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Context sensitive 'how' explanation in children's multimodal behavior

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Abstract

In this paper we describe how pragmatic constraints of two types of explanatory interactions influence both the organization of syntactic elements in clauses and gestural behavior. We provide evidence on how young children confronted with a dual-goal task including both a referential issue and a social interactional issue start to show competencies that are not present in a single referential task. Further, our intention is to contribute to theoretical issues in pragmatics through a study of how children mobilize pragmatic constraints of language production and also to account for language development within the framework of it being understood as a multimodal phenomenon. Results show that children's linguistic and gesture choices depend on the type of explanation they are giving. While in a process explanation, children perform more referential gestures whereas in instructional explanation, they perform more pragmatic gestures.

1. How does context influence language production and understanding?

It may seem obvious to state that characteristics of human communication are influenced by the context in which such communication occurs, but context is a problematic concept to define (Duranti & Goodwin, 1992). Research in Conversation Analysis and Interactional Linguistics (i.e. the study of grammar in interaction) and in particular, video analyses of talk-in-interaction, focus on specific aspects of context in which language is produced as their goal is to "investigate the procedural bases of reasoning and action through which actors recognize, constitute and reproduce the social and phenomenal worlds they inhabit (Goodwin & Heritage, 1990, pp. 286-287)." Here, gesture, posture, gaze, pauses and manipulation of resources — are all viewed as meaning carrying elements of how the interaction is organized and coordinated by the participants (e.g. Goodwin, 1986; Kendon, 2004).

In this paper, we constrain the definition of context in a way that is compatible with our own overarching goal and that is to compare two pragmatically different situations in which children give "how" explanations. Our approach is original in that we aim to describe how pragmatic constraints of two types of explanatory interactions influence the organization of syntactic elements in clauses as well as gestural behavior. More precisely, we provide evidence on how young children confronted with a dual-goal task including both a referential issue and a social interactional issue show competencies that are not present in a single referential task. Further, our intention is to contribute to theoretical issues in pragmatics through a study of how children mobilize pragmatic constraints of language production and also to account for language development within the framework of it being understood as a multimodal phenomenon.

2. On contextualized multimodal explanation in children

Gesture, gaze and the interplay between language, deixis and other types of gesture in everyday social interaction have been studied extensively since Goodwin (1981) and Kendon's (1990) pioneering work. Today we have at our disposal a substantial volume of observation on pointing and gaze (Kita, 2003; Mondada, 2009), hand gestures (Calbris, 2012; Kendon, 2004), head gestures (McClave, 2000), emblematic gestures (Brookes, 2004), and use of gesture in more specific contexts such as the classroom (e.g. McCafferty & Stam, 2008). In addition, gesture use and multimodal means for communication and mutual understanding were studied in the context of more specific discourse genres such as the narrative in adults (McNeill, 1992; Bouvet, 2001) as well as in children. Children aged 9 years and over were found to rely more on gesture and gaze resources and to deliver truly embedded narratives, i.e. narratives introduced and commented on during the interaction process, with the child acting as a genuine narrator instead of barely recounting facts and events he witnessed (Colletta, 2009). These results were later replicated for French (Colletta, Pellenq & Guidetti, 2010) as well as for other languages (Graziano, 2009; Kunene, 2010). Altogether, the study of children's narratives indicates a strong and enduring relation between language and gesture throughout the child age span (Alibali, Evans, Hostetter, Ryan, Mainela-Arnold, 2009; Laurent, Nicoladis & Marentette, 2013).

