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Jean-Marc Colletta, Catherine Pellenq

► **To cite this version:**

Jean-Marc Colletta, Catherine Pellenq. The development of multimodal explanations in French children. Nippold, M. ; Scott, C. Expository Discourse in Children, Adolescents, and Adults. Development and Disorders, Taylor and Francis, pp.63-99, 2009. hal-01292684v1

**HAL Id: hal-01292684**

**<https://hal.univ-grenoble-alpes.fr/hal-01292684v1>**

Submitted on 25 May 2016 (v1), last revised 29 Mar 2016 (v2)

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## **The Development of Multimodal Explanations in French Children**

Jean Marc COLLETTA  
Lidilem, IUFM de Grenoble  
[jean-marc.colletta@u-grenoble3.fr](mailto:jean-marc.colletta@u-grenoble3.fr)

Catherine PELLENQ  
Laboratoire des Sciences de l'Éducation, IUFM de Grenoble  
[catherine.pellenq@grenoble.iufm.fr](mailto:catherine.pellenq@grenoble.iufm.fr)

In this chapter, we focus on the development of explanatory abilities in French children attending nursery and grade school. Even if young children are unable to produce written explanatory texts, there is nothing to stop them from formulating oral explanations. It is the "why" type explanation that we intend to examine here, and more specifically the way it develops with age. Furthermore, since speech acts are multimodal, children's explanatory verbal productions are frequently accompanied by bodily movements (hand and head gestures, facial expressions, changes of posture). The observation of gesture associated with speech provides data of considerable interest to anyone in the field of discourse development and the evolution of abstract thought.

In the first section of this chapter, we start by defending the idea that the study of the way explanations develop is a valuable starting point in gaining an understanding of how children come to master the academic (i.e., monologic) uses of discourse. In section 2, we report certain data which shed light on the importance of gesture in spoken communication as well as other data which suggest that the gestural system associated with speech undergoes an undeniable development. In section 3, we document the methodological choices made for the study which underlie the results and analyses presented in this chapter. This comparative study consists of two facets, one relating to the explanatory behaviour of children aged 6 to 11 years and the other relating to the equivalent behaviour in younger children aged 3 to 6 years. In section 4, we present the most significant results of this study, showing that spoken explanations are more complex in older children than in younger ones. These results argue in favor of the idea that the ability to verbalize monologic explanations develops with age.

The gestural aspects of children's explanations are discussed in sections 5, 6 and 7. First of all, it would appear to be gestures relating to abstract dimensions and discourse cohesion that are most prominent among the gestures that accompany the explanations produced by children aged 6 years and over (section 5). While the utilization of such gestures is well

documented in adults, their high rate in this corpus may seem surprising. Nevertheless, a semiotic analysis of these gestures reveals that they are based on the same properties as those observed in adults: abstract pointing and spatial metaphors (section 6). In contrast, a comparison with the gestures produced by younger children indicates that they are practically absent in the latter. This finding is consistent with the hypothesis that the gestural system associated with speech develops through childhood (section 7). The conclusion proposes a summary of this set of observations and results and addresses the implications both for explanatory development and, more generally, for language and cognitive development.

## **1. DISCOURSE DEVELOPMENT AND EXPLANATORY ABILITIES IN SPEECH**

Language acquisition is far from complete when a child enters primary school and, as many authors have pointed out, six-year-old children still master very few textual abilities that go along with monologic discourse (Halliday, 1975; Fayol, 1997; Hickmann, 2003; Jisa, 2004; Berman's and Nippold's contributions to this volume). There are several reasons for the late mastery of monologic discourse, which we define here as the individually controlled use of language.

First, monologic discourse, like narratives and other facets of academic discourse, is language built at a textual level (Bartlett, 1964; Mandler and Johnson, 1977; Fayol, 1985; Van Dijk, 1985; Adam, 1999; Roulet et al., 2001), and its use is based on the ability to understand and generate linguistic information organized at this additional level. Second, monologic discourse displays specific properties of coherence and cohesion (Halliday and Hasan, 1976; Lundquist, 1980; Weinrich, 1989) that have no equivalent in conversation, which is constructed from the sequencing of short speech turns. At the same time, these properties define the written use of language with the result that later language development proves to be directly related to the acquisition of literacy (reading and writing) abilities (Jisa, 2004; Tolchinsky, 2004). Third, monologic discourse is language that is underpinned by reference displacement, decontextualization and cognitive decentration. These involve cognitive abilities not exhibited by young preschool children (Karmiloff-Smith, 1979; Golder, 1996; Hickmann, 2003). Nevertheless, the studies of text production in children primarily focus on the development of textual abilities in terms of writing (Fayol, 1997). Consequently, little is known about the way children over five years of age come to perform oral monologic discourse.

However, for anyone interested in monologic discourse acquisition, the development of the ability to produce spoken explanations is of particular importance for a variety of reasons. Firstly, unlike narratives, which are built from distinct sequences, explanations do not necessarily require an internal textual organization. Of course, there is such a thing as an "explanation" in the strict sense of the term, that is to say a causal explanation in cases where there is an *explanandum*, i.e., a phenomenon or behaviour to be explained, and an *explanans* or cause, reason, or motivation for this phenomenon or behaviour (Veneziano and Sinclair, 1995; Veneziano and Hudelot, 2002). At the structural level, causal explanations necessarily link two sequences in the textual form < P because Q > (Adam, 1992). However, whereas in writing, a relationship is established between these two components in explanatory texts, this is not necessarily the same in spoken communication where the dynamic of spoken exchanges means that the *explanandum* and *explanans* tend to be split over two speech turns:

- Speaker 1: "why P"
- Speaker 2: "because Q"

The second reason relates to the heterogeneity of the explanatory forms: because spoken explanations may take the simple form with a single clause < because Q >, we might expect them to appear before narratives in children's language production. This is indeed the case: studies of narrative development show that children are scarcely able to produce a narrative before the age of five years (Fayol, 2000), whereas the first explanations appear even before the end of their second year (Veneziano, 1998). Of course, these are not genuine causal explanations and the productions observed at this age are really justifications: children provide a reason for their demands, refusals or behaviour. For example, they may stretch their arm out towards their cup which is out of reach, look at the accompanying adult and say "want drink" in order to justify the request, or push away an extra spoonful of food while saying "not hungry" to justify the refusal. Another specific characteristic of these initial verbalizations is that they do not include the connector "because" which does not appear until the child's third year (Kail & Weissenborn, 1984; Veneziano & Sinclair, 1995; Diessel, 2004). What is more, children rarely verbalize the *explanandum* with the result that the adult has to identify it himself or herself in the context.

The third reason for our interest in the development of explanations comes from the observations set out above. Purely at the linguistic level, there is an immense gap between children's first verbalized situational explanans and the explanatory written texts that they are able to draft during their final years of grade school. By now, they can dissociate themselves from the immediate situation and have acquired a decontextualized use of language, and, additionally, they have assimilated the constraints relating to cohesion and coherence which underlie the use of the textually organized forms of language both in individually controlled speech and in writing.

A priori, one might therefore imagine that the development of explanations between the ages of 3 and 11 years acts as a window into the development of monologic discourse. During the study described in this chapter, we tested the hypothesis that the ability to produce spoken explanations develops throughout nursery, preschool, and grade school towards the production of textual uses of language.

## **2. MONOLOGIC DISCOURSE AND GESTURE DEVELOPMENT**

For over half a century, since the pioneering work of Birdwhistell (1952), Schefflen (1964), Condon and Ogston (1966, 1967), and Kendon (1972, 1980), researchers have been interested in the scientific study of communications conveyed by body signals. The observations made by specialists in the study of gestures have led us to consider situation-based spoken communication to be a flow of multimodal information coming from the words, the voice, and the body.

