

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a score of -1DS (according to the categories defined by Wiig et al.²⁸ higher in children aged 5 years and 6 months).

In our study, we found association between imitation capacities and verbal skill. Numerous studies have analyzed the imitation in autism spectrum disorders, but few studies have studied imitation in specific language impairment. Charman et al.²⁹ demonstrated that imitation of action or objects at the age of 20 months was associated with language ability in the fourth year of life. De Giacomo et al.³⁰ have highlighted that a reduced or totally absent spontaneous imitation of action in children with autism disorder is related to reduced or totally absent communication skills. In children with SLI, imitation skill and gestural joint attention have been found to correlate with verbally responsive abilities. Children with SLI performed more poorly than their peers in body posture imitation, and their performances indicated more complex errors than those observed in typically developing children. Sentence imitation has been identified as a good indicator of children's language skills, with performance differentiating children with specific language impairment and showing relationships with other language measures.

Our study showed that children with impaired imitation show in NRDL very limited expressive language. Although, imitation and verbal communication are independent for socioeconomic status. This association, in fact, could be explained by the fact that during the pre-linguistic stage of child development, communication is based on nonverbal behavior such as gaze, facial expression and body language to communicate their needs, wishes, and social intentions and gesture often conveys information that is not conveyed in the speaker's words^{31,32}. Furthermore, during the first stages of verbal skill development, language always accompanies the child's play and only after age two do children abandon their own gestures in favor of the exclusive use of verbal language, when they can manage it in a more mature way. Our findings seem to support the concept that failure to develop imitation skills could affect the whole communication domain, both gesture and verbal, in language disorders³⁰.

Several authors discussing modern neuropsychological interpretations have assumed that mirror neurons act as a bridge between perceived action and language. It is important to note that a human mirror neuron is involved in imitation and probably in language³¹⁻³⁵.

The present findings support the new concept of a neuropsychological implication of the mirror neuron system in these language deficits. Also Volterra et al.²⁰ showed that gestures help the child in construction meanings of words, imitation gestures help language development.

CONCLUSIONS

The correlation between imitation and communication skills can be useful for planning rehabilitation treatment for these children. Watchful waiting alongside well informed classroom teachers coupled with appropriate classroom language enhancing activities could be successfully implemented for the other children to ascertain whether these children are slow developers who will catch up or have atypical development and require specialist intervention. The present study is limited by the population sample than is necessary additional support from previous finding.

Acknowledgements: we would like to thank dott. Pietro Iafaldano for his valuable collaboration in statistical process.

Conflict of interests: the authors have no conflict of interests to declare.