Another discourse genre for which multimodal aspects of communication and mutual understanding were studied is explanation. Lund (2007) focused on the specific pragmatic roles that gaze and gesture play in interactive face-to-face explanation between pre-service teachers studying filmed interactions of students in the classroom. The work of Lund & Bécu-Robinault, (2010) also illustrated the differences in how expert teachers and novice students reformulate physics knowledge across talk, gestures, drawings and manipulations of resources during their explanations. Similarly, Goldin-Meadow and her collaborators studied children's use of gesture in the resolution of problem solving and mathematic tasks (Goldin-Meadow, 2003). They showed how children use gestures in their explanations and how other children can interpret these gestures. In addition, Colletta and Pellenq (2009) studied explanations produced by French children aged 3 to 11 years. In their study, all explanations were formulated by children in response to a 'why' question. The authors analysed the formal aspects of the explanations and found an increase in all observed measures: duration, number of syllables, number of clauses, use of connectives and use of co-speech gestures. The results provided strong evidence for the existence of language developmental changes affecting the multimodal construction of explanations. More recently, a study by Reig Alamillo, Colletta & Guidetti (2013) complemented these findings by analysing explanations produced by French children and by comparing this type of discourse with narratives produced by the same group of children. The task (explanation vs. narration) also had effects on the use of both language and gesture: gestures and subordinate markers were more frequent in explanations than in narratives, whereas cohesion markers were more often used in narratives. Finally, Mazur-Palandre & Lund (submitted) analysed verbal and gestural behavior of 6 year-old children during explanation of on-line educational games. They focused on the communication behavior of child-instructors explaining two games to child-learners in either one of two conditions: 1) where both of the role-playing children could see each other and 2) where a curtain separated them. Gesture and clause profiles depended on both context of production (which game was played) and communicational situation (the explainer's addresse was visible or not) (cf. also Mazur-Palandre & Lund, 2012). Here again, multimodal language production was found to be closely tied to context.

In this paper, we present a follow up study aimed at examining in greater detail the way contextual constraints find their expression in children's gesture and speech. In the aforementioned studies, contextual constraints either appeared in dialogue tasks with an adult monitoring the answer-giving or in dialogue tasks with the child doing the monitoring. In the aforementioned studies, contextual constraints either appeared in dialogue tasks with an adult monitoring the answer-giving or in dialogue tasks with the child doing the monitoring. But there are many different ways of taking part in a conversation, depending on who is doing the monitoring and on the language activities themselves. Thus, many types of finalized dialogue that include an interaction monitoring task are more complex in that they involve several pragmatic constraints, e.g. reasoning, explaining or narrating, *but also* monitoring and regulating the social interaction, for example in the form of management of speech

turns. Thus, can we find linguistic and gestural differences that illustrate children's competency in such complex communication tasks? How do pragmatic constraints shape their language and gesture behavior? As far as we know, this issue remains largely unstudied. In this sense, the present paper focuses on the ability of six-year-old children to adapt their linguistic and gestural behavioral to different pragmatic contexts.

3. Method

3.1 Research questions and hypotheses

In order to find some answers to the above questions, we gathered data on two distinctive types of 'how' explanations. As a discourse genre, the 'how" type of explanation is interesting to investigate compared to the 'why' type of explanation. The 'why' type of explanation, also named 'causal' explanation, is a type of expository discourse (Nippold & Scott, 2009) that links an *explanandum*, i.e., a phenomenon or behavior to be explained, to an *explanans* or cause, reason, or motivation for this phenomenon or behavior (Hempel & Oppenheim, 1948; Veneziano and Sinclair, 1995). At the structural level, causal explanations necessarily link two sequences in the textual form < P because Q > (Grize, 1990; Adam, 1992). In contrast, the 'how' type of explanation is more closely related to depiction rather than to expository discourse (Adam, 1992). As a discourse genre and in the same way as depiction, 'how' explanation is less formally structured and is more dependent on reference features. As a consequence, there are several kinds of 'how' explanation'. In this study, we considered two kinds of 'how' explanations:

- 'process' explanation (hereafter referred to as PROCESS-EX): depiction of a set of actions leading to some result,

- 'instructional' explanation (hereafter referred to as INSTRUCT-EX): formulation of a set of instructions leading to some result.

We selected these two types of 'how' explanation as they show some strong differences. PROCESS-EX is fundamentally a dialogue type of discourse act with an adult monitoring the interaction: it normally answers a 'how' question such as "how did this happen", but subsequently, all a speaker needs to do is coherently build reference in order that the explanation succeed as a discourse act. Moreover, in this context of production, children explain something to an adult. In contrast, although INSTRUCT-EX is fundamentally also a dialogue type of discourse act, the children themselves monitor the interaction: it normally responds to a "how shall I proceed?" question. Children explain a game to a peer, in other words to a friend from school. To succeed as a discourse act, the speaker must both coherently build reference *and* monitor the interactional process with his or her addressee. Consequently, these two contexts differ in their inherent pragmatic constraints: both involve referential constraints, yet only instructional explanation involves interactional (i.e. joint-action) constraints from the point of view of being responsible for the active monitoring of the social interaction.