Naturally, this observation may appear trivial: after all, don't we greet a friend with our hand or head while also using words? Don't we smile at the same time as offering an excuse? Don't we nod our heads to answer a question in the affirmative? However, the studies undertaken by gesture specialists tell us much more than these simple observations that relate only to the accomplishment of everyday language acts. When someone starts speaking to defend a point of view, offer an explanation or recount an event, the person's face is frequently seen to express mental states and emotions, while the head and hands move to express the speaker's thoughts. These face, head, and hand movements, sometimes accompanied by changes of posture, are known as "coverbals". They serve a number of functions, the most important of which are listed below (McNeill, 1992; Cosnier and

Vaysse, 1997; Kendon, 2004; Colletta, 2004). See definitions and examples in Appendix I at the end of this chapter:

- the identification of discourse objects with deictic or directional pointing when they are present and localizable in the physical communication setting or nearby;
- the representation of discourse objects by means of gestures which depict or mime concrete referents and symbolize abstract referents;
- the expression of emotions, mental states, and everyday language acts;
- the structuring of language production through the emphasizing of basic components of speech (syllable, word, word group);
- discourse cohesion by means of gestural anaphora and the marking of inter-clause relations, discourse units and discourse structure;
- synchronization between speakers and the coordination with each other's behaviour during social interaction.

It is true that some speakers "move" more than others when they are talking, that some express a lot with their faces and little with their hands while others do the opposite, and it is also true that variables such as age, gender, or cultural environment influence gestures just as they impact -- communication behaviour in general. However, it is still the case that, beyond our individual differences, we are all able to use our bodies to accompany our speech and that when we do so, our gestures are co-expressive with our speech (Kendon, 2004). By calling on coverbal resources, we are able to perform multimodal messages in which the visual signals provide information that is sometimes redundant and sometimes complementary or supplementary to the voco-verbal signals. However, while we now possess a substantial volume of multimodal observations concerning adult speakers and social interactions between adults in English and other languages (Kendon, 1990, 2004; Poyatos, 1992; McNeill, 1992, 2000; Poggi and Magno Caldognetto, 1997; Brookes, 2004, 2005) including French (Calbris and Porcher, 1989; Léonard and Pinheiro, 1993; Bouvet, 2001; Calbris, 2003), the multimodal study of children's language is not so far advanced.

Although many descriptions of young children's communicative behaviour are available (see Marcos, 1998; Iverson and Goldin-Meadow, 1998 or Guidetti, 2003 for more details), we still know little about the way multimodal speech develops after the age of two years, once the child has gone past the preverbal stage. A few studies have focused on the non-verbal behaviour of children age three and above (Montagner, 1978; Cosnier, 1982;

McNeill, 1992; Garitte, Le Maner and Le Roch, 1998; Goldin-Meadow, 2003). Although the results of these studies are not always consistent, they nevertheless lead us to hypothesize the development of the gestural system associated with speech. In other words, the use of hand and head gestures, facial expressions, and changes of posture directly linked to speech should vary with age and develop as the child gains new cognitive and linguistic abilities. The fact that new gestural behaviours (pointings, representational gestures) emerge at the same time as new linguistic abilities in younger children (Bates et al., 1979; Capirci et al., 1996, 2002; Butcher and Goldin-Meadow, 2000; Goldin-Meadow and Butcher, 2003, Özçaliskan and Goldin-Meadow, 2005) is consistent with this hypothesis.

In the study presented here, we attempted to test the hypothesis that the gestural system associated with speech develops in ways that abstract and discourse gestural behaviours appear and grow in the course of language acquisition. To do so, we observed the oral explanatory behaviour of children aged between 3 and 11 years. Apart from confirming the existence of this development, the semiotic study of the gestures that accompany the spoken explanations yields some fascinating observations which we shall consider in greater detail in sections 5 and 6 of this chapter.

### **3. METHODOLOGICAL ISSUES**

In recent years, we collected two corpuses of children's explanations. We had two objectives in doing so: first of all, we wanted to gather a set of data which was otherwise almost or totally non-existent at the time, and secondly we wanted to study the development of multimodal explanatory abilities between the ages of 3 and 11 years.

The first set of data was taken from video recordings of children aged from 6 to 11 years engaged in conversation with an adult (Colletta, 2004). Sixty children from grade school were filmed in groups of three children of the same age. The interviews focused on family and social topics and their main purpose was to prompt the children to produce causal explanations and verbal reasoning. These recordings enabled us to derive an initial corpus of 232 spoken explanations.

The second set of data was taken from video recordings of nursery and preschool classroom interactions during teaching sessions. Twenty-four sessions were chosen for their exemplary value as classroom activities used by teachers to elicit causal explanations from young

children aged from 3 to 6 years (Colletta, Simon, Vuillet and Prévost, 2004; Colletta, Simon and Lachnitt, 2005). Language sessions, experiments relating to the topics of air and water, art workshops and sessions involving logical reasoning were filmed in 6 nursery schools. These recordings yielded a second corpus of 268 spoken explanations.

All 500 explanations present in these two corpuses were formulated by children in response to a why-question asked either by an adult (interviewer or teacher) or by another child. Because of the widely divergent educational contexts and discourse topics, the semantic and thematic aspects of these causal explanations could not be taken into account. We therefore restricted our observations to the formal aspects of the collected data. Each explanation was verbally transcribed and the transcriptions were checked several times by different people.

Each explanation was then carefully analysed. We measured its duration as well as its linguistic content: number of syllables, number of clauses, number of connectives. Duration is an interesting parameter since it provides information about the child's ability to manage varying lengths of explanatory speech turns. The number of syllables provides additional information about children's verbal production abilities but tells nothing about their discourse capacity. In contrast, the fact that a child produces an explanation composed of several clauses linked by connectives, which represent genuine tools for the establishment of textual cohesion, provides direct information about his or her monologic discourse abilities. In line with our aim, which is to study the gestural, and not solely the verbal, aspects of children's explanations, we also measured the number of coverbal movements performed by the child while formulating his or her explanation.

The coverbal movements were identified using a somewhat complex procedure that needs to be explained in greater detail. A prior examination based on our initial data (Colletta, 2000) allowed us to construct a classification of children's coverbal movements. The head and hand gestures, facial expressions, and changes of posture that we observed were found to be very similar to those found in adult studies. Whether children use them in the same manner as adults remains an unanswered question, but we found that children's coverbal gestures can be assigned to the same categories as those set out in section 2 and defined in Appendix 1. Two categorization tests were later constructed from the corpus and 122 university



students were asked to classify and code the coverbal movements that were shown to them during the experiment.

The results (Colletta, 2000) indicated that some gestures were easily classified, while others proved harder to code. We learned that coverbal gestures can be coded with a fair level of interjudge agreement (65% overall agreement) by persons who have never been trained to do so, thus indicating that everyone has some knowledge of the functions and meanings of coverbal gestures. Further, there was a very high level of agreement (up to 90%) for pointing gestures, synchronization gestures, expressive gestures and concrete representational gestures (see Appendix 1 for definitions). Third, agreement was poor (as low as 40%) for abstract representational gestures and gestures which mark discourse cohesion (see Appendix 1 for definitions). It is worth noting that all gestural categories that were easy to code play an active role in the construction of reference or in the expression/detection of communicative intentions. Other categories of gesture may prove to be more important for the speaker himself than for the listener during the speech production process.