REFERENCES

1. McLoyd VC. Socioeconomic disadvantage and child development. *Am Psychol* 1998; 53: 185.
2. Anderson NB, Armstead CA. Toward understanding the association of socioeconomic status and health: a new challenge for the biopsychosocial approach. *Psychosom Med* 1995; 57: 213-25.
3. Brooks-Gunn J, Duncan GJ. The effects of poverty on children. *Future Child* 1997; 7: 55-71.
4. Evans GW. Child developmental and the physical environment. *Annu Rev Psychol* 2006; 57: 423-51.
5. Gottfried AW, Gottfried AE, Bathurst K, Guerin DW, Parmore MM. Socioeconomic status in children's development and family environment: infancy through adolescence. In: Bornstein MH, Bradley RH (eds). *Socioeconomic status, parenting and child development*. Mahwah, NJ: Lawrence Erlbaum Associates, 2003.
6. Smith JR, Brooks-Gunn J, Klebanov P. The consequences of living in poverty for young children's cognitive and verbal ability and early school achievement. In: Duncan GJ, Brooks-Gunn J (eds). *New York, NY: Russell Sage*, 1997.
7. Hackman DA, Farah MJ, Meaney MJ. Socioeconomic status and the brain: mechanistic insights from human and animal research. *Nat Rev Neurosci* 2010; 11: 651-9.
8. Hanson J, Hair N, Shen D, et al. Family poverty affects the rate of human infant brain growth. *PLoS ONE* 2013; 8: e80954.
9. Rowe ML, Goldin-Meadow S. Early gesture selectively predicts later language learning. *Dev Sci* 2009; 12: 182-7.
10. Coleman JS. Social capital in the creation of human capital. *Am J Sociol* 1988; 94 (suppl): 95-120.
11. Tomasello M, Kruger AC, Ratner HH. Cultural learning. *Behavioral and brain sciences* 1993; 16: 495-552.
12. Goldenberg G, Karnath HO. The neural basis of imitation is body part specific. *J Neurosci* 2006; 26: 6282-7.
13. Rizzolatti G, Arbib M. Language within our grasp. *Trends Neurosci* 1998; 21: 188-94.
14. Marshall D, Meltzoff A. Neural mirroring mechanisms and imitation in human infants. *Philos Trans R Soc Lond B Biol Sci* 2014; 369: 20130620.
15. Meltzoff A, Moore MK. Imitation of facial and manual gestures by human neonates. *Science* 1977; 198: 75-8.
16. Meltzoff AN. 'Like me': a foundation for social cognition. *Dev Sci* 2007; 10: 126-34.
17. Meltzoff AN, Moore MK. Imitation, memory, and the representation of persons. *Infant Behav Dev* 1994; 17: 83-99.
18. Decety J, Chaminade T, Grèzes J, Meltzoff AN. A PET exploration of the neural mechanisms involved in reciprocal imitation. *NeuroImage* 2002; 15: 265-72.
19. Chaminade T, Meltzoff AN, Decety J. An fMRI study of imitation: action representation and body schema. *Neuropsychologia* 2005; 43: 115-27.
20. Volterra V, Caselli MC, Capirci O, Pizzuto E. Gesture and the emergence and development of language. In: Tomasello M, Slobin DI (eds). *Beyond nature-nurture: essays in honor of Elizabeth Bates*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers, 2005.
21. Legambiente dossier Urban Ecosystem, October 26, 2015 to 66th place on Bari 100; values Pollutant: O2 = 42; NO2 = 12; SO2 = 1.5; CO = 185; PM10 = 10; PM2.5 = 5.3; Legambiente October 26, 2015.
22. Il Sole 24 Ore September 2014; April 6, 2014 Bari is at 33rd place out of 106 cities under consideration.
23. Istat 2014, www.istat.it/it/archivio/164869.

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24. Edward S, Letts C, Sinka I. The New Reynell Developmental Language Scales. London: GL-Assessment, 2011.
25. Rowe ML. Child-directed speech: relation of socioeconomic status, knowledge of child development and vocabulary skill. *J Child Lang* 2008; 35: 185-205.
26. Sylva K, Siraj-Blatchford I, Taggart B. Assessing quality in the early years. New York: Teachers College Press, 2011.
27. Roulstone S, Law J, Rush R, Clegg J, Peters T. Investigating the role of language in children's early educational outcomes. Bristol: University of the West, 2011.
28. Wiig EH, Secord W, Semel E. Clinical evaluation of language fundamentals – Preschool. Second UK edition. London: Harcourt Assessment, 2006.
29. Charman T, Baron-Cohen S, Swettenham J, Baird G, Cox A, Drew A. Testing joint attention, imitation and play as infancy precursors to language and theory of mind. *Cogn Dev* 2000; 15: 481-98.
30. De Giacomo A, Portoghesi C, Fanizza I, Margari L, Martinelli D, L'abate L. Imitation and communication skills development in children with pervasive developmental disorder. *Neuropsychiatr Dis Treat* 2009; 5: 355-62.
31. Rizzolati G, Fadiga L, Gallese V, Fogassi L. Premotor cortex and recognition of motor actions. *Corn Brain Res* 1996; 3: 131-41.
32. Rizzolati G, Craighero L. The mirror neuron system. *Ann Rev Neurosci* 2004; 27: 169-92.
33. Rizzolati G, Arbib MA. Language within our grasp. *Trends Neurosci* 1998; 21: 188-94.
34. Rizzolatti G, Fogassi L, Gallese V. Cortical mechanism subserving object grasping and action recognition: a new view on the cortical motor functions. In: Gazzaniga MS (ed). *The new cognitive neurosciences*, 2nd Edition. Cambridge, Ma: MIT Press, 2002.
35. Locke A, Ginsborg J, Peers I. Development and disadvantage: implications for the early years and beyond. *Int J Lang Commun Disord* 2002; 37: 3-16.