Contrasting these two types of 'how' explanation allows the study of how pragmatic constraints find their expression in language and gesture. In the study we detail here, we investigate whether young children confronted with a dual-goal task including both a referential issue and a social interactional issue (i.e. the INSTRUCT-EX) show competencies that are not present in a referential task without a social component (e.g. the PROCESS-EX). Our hypotheses are as follows:

- Hypothesis 1. Young children aged 6 years show competencies related to a dual-goal finalized dialogue task (i.e. the INSTRUCT explanation in which children have the responsibility of monitoring the interaction);
- Hypothesis 2. At this age, a dual-goal dialogue task (i.e. the INSTRUCT explanation with a monitoring of the interaction) is more difficult to manage than a single goal dialogue task (i.e. the PROCESS explanation without the responsibility for monitoring the interaction);
- Hypothesis 3. Pragmatic constraints are separately definable for each task and are illustrated in both in language and gesture;
- Hypothesis 4. Young children adapt their use of gesture resources to accomplish the task.

3.2 Population

In order to investigate the way children integrate various constraints and communicate accordingly using gesture and language resources, we compared two populations of two different studies. In the first study on INSTRUCT-EX, 30 French monolingual children participated and half of the children explained two video games to the other half of the children. In the second study on PROCESS-EX, 41 French monolingual children participated and gave an answer to a "how did this happen" prompt after viewing a short cartoon video clip. All participants were first graders attending primary schools with similar social and environmental characteristics. All children were French native speakers from the Rhône-Alpes region in France. They were non-bilingual and did not have any behavioral or learning problems. Each child was authorized by his/her parents and participated on a voluntary basis. We filmed all students from both schools during regular classroom hours inside their school buildings, in a separate room in order not to disturb ordinary classroom work.

From the entire set of data, we extracted 15 INSTRUCT-EX from study 1 (mean age 6.6 years, age range 6.4-7.2 years) and 15 PROCESS-EX from study 2 (mean age 6 years, age range 5.7- 6.4 years). Only children producing explanations face-to-face (as opposed to in a non visible condition) were chosen from study 1. We excluded from analysis all explanations produced by children who would not complete the task as well as explanations from children who did not produce any co-speech gesture. Explanations were selected on the basis of age in order to find the best match between the two populations.

3.3 Procedure

In study 1 (INSTRUCT-EX), all children played two games from a French on-line educational game site (www.cognik.net): (a) a numbers game in which the player is asked to recognize numbers or count objects by clicking on the correct image and (b) a spatial game in which the player must hit back a ball with the help of a kind of racket, and in doing so break bricks.

Children worked in pairs that were constituted by their teacher, according to the criteria of being able to work well together. Teachers also assigned a role to each child: child-instructor or child-learner. The experiment was divided into three phases. The child-instructor was first asked to play a game (either the numbers or spatial game) in order to explain it to a peer (phase 1). Once the child-instructor finished the game, the experimenter brought in the child-learner and the child-instructor explained the game to the child-learner face-to-face (phase 2, INSTRUCT-EX — the focus of half of our analyses for this article). Next, the child-learner played the game under the watch of the child-instructor; the latter was instructed to help the former if need be (phase 3). The experiment took place during two weeks (A and B). Game playing was counter-balanced between week A and week B.

In study 2 (PROCESS-EX), all children participated in a developmental and comparative study. A narrative task and an explanatory task were administered in the same session and were based on a 2 minute 43 second clip of a Tom & Jerry cartoon shown to the participants on a laptop computer. In the story, a mother bird leaves her egg in the nest. The egg accidentally falls out and rolls into Jerry's house. The egg hatches in Jerry's house and a baby woodpecker emerges. The baby bird then starts damaging Jerry's furniture. After a few failed attempts to calm the bird down, Jerry gets angry and decides to put the bird back in its nest. The narrative task was proposed first: every child was asked to tell the story he or she had just seen to an adult sitting next to him/her. Immediately after, the experimenter told the child that he was going to ask him or her some questions, and asked the following: 1. Why does the mummy woodpecker leave the nest? 2. How come the egg ends up in Jerry's house? 3. Why is the baby bird pleased to see Jerry? 3. Why does