As part of the current debate concerning the role of gesture in speech, some researchers (Levelt, 1989; Feyereisen, 1994; Hadar and Butterworth, 1997; Krauss and al., 1995, 2000) have claimed that gesture has no real communicative purpose because of its fuzzy semiotic properties (for instance, the meaning of a coverbal gesture is highly dependent on its context). Others, like McNeill (McNeill and Duncan, 2000; McNeill, 2005), Kita (2000) or de Ruiter (2000), claim that gesture plays a crucial role in communication and that the listener pays close attention to it while processing the speaker's message, which is both audible and visual. We claim that both postulates may be true, depending on the category of gestures investigated in each study, whether they have an obvious communicative purpose (deictic gestures, concrete representational gestures, expressive gestures) on the one hand, or whether they help the speaker during the speech production process (abstract representational gestures, gestures which mark discourse cohesion, and beats which mark the structure of speech) on the other hand.

In the present study, all the coverbal movements performed by the children aged from 6 to 11 years were identified and coded by several independent coders. The coverbal movements

performed by the children aged from 3 to 6 years (second set of data) were identified and coded by two independent coders. Let us now present the main results arising from this study.

#### 4. THE DEVELOPMENT OF EXPLANATORY ABILITIES IN FRENCH CHILDREN: FROM CLAUSE TO TEXT

The results presented in Table 1 come from the fusion of the two sets of data, thus giving us a complete picture of the formal changes observed in explanatory behaviour from the nursery school (children aged from 3 to 4 years) to the last grades (children aged from 9 to 11 years).

These results show a gradual increase on all our measures. This is not surprising: as children get older, the duration of their entire explanations get longer and they contain more syllables, more clauses, and more connectives (i.e., linguistic elements that relate two or more clauses or bigger discourse units; connectives are formed with coordinate conjunctions, subordinate conjunctions, adverbs, and formulaic constructions like “for example”, “all the same”, “on the other hand”, etc.). However, as shown in Table 2, this change also has a qualitative aspect. The 500 explanations can be assigned to two categories on the basis of their textual structure: “simple explanations” and “complex explanations.” Simple explanations contain either one clause only, as in (1), or two or more clauses which are simply juxtaposed with no logical or chronological link between them, as in (2) (the second clause corresponds to a second reason given by the child and is linked to the first clause by a conversational leap, so that the connector “et” (and) has no obvious logical meaning in this speech turn):

**(1) Girl, 4 years old:**

Explanandum: pourquoi elle pleure la p'tite fille ?  
why is the little girl crying ?

Explanans: parce qu'elle est punie  
because she was punished

Textual structure : < because P1 >

\* P1, P2, P3, etc. = clause one, clause two, clause three, etc.

**(2) Girl, 3.5 years old:**

Explanandum: pourquoi tu dis que c'est de la fraise ?  
why do you believe it's strawberry juice ?

Explanans: parce que c'est rouge et ça sent la fraise

because it's red and it smells of strawberry

Textual structure: < because P1 and P2 >

Complex explanations contain at least two clauses which are bound together, either logically or chronologically, as in (3) and (4):

**(3) Boy, 5.5 years old:**

Explanandum : pourquoi le ballon s'est-il envolé si vite ?  
why did the balloon fly away so fast ?

Explanans : parce qu'il a mis beaucoup d'air alors ça avance encore plus  
because he put a lot of air in it so that it moves faster

Textual structure: < because P1 so that P2 >

**(4) Boy, 6 years old:**

Explanandum : pourquoi est-ce que ça peut faire mal ?  
why can it hurt you ?

Explanans : parce que si tu lances en arrière ça tombe sur la tête et après ben t'es mort  
because if you throw it in the air it falls on your head and then well you die

Textual structure: <because if P1, P2 and then P3 >

As Table 2 shows, the proportion of complex explanations increases greatly with academic age, from 3% in the explanations produced by the younger children, to 83% in the explanations observed in the older ones. This is proof that with increasing age, children tend to produce increasingly long explanations with an ever richer verbal information content and a greater presence of explicit logical or chronological links expressed by connectives which link clauses. We also observe a constant diversification of the way these connectives are used with increasing age as shown in Table 3:

This change from the use of simple explanation to the use of complex explanation, as well as the constant diversification in the use of connectives, leads older children to verbalize genuine monological explanatory discourse, e.g., explanations built out of coherent and logical/chronological relations between clauses, like in (5):

**(5) Boy, 9 years old:**

Explanandum : pourquoi les parents d'un enfant ne sont-ils pas originaires d'une même famille ?  
why don't a child's parents come from the same family ?

Explanans : c'est parce que [...] nos parents i' z'avaient des parents - qui: sont nos  
grand parents [...] et:: - i' sont pas fait d' la même famille pas'que si i' sont faits

d' la même famille et qu'i' z'auraient fait un bébé - ben ça aurait fait un enfant handicapé quoi - et ça peut pas [...] sinon: i' s'rait pas un papa et maman - seront frère et sœur  
because our parents had their parents, who are our grand-parents, and they are not from the same family because if they were and if they had had a baby, well he would have been handicapped, and that can't be the case otherwise they wouldn't be a dad and a mum, they would be brother and sister

Textual structure: < because P1, P1' and P2 because if P3 and if P4, P5 and P6 otherwise P7, P8 >

From our point of view, and even though our analyses relate only to the form of the explanations and not to their content, all the observed developments indicate the gradual emergence in children of the ability to produce coherence, that is to say speech organized as monologic discourse. Let us now consider the multimodal aspects of children's explanations.

## 5. THE CLOSE RELATIONSHIP BETWEEN DISCOURSE AND GESTURE

Table 1 not only shows a gradual increase in the linguistic content of explanations with age, it also indicates a similar increase in the use of coverbal gesture. The data provided by children aged from 6 to 11 years reveal two interesting findings. First, there are significant correlations between the linguistic productivity measures and the gestural productivity of explanations. We found a correlation of .72 between the number of syllables and the number of coverbal gestures, and a correlation of .70 between the number of clauses and the number of coverbal gestures (Colletta, 2004). In other words, the more linguistic information there is, the more gestural information is associated with it. This finding is consistent with the multimodal speech processing hypothesis put forward by McNeill (2005), Kita (2000) or de Ruiter (2000) (see section 3 of this chapter).

The second finding suggests that there are very close relationships not only between gesture and monologic productivity generally, but more precisely between gesture and the type of monologic discourse. The main purpose of the interviews we conducted with grade school children was to elicit causal explanations. However, the children also debated freely about various subjects, reported events they had witnessed, and described objects or places they were familiar with. Thus, together with the 232 explanations, we extracted 23 debating sequences, 32 narratives, and 25 descriptions (see Colletta, 2004 for more details). The duration, linguistic content, and gestural content of these debates, narratives, and descriptions were measured. The coverbal gesture was coded using the same method as for the causal explanations. Among the representational movements (see Appendix 1 at the end of this chapter), the gestures of the concrete, which proved easy to code in the categorization experiment reported in section 3, were counted separately. The gestures of the abstract,

which proved difficult to code, were counted together with the discourse cohesion gestures, which also proved difficult to code. As mentioned in section 3 of this chapter, we claim that abstract representational gestures together with discourse cohesion gestures and beats primarily express the speaker's enunciative efforts rather than the deliberate intention to communicate a visual message that is complementary or supplementary to the utterance.

As Table 4 shows, we found that children use specific coverbal resources with each type of monologic discourse task (Colletta, 2004). They use a large number of concrete representational gestures while describing and narrating, many expressive gestures while debating, and mainly abstract and discourse cohesion gestures while explaining.

The most striking phenomenon here is the high rate of abstract and discourse cohesion gestures in children's explanatory discourse. Adult speakers use discourse cohesion gestures and beats in spoken monologic discourse in order to segment their verbal production (background vs foreground, narrative frame vs comment, thesis vs antithesis) and mark its cohesion (McNeill, 1992; Bouvet, 2001). In addition, they use abstract representational gestures in spoken explanatory discourse in order to convey abstract thought, thanks to the spatial metaphorical properties of such gestures (McNeill, 1992; Calbris, 2003). Do children over 6 years of age use abstract representational gestures when they provide causal explanations in speech as adult speakers do? Do younger children also use abstract and discourse cohesion gestures when giving causal explanations? Let us first consider the abstract thought question (section 6), and subsequently the question relating to gesture development (section 7).


## **6. ABSTRACT AND DISCOURSE COHESION GESTURES IN CHILDREN'S SPOKEN EXPLANATIONS**

We list the main types of abstract representational gestures and discourse cohesion gestures identified in children aged from 6 to 11 years. Each type is defined and illustrated below.

**Indirect pointing:** Unlike deictic or directional pointing, indirect pointing does not indicate a referent that is physically and directly perceptible or localizable in the communication setting. We have identified at least two types of indirect pointing: anaphoric pointing, which has been amply described in studies of the gestural language used by individuals who are deaf in which it plays the linguistic role of a reference pronoun, as well as another type of pointing we called "substitution pointing." Anaphoric pointing makes it

possible to designate a referent previously assigned to a location in the frontal space when the subject subsequently points to the same spot that is thought to represent it. To illustrate, (6) shows a speaker who, while describing where he lives, makes locative gestures (a and b) on the table to represent the location of two blocks of flats in his district, followed by two anaphoric gestures (c and d). The first one designates the initial block on the left and the second one the other block on the right:


**(6) Boy, 7 years old, locative and anaphoric gestures**



Là t'as un immeub' qui fait comme ça et: - comme ça - ben celui qu'est peint c'est pas celui qu'est peint - c'est l'autre  
 There you've got a block like that and - like that - well the one that's painted isn't the painted one - it's the other  
 (2 hands locating the blocks on the table) (R hand points > L) (R hand points > R)

Anaphoric gestures can also be used for abstract referents. In (7), a speaker is explaining that a child in a family generally gets the father's name. He positions abstract entities in the front space before selecting the required ones thanks to the anaphoric properties of his gestures: he uses his index finger to locate on his right the mother's family name (a), then the ring finger to locate the father's family name on his left (b); he then points to the left (c) to select the latter while saying the father's name again:


**(7) Boy, 11 years old, anaphoric gesture on c**



i' z'ont une mère elle s'appelle Martin - et l'autre - le père Martinez - et ben: ça - le nom d' famille ça s'ra Martinez  
 they've got a mum she's called Martin - and the other - the dad Martinez - and well it - the family name will be Martinez  
 (R index > R) (R ring > L) (R hand points > L)

Substitution pointing is not based on co-reference but on substitution: the object, action or person designated by pointing does not correspond to the referent but to a substitute in the physical setting. In (8) below, the speaker evokes the possible danger of badly placed objects which may fall and cause injury. He gives the example of a drum placed on a shelf in the room in which the interview was held; after designating the drum by means of direct pointing, he touches the top of his head to evoke the head of a child hit by this badly placed object while walking underneath it:


**(8) Girl, 8 years old, substitution pointing**



comme le tambour là-bas - et ben - par exemple [...] il va tomber sur la tête et [...]  
like the drum there - and well - for example [...] it'll fall on your head and [...]  
(touches the top of her head)


Introduction of a new referent: by means of a hand or head movement, the speaker locates a new object of discourse towards one spot in the frontal space or in one direction (right, left, up or down). We show examples of the gestural introduction of a new referent in the following explanations:

**(9) Boy, 7 years old, gestural introduction of a new referent**



moi j'ai plus d'arrière-grand-père ni d'arrière-gra'-mère - pas'que mon arrière-grand-père heu: - il a fait la guerre  
I've no longer got a great grand-dad or a great-grandma - not just my great grand-dad, eh - he fought in the war  
(head > R)


**(10) Boy, 7.5 years old, gestural introduction of a new referent**



pas'que [...] - et ma am' - ma - mon aut' mamie - elle a fait maman  
because [...] - and my gra - my - my other granny - she had mum  
(head > R) (head > L)

In the two previous extracts, the new referents introduced as gestures at the same time as verbally are persons related to the speaker. In (10), the gesture refers to an ancestor ("my great granddad") who is positioned to the speaker's right by means of a quick sideways movement of the head; the two people (granny, mum) are positioned in two different directions, again by means of two quick head movements, the first to the right and the second to the left. In the next example, however, the referent is not a concrete referent but an abstract one: a moment in the day ("this afternoon") which the speaker locates on the right, again by means of a quick sideways head movement:


(11) Girl, 9 years old, gestural introduction of a new abstract referent



ma maman elle c'est tous les jours que: elle travaille du matin - comme - c't' après midi là - ben elle s'ra à fa maison [...]  
my mum every day she works in the morning - like - this afternoon - well, she'll be at home [...]  
(head + chest > L)


Finally, the referent can be introduced by means of a metaphorical gesture. In the next two examples, the referent is introduced with a votive gesture (i.e., hand forward with the palm up). The metaphorical properties of this gesture have been analyzed in detail by Calbris and Porcher (1989) and McNeill (1992) and are now well known: the hand represents a container and the hollow of the hand suggests an invisible content which corresponds to the subject of the discourse offered to the partner in the conversation and to which the speaker wants to draw the partner's attention.

(12) Boy, 7.5 years old, metaphorical introduction of a new referent



et d'abord on est obligé d'avoir des parents - si moi chus fait - chus bien fait par quelqu'un  
and you've got to have parents - if I was made - then I was made by someone  
(R hand > R in votive gesture)

(13) Girl, 10 years old, metaphorical introduction of a new referent



ben - quand i' t'arrive des problèmes tu peux leur en parler: tu heu [...]  
well - if you have problems you can talk to them about it: you uh [...]  
(R hand > R in votive gesture)

Symbolizing time and aspect: the gestures which symbolize time and aspect and which have been recorded by Calbris (1985), Calbris and Porcher (1989) are also present in children's gestural repertoire. These are generally built on the basis of a left/right opposition (a gesture to the left designates the past while a gesture to the right designates the future or vice versa) or, less frequently, on the basis of a front/back opposition (the back designates the past and the front designates the future). Here is an example:



(14) Boy, 10 years old, metaphoric gesture for time



pas'que - avant - avant dans l' temps - on pouvait faire c' qu'on veut y avait pas de truc de drogue [...]  
 because - before - earlier on - you could do what you wanted and there were no drugs and stuff [...]  
 (gaze + L hand > L)

The speaker in (14) evokes a past period of time ("before, earlier on") and locates it at the top left of his frontal space by means of a gesture accomplished with the left hand while simultaneously looking in the same direction. The production of gestures which support the expression of time or aspect are generally accompanied either by an adverb ("avant/before" in extract 14) or by a noun or prepositional phrase relating to time or aspect ("dans le temps/earlier on" in the same extract).

Symbolizing a process, an action: some children exhibit gestures that serve as metaphors for processes and actions. The most frequent of these is a cyclical movement of the hand (the hand draws one or more circles in the air) that goes with verbs such as "faire/do", "fabriquer/make", "devenir/become" or "conquérir/conquer". The metaphorical functioning of these gestures, based on the circular shape and the mode of repetition has been excellently analysed by Calbris and Porcher (1989), Calbris (2003). Two other examples of gestural metaphors for processes are given below:

(15) Boy, 11 years old, metaphoric gesture for a process



Puisque le père - i' garde - c'est lui qui: - qui garde le nom d' famille [...]  
 Because the father keeps it - it's him who - who keeps the family name [...]  
 (R hand closes to form a fist)

(16) Boy, 11 years old, metaphoric gesture for a process




Pas'que les jeunes (xxx) - i' viennent heu d'apprendre - alors [...]  
 Because the young ones (xxx) - have just learned - well [...]  
 (L hand makes a grasping gesture, illustrated in two sequential photos here)

In (15), the gesture of closing the hand as a fist symbolizes gathering, putting back together. It is a metaphor for the verb "garder/keep" in the sense of "conserve". The gesture in (16) mimics the act of seizing something (here illustrated by means of two photos, a and b) that symbolizes the concept of learning, as if, for the speaker, learning signifies the acquisition of new knowledge.

**Symbolizing a quantity:** some gestures symbolize an indefinite quantity linguistically marked by indefinite determiners such as "des/some", "quelques/some" or "plusieurs/a few". They are hand or head gestures designating a poorly defined area in the frontal space performed together with a side-to-side gaze. This imprecise designation of space turns out to be a metaphor for an indefinite entity. See this example:


**(17) Boy, 11 years old; metaphoric gesture for a quantity**



t'es trop p'tit pour aller heu - heu sortir le soir pas'que y a- y a des voleu:rs y a - et t'es heu (xxx)  
 you're too small to go um - um go out in the evening because there are there are thieves there are - and you are um (xxx)  
 (head and eyes moving through the space from L to R)

Here, the speaker combines a head gesture and a side-to-side gaze to express the idea that an indefinite number of people representing a potential danger ("thieves") could be present in town during the evening or night and that is the reason why children should not go outside late in the evening. Other gestures symbolize a large quantity linguistically marked by determiners such as "tous or toutes/all". In (18) for example, the speaker's hand gesture – hand open and moving through space from left to right and then from right to left – seems to enclose all the immediate frontal space and draw a field which metaphorically represents the concept of entirety encoded by the determiner "toutes/all":

**(18) Boy, 11 years old, metaphoric gesture for a quantity**



et là quand heu quand il aura fini toutes ses études il aura quarante-cinq ans - enfin- [...]  
 and when he's finished all his studies he'll be forty-five years old - well- [...]  
 (head and R hand sweep through space from L to R)

Symbolizing modality: a gesture of frequent use is the emblematic symbol of negation that consists of shaking the head from left to right. When talking about this gesture, one initially thinks of its pragmatic uses, for example, when it accompanies a negative response as in (19) below, or when, in the absence of speech, it accompanies and reinforces an act of denial or refusal. However, this gesture also has referential meanings when performed with assertive utterances. It then acts as the metaphorical representation of ignorance (in (20) where the speaker admits not knowing how to act in the event of danger in the home), inability (in (21) where the referent is a small child unable to accomplish household tasks), or obligation (in (22) in which the speaker evokes situations in which he has to give way to the demands of his younger brother):

**(19) Boy, 7 years old, emblematic gesture of negation**

Sp.A: on peut s'amuser quand on a fini not' travail  
 Sp.A: we can have some fun when we've finished our work  
 Sp.B: non - non - non - non non  
 Sp.B: no - no - no - no no  
 (symbol of negation)

**(20) Boy, 8 years old, negation gesture as a metaphor for ignorance**

pas'que après ch' peux m'é' - heu m'électrogu' - m'électrocuter: ou faire brûler la maison -  
 et moi je sais pas - 'fin: on m'a expliqué comment fallait m' dégager mais:  
 because I might e' - uh elegro' - electrocute myself or burn myself at home -  
 and I'don't know - anyway I've been told how to get out of it but  
 (symbol of negation)

**(21) Girl, 8.5 years old, negation gesture as a metaphor for inability**

et si on est petit par exemple - eh ben on peut pas faire à manger pa'squ'on n' sait pas faire  
 and if you're small, for example - you can't do the cooking because you don't know how  
 (symbol of negation)



**(22) Boy, 7 years old, negation gesture as a metaphor for obligation**

'près i' dit - maman: c'est ma voiture - a'ors chu's obligé d' lui donner p'squ' i' va m' [...] give it to him  
 then he said - mum: it's my car - so I had to give it to him or he'd have [...]  
 (symbol of negation)

Symbolizing opposition: finally, we collected gestures of opposition that were mostly oriented around the left/right axis in order to distinguish between or oppose two referential entities: the hand or head designates the right-hand side and then the left-hand side or vice versa. Example (10) has already provided an illustration of this since the two head movements used by the speaker are polarized around the lateral axis and thus accentuate the distinction between the two referents (granny/mum). However, this opposition may also be symbolized in other ways. In (22), for example, it is based on the use of a listing gesture: the speaker states the possibility that, within a family, the two parents

may be of different ethnic origin and symbolizes this difference by means of a listing movement.

(23) Boy, 10 years old, gesture symbolizing opposition

 <p>a</p>	 <p>b</p>
<p>y a une CM1 - ses pa' - <u>un parent</u> - son papa il est - heu: noir - et sa maman - elle est blanche [...]          there's a kid at school - his pa' - <u>one parent</u> - <u>his dad i</u> - um: black - and his mum - she's white [...]          (points to his L thumb with his R index finger) (points to his L index finger with his R index finger)</p>	

**7. THE DEVELOPMENT OF GESTURE IN CHILDREN'S EXPLANATIONS:  
TOWARDS ABSTRACTION**

Not all the types of gesture that we have just reviewed are abstract to the same degree nor in the same regard. We have identified two types of indirect, non-deictic pointing: substitution pointing and anaphoric pointing. The first is based on the identification in the communication setting of an object which has characteristics similar to those of the object of discourse, and therefore relies purely on perceptual analogy. The second exhibits an additional level of abstraction in that it refers to time and not just to space. Indeed, it becomes necessary to establish a relation between two types of phenomena: on the one hand, a discourse object (the referent) and a location in the frontal space randomly chosen to represent it and, on the other hand, the successive pointings to this spot which reactivate the initial relation on each occasion. It is this reactivation that makes anaphoric pointing a genuine tool for discourse cohesion, thus making it possible to maintain referential continuity. Anaphoric pointing therefore presumes the individually controlled use of language and can be considered as an index of the ability to produce monologic discourse.

The gesture that introduces a new referent locates the referent at a spot in the frontal space that is randomly chosen to represent it. It corresponds to some extent to the initial stage of anaphoric pointing. However, whether the referent is concrete or abstract, the gesture used to assign it a location operates as a pointing gesture with simple indexical properties, while the gesture which simultaneously acts as a metaphor for the introduction of a new referent (the votive gesture in (12) and (13)) is based on conceptual analogy (Johnson, 1987) and is therefore more complex. It is therefore necessary to distinguish between the simple gestural introduction of a new referent, and the metaphorical gestural introduction of a new referent,

and there is every reason to believe that the former appear in children far earlier than the latter.

Like the metaphorical gestural introduction of a new referent, the gestural expression of time and aspect, processes, quantity, and opposition are based on conceptual analogy since they require the establishment of relations between two representations (one of the source, the other of the target) on the basis of a shared starting point for comparison (the metaphorical functioning of gestures has been described in detail by McNeill, 1992). The gestures which symbolize processes or quantities have provided us with excellent examples of this metaphorical functioning in children's coverbal gesture alongside the metaphors of time, aspect, and opposition which are based on the body schema.

We still need to mention the case of gestures which express modes such as ignorance, inability, impossibility, or obligation. These are abstract for two reasons: first, because of their content given that the modes themselves are abstract concepts, and second because of their functioning which is also metaphoric (the use of the symbol of negation results in the expression of ignorance as lack of knowledge, inability as lack of ability, obligation or necessity as a situation in which there is no choice). That notwithstanding, the sign used to express these modes (the gesture of negation) is an emblematic gesture with an undeniably conventional character, and it is plausible that young children learn to use it simply by imitating adults. Concerning this issue, we do not possess the necessary data to assess the level of complexity required by the modal use of the gesture of negation.

To summarize, gestures based on perceptual analogy (substitution pointing) and the establishment of a location (the gesture that simply introduces a referent) do not imply a high degree of abstraction and probably appear earlier in children's coverbal repertoires than gestures which form relations between discourse segments (anaphoric pointing) and gestures which are based on conceptual analogy (metaphorical representational gestures). However, further observations are now required to identify the age and conditions necessary for the emergence of these latter gestures. Let us now turn away from the corpus and the gestures produced by grade school children and look at the more general picture.

As shown in section 5, children aged 6 to 11 years used a high rate of abstract and discourse cohesion gestures during their explanations. We still need to check whether the

proportion of such gestures when all categories are taken together is as high in younger, nursery school and preschool children as it is in children aged 6 years or more. To do this, it is necessary to compare the types of coverbals produced by the two groups of children in our two sets of observations.

As Table 5 shows, there is a clear difference in the results: unlike grade school children, children aged between 3 and 6 years produce very few abstract representational gestures and discourse cohesion gestures. Indeed, the gestures which accompany their explanations are primarily concrete gestures and, more specifically (even though this is not apparent from the table), deictic gestures which were counted together with concrete representational gestures.

It is true that the two sets of observations are not strictly comparable since the explanations produced by the grade school children related to family and social knowledge whereas those produced by the nursery and preschool children related to distinctly more varied content. In the latter case, the frequent use of deictic gestures can also be explained by the fact that many of the school activities used media (posters, albums, study sheets) that promote the use of gestural deictic. However, given the two sets of data, we have to acknowledge the almost total absence of indirect pointing, gestural introduction of new referents and metaphorical gestures in younger children, whereas these gestures represent half of the coverbal repertoire exhibited by children aged 6 years and more.

In other words and in the light of these two sets of observations, the study of the coverbal gestures which accompany children's explanations indicates that the use of these gestures increases with age and that they change in nature during cognitive and language development. With increasing age, children are able to produce the representational gestures which make it possible to symbolize the abstract concepts which are not yet present in younger children's thought since they do not possess the necessary knowledge and cognitive tools. Increasing age also brings gestures that contribute to the maintenance of referential continuity, and these discourse cohesion gestures are clearly absent in young children whose textual abilities are still limited. The presence of these gestural categories in children's explanations and, more generally, in their linguistic behaviour, is of particular interest since it testifies to new cognitive (in terms of abstract representations) and discourse (in terms of individually controlled speech) abilities.

## CONCLUSION

The first spoken explanations are observed in children in their second year. These take the form of justifications rather than real causal explanations. They are very short, dependent on the context, and exhibit no textual properties. Much later, at the age of 8 years, children are able to draft short written explanatory texts in the context of classroom activities and at the teacher's request. But what happens in the intervening period? How do children come to produce explanatory texts? Do they exhibit textual abilities in oral mode, i.e., when producing spoken explanations, before they can do so in writing?

The inability to answer these questions was a starting point for the two collections of data that we have presented in this chapter. The first consisted of gathering spoken explanations during interviews with children aged from 6 to 11 years while the second consisted of obtaining spoken explanations from children aged from 3 to 6 years during classroom activities. Although developments were clear within each corpus, we needed to harmonize the two sets of data in order to gain a more complete understanding of the development of explanations between the first (3-4 years) and last (10-11 years) years of French primary school. We therefore compared the 500 explanations collected not in terms of their content (given the differing nature of the contexts in which they were observed) but instead in terms of their linguistic form and coverbal gestures.

The results of this study reveal two types of development in children's explanations: (a) a development of the linguistic forms of the explanations which, in general terms, progress from clause to text and (b) a development of the gestures that accompany the explanations which, in general terms, progress from the concrete to the abstract and towards the marking of discourse cohesion. In fact, the older the children are, the longer and richer in terms of linguistic information their explanations become. This change also has a qualitative aspect: explanations performed by the older children show far more interclausal relations, due to an increase with age of the number of clauses and connectives per explanation. Thus, as the children get older, their explanations exhibit more and more textual relations, and they gradually come to verbalize genuine monological explanatory discourse.

At the same time, as children become older, the more they make use of coverbal gesture since the increase in gestural information goes hand-in-hand with the increase in linguistic information. Furthermore, we can observe a change in the type of gestures they use. Nursery and preschool children use concrete representational gestures and deictic pointings (88.5%) and make no use of abstract or discourse cohesion gestures, whereas grade school children

use many of the latter (53%). To sum up, 6 years old children who verbalize explanations begin to use abstract representational gestures and discourse cohesion gestures that are quasi nonexistent in younger children.

The linguistic and the gestural changes are closely related. The reason why discourse cohesion gestures are almost nonexistent in the coverbal repertoire of children under 6 years of age is that their use depends on the speaker's textual ability to verbalize monologic explanatory discourse, which at this age is still a challenge. This ability does not emerge before first grade in our data (Table 1): from then on, explanations contain more than two clauses and two connectives and begin to resemble explanatory texts.

A pending question would be the role played by coverbal gesture in this process. Do the changes in gesture reveal linguistic acquisitions that occur within an independent process of monologic discourse development, or does gesture play an active role in this development due to its cohesion and segmentation properties? Results from studies on the role of gesture in language acquisition show that a new linguistic acquisition is often preceded by a change in the gestural behaviour of the child. For instance, the emergence of the pointing gesture before the end of the first year is a major milestone in the acquisition of a lexicon by the child; it shows the understanding of the semiotic principle "one signal for one referent" (Bates et al., 1979). A few months later, during the one-word period, the child performs word+gesture combinations. Some of them are redundant, and others are not. Nonredundant combinations have been proved to be good precursors of the two word utterance stage (Capirci et al., 1996, 2002; Butcher & Goldin-Meadow, 2000; Goldin-Meadow & Butcher, 2003, Özçaliskan and Goldin-Meadow, 2005).

Would there be a similar developmental schema for monologic discourse acquisition? More precisely, we can hypothesize that gestural anaphora may precede linguistic anaphora in the child's first attempts to verbalize interclause relations and then be followed by more elaborate monologic spoken texts. Evidently, we need to collect new data to answer this question.

Another interesting point is the change towards the use of gestures of the abstract. It is closely related to the ongoing debate on the link between language and thought. McNeill (1992; 2005), Kita (2000), Goldin-Meadow (2003) and others postulate that gesture is a



window into thought. As McNeill points out: « Gestures and speech occur in very close temporal synchrony and often have identical meanings. Yet they express these meanings in completely different ways... Gestures exhibit images that cannot always be expressed in speech, as well as images the speaker thinks are concealed... These gestures are the person's memories and thoughts rendered visible. Gestures are like thoughts themselves » (McNeill, 1992: 11-12).

In our study, we focused on the abstract gestures performed by grade school children. We called « abstract representational gestures » those gestures which introduce a new referent, which represent an abstract referent or which use metaphoric properties. As previously mentioned, these gestures are not abstract to the same degree nor in the same regard. Furthermore, psychologists would argue that concrete representational gestures are also abstract to an extent. For instance, a gesture that draws the image of a ball needs to extract certain properties of the object “ball” (Barsalou, 2003). All the same, the higher rate of metaphoric gestures in explanatory behaviour of the older children illustrates a change in the way that the physical and social world is represented. It would be most beneficial to examine closely this developmental change with a more experimental protocol.

The picture we have of the explanatory and gestural development in our study has given rise to further questions which need to be fine-tuned both in terms of the linguistic form of children's explanations and the level of the coverbal resources which children deploy when producing their explanations. New data which we are currently gathering in schools will help us provide a more precise description of this dual development towards monologic discourse and abstract gestures. This ongoing project funded by the Agence Nationale pour la Recherche in France also has an inter-language dimension (cooperation with US, Italian and South African collaborators) that additionally will enable us to assess the impact of language and culture on the development of multimodal explanations.

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## Appendix 1 :

### Main functional types of coverbal gestures

#### < Pointing gestures >

Hand or head gestures directed towards the referent of discourse that helps identifying it or localizing it in situ. We may distinguish:

**Deictic pointing:** the speaker points to an object or a person directly present and perceptible in the physical context. It may be:

- the object he is talking about: "it is that book on the table"
- a place in the immediate physical setting: "leave your jacket over there on the sofa please"
- the interlocutor while addressing to him: "and what is your opinion on this subject ?"
- himself while saying: "as for me...", "I think...", etc.

**Directional pointing:** the speaker shows where to localize the referent when it is not directly perceptible. For instance, while answering a question about the place of a building, a park or a river nearby, the speaker points into its absolute direction:

- "the museum you are looking for is in that direction, at three hundred yards from here"

**Indirect pointing:** some pointing gestures do not permit to identify or locate a referent in (or from) the communication setting. These gestures called "substitution pointing" and "anaphoric pointing" are defined below.

#### < Representational gestures >

Hand gestures, head gestures, facial expressions or other body movements which help representing a concrete referent (object, person, place, event...), or symbolizing an abstract referent. McNeill (1992) calls "iconic gestures" those which represent concrete referents, and "metaphoric gestures" those which symbolize abstract ideas and concepts. Yet, representational gestures are more or less iconic, and all gestures of the abstract are not based on metaphor, as this study shows. We may distinguish:

**Representational gestures of the concrete, examples:**

- **Gestures depicting objects and their properties:** the speaker gives the size of the referent with both hands while saying "the fish was as big as this"; the speaker draws a picture of the referent in the air with his finger while saying: "the pipe is curved like this"
- **Locative gestures describing places:** the speaker uses hand gestures to place in the frontal space or to construct the topological relations between the referents while describing a place or a route: "when you pass the bridge, you find a small church on your right, then you cross High Street..."
- **Locative gestures tracing moves:** the speaker shows the directions of a character's moves with the hands or the head while narrating: "when he heard the dog, the cat jumped over the bin but the dog went on after him barking" (these gestures are called "Observer Viewpoint gestures" in McNeill's 1992 classification).
- **Gestures miming processes and actions:** the speaker mimes an action using a rotating gesture: "it opens like this", or mimes the action performed by a character while narrating: "he carefully climbed up the ladder" (these gestures are called "Character Viewpoint gestures" in McNeill's 1992 classification).
- **Gestures miming person's attitudes or behaviour:** the speaker mimes the attitudes or behaviour of a person or a character using gestures, facial expression, the whole body, and sometimes the voice as well when he reports speech: "and you know what she answered ? 'you'll have to do it on your oowwwn 'cause I'm too tiiiired darling' ! could'nt believe it !".

**Representational gestures of the abstract:** several illustrations are given in section 6. We may distinguish :

- **Substitution pointing:** the speaker points to an object or a person directly present and perceptible in the physical context, and this object or person represents the referent of discourse on the basis of perceptual analogy. For instance, while narrating an event, the speaker points to the window as she says: "... then the little girl, she climbed on the windowsill, and she fell ...". See example 8 in section 6 for another illustration.
- **Gestural introduction of a new referent:** the speaker uses a hand or a head gesture to arbitrarily locate the referent in the frontal space. See examples 9, 10 and 11 in section 6.
- **Metaphorical gestural introduction of a new referent:** the speaker uses a votive hand gesture to arbitrarily locate the referent in the frontal space, and the hand, palm up, represents a container for an invisible content which is a metaphor of the referent. See examples 12 and 13 in section 6.
- **Gestural expression of time, processes, opposition, quantities and other abstract concepts:** the speaker uses hand or head gestures to perform gestural metaphors of these concepts. All metaphoric gestures are based on conceptual analogy. See examples 14, 15, 16, 17, 18 and 23 in section 6.
- **Gestural expression of modalities:** the speaker uses hand or head gestures, facial expressions and other bodily movements to express assertive modalities like certainty vs doubt, possibility vs impossibility, ability vs inability, etc. See examples 20, 21 and 22 in section 6.

#### < Discourse cohesion gestures >

Hand or head gestures which have representational properties like the previous ones and at the same time play a role in the marking of discourse cohesion and structure, as well as other movements like postural changes which do not have any representational properties and nevertheless share the same discourse properties. We may distinguish:

**Anaphoric pointing:** after having assigned a referent to a location in the frontal space using a gestural introduction of a new referent, the speaker points again to the same spot while mentioning the same referent. Thus, as for the maintaining of reference, anaphoric pointing plays in visual modality the same role as linguistic anaphora in the auditory modality. See examples 6 and 7 in section 6.

**Connexity gestures:** short hand or head gestures that mark the transitions and symbolize the relations between clauses and bigger discourse units. Ex.:

- the speaker points to the left as to refer to the future while recounting the following event during narration: "The three companions left home in the morning and walked all day long. In the evening, they were about to enter the forest..."
- the speaker performs a short chasing hand or head gesture while using a connective like "anyway", "okay", "right" while closing a parenthetical comment and getting back to the main discourse.

**Segmentation and demarcation gestures:** hand or head gestures as well as postural changes that mark clauses and bigger discourse units. Ex.:

- the speaker tilts the head and chin to the right while expressing a first point of view, then tilts it to the left to express a second and opposite point of view : "on the one hand it can help the poor to survive, ... on the other hand it doesn't help them to gain any financial autonomy !".

### < Speech structuration gestures >

Short binary hand or head movements called “beats” as well as other movements like a shrug of eyebrows which closely accompany the speech flow. Contrary to the previous ones, these movements have no representational properties. Together with prosody, they rather help marking short linguistic units (syllables, words) which the speaker wishes to accentuate. Ex.:

- head beats while enumerating: “several countries will sign on this treaty, for example Australia, Japan, China, India and also New Zealand” [unclear syntax: “among which”]
- hand beats and prosodic accentuation while arguing: “is this our children’s future? No, then we MUST take the RIGHT DEisions”.

### < Expressive gestures >

Facial expressions as well as other body movements with which they can combine to express speech acts, emotions and mental states. Following Kendon (2004), we may distinguish :

**Performative gestures** are used either to accomplish speech acts (questions, yes and no answers, requests, commands, etc.) through bodily means of expression, or to reinforce their illocutionary value when they are verbalized. Ex.:

- head nod as an affirmative answer or performed while answering “yes”
- head shake as a negative answer or performed while answering “no”
- shrug of shoulders performed while answering “I don’t know” or “sorry, I don’t care”
- index to the lips while saying “hush ! ”.

**Framing gestures** are used to express emotions and mental states linked to the content of the linguistic utterance. Ex.:

- smiling face to express fun while recounting a funny event
- face expressing fear while reporting on a dramatic event [please check syntax here]
- face expressing reflection while searching for words
- use of the gestural quotation marks to express enunciative distance with regard to the utterance.

### < Synchronization gestures >

Head and hand gestures, facial expressions, gaze and other body movements that help speakers to coordinate their behaviour during the social interaction. We may distinguish:

- **Phatic signals** performed by the speaker during his speech turn to beg the interlocutor’s attention and signal his immediate intentions to go on or stop speaking.

- **Feedback signals** performed by the interlocutor during the speaker’s speech turn: head nods and facial expressions that may accompany audible feedback signals like “hum”, sighs or grunts.

## Appendix 2 :

### Transcription conventions

- For all extracts we used orthographic transcription.
  - Conventions relating to the linguistic data (all extracts):
    - speech items which are difficult or impossible to identify are signaled by parentheses (xxx)
    - interruptions in transcription are identified by 3 dots in brackets: [...]
    - elisions are identified by an apostrophe: "ben moi j' l'ai dit"
    - hesitations are identified by "um" or "uh"
    - vocalic prolongations are identified by two colons: "et::"
    - pauses are identified by a dash: -
  - Conventions relating to the gestural data (extracts 6 to 23 and appendix 1):
    - each occurrence of a gesture is signalled on the transcription line by the underlinement of the segment of speech corresponding to its stroke or duration.
    - the gestures (position and configuration) are generally represented using photographs, except in the case of extracts 19 to 22 which require no illustration given the symbolic nature of the gesture of negation. The eyes of some speakers are covered in order to preserve their anonymity.
    - the direction of the movements is represented by an arrow on those photographs where it is required.
    - each gesture is briefly described immediately below the line containing the speech.
- abbreviations used:
- |    |   |         |
|----|---|---------|
| R  | = | right   |
| L  | = | left    |
| U  | = | up      |
| D  | = | down    |
| Fr | = | front   |
| Ba | = | back    |
| >  | = | towards |



### Appendix 3 :

#### Tables and figures

Measures per explanation	3-4 yrs	4-5 yrs	5-6 yrs	6-7 yrs	7-9 yrs	9-11 yrs
Duration (s)	2.10 (0.82)	4.43 (3.15)	4.05 (2.77)	7.00 (4.72)	9.38 (6.54)	10.56 (5.80)
Syllables (n)	7.13 (3.36)	12.35 (7.38)	13.08 (7.97)	23.23 (13.85)	30.69 (18.16)	39.32 (20.12)
Clauses (n)	1.13 (0.41)	1.44 (0.82)	1.61 (0.87)	2.37 (1.25)	3.28 (2.10)	3.70 (2.02)
Connectives (n)	1.08 (0.53)	1.40 (1.06)	1.70 (1.11)	3.10 (2.25)	3.47 (2.27)	4.67 (2.78)
Coverbal gestures (n)	0.31 (0.47)	0.75 (0.89)	0.98 (1.27)	2.23 (2.56)	2.48 (2.94)	3.47 (3.06)

Table 1: Mean scores (with standard deviations) based on 500 explanations.

	3-4 yrs	4-6 yrs	6-9 yrs	9-11 yrs
Simple explanations	97	79	39	17
Complex explanations	3	21	61	83

Table 2: Proportion of simple and complex explanations as a function of age (%).

3-4 yrs	<b>parce que (because), quand (when), et (and)</b>
4-5 yrs	parce que (because), quand (when), et (and) <b>si (if), alors (then), mais (but), donc (thus), même (even), or (now), à cause de (because of), après (later), maintenant (now), avant (before), aussi (so)</b>
5-6 yrs	parce que (because), quand (when), et (and), si (if), alors (then), mais (but), donc (thus), même (even), or (now), à cause de (because of), après (later), maintenant (now), avant (before), aussi (so) <b>alors que (while), tandis que (whereas), comme (as), au début (at the beginning), puis (then), et puis (and then)</b>
6-7 yrs	parce que (because), quand (when), et (and), si (if), alors (then), mais (but), donc (thus), même (even), or (now), à cause de (because of), après (later), maintenant (now), avant (before), aussi (so), alors que (while), tandis que (whereas), comme (as), au début (at the beginning), puis (then), et puis (and then) <b>par exemple (for example), sinon (otherwise), pour (for, to)</b>
7-9 yrs	parce que (because), quand (when), et (and), si (if), alors (then), mais (but), donc (thus), même (even), or (now), à cause de (because of), après (later), maintenant (now), avant (before), aussi (so), alors que (while), tandis que (whereas), comme (as), au début (at the beginning), puis (then), et puis (and then), par exemple (for example), sinon (otherwise), pour (for, to) <b>pourtant (nevertheless), par contre (on the other hand), autrement (otherwise), quand même (all the same)</b>
9-11 yrs	parce que (because), quand (when), et (and), si (if), alors (then), mais (but), donc (thus), même (even), or (now), à cause de (because of), après (later), maintenant (now), avant (before), aussi (so), alors que (while), tandis que (whereas), comme (as), au début (at the beginning), puis (then), et puis (and then), par exemple (for example), sinon (otherwise), pour (for, to), pourtant (nevertheless), par contre (on the other hand), autrement (otherwise), quand même (all the same) <b>soit (either... or), puisque (because), de toute façon (anyway)</b>

Table 3 Types of new connectives collected in each of the main age groups.

	Abstract and discourse cohesion gestures	Expressive gestures	Concrete representational gestures	Synchronization gestures
Explaining	52.50	28.50	17.50	01.50
Describing	22.00	17.50	57.50	03.00
Narrating	29.50	23.50	42.00	05.00
Debating	19.00	56.00	10.00	15.00

Table 4: Proportion of coverbal movements in four discourse tasks (%).

	Abstract and discourse cohesion gestures	Expressive gestures	Concrete representational gestures
3-6 years	8.00	3.50	88.50
6-11 years	53.00	29.00	18.00

Table 5: Proportion of coverbal movements as a function of age (%).

## Questions :

Q1 : Monologic discourse development :

- A : develops early
- B : is identical to conversational or dialogic discourse development
- C : relies on linguistic acquisitions that are not exhibited by the young child
- D : relies on linguistic acquisitions and cognitive abilities that are not exhibited by the young child

correct answer: D

Q2 : the study of children's explanations provides information on discourse development because :

- A : its basic textual structure is presented in its simple as well as complex forms
- B : its basic textual structure is complex
- C : explanatory discourse and narrative discourse share the same basic discourse properties
- D : only older children are able to verbalize explanations

correct answer: A

Q3 : Coverbal gesture :

- A : has no clear nor precise communicative function
- B : is not linked with speech
- C : is not able to symbolize abstract ideas
- D : serves several functions, including representational and expression functions

correct answer: D

Q4 : Does gesture that occur with verbal explanations develops with age ?

- A : no, it does not develop with age
- B : yes, the use of gesture decreases while verbal explanations develops
- C : yes, it expresses increased abstract thought with the development of age
- D : yes, but it develops independently from speech

correct answer: C

Q5 : Gestures that occur with verbal explanations :

- A : have no representational meaning
- B : are mostly abstract representational gestures and discourse cohesion gestures
- C : are mostly expressive gestures
- D : are the same gestures as those that occur with narratives and other discourse genres

correct answer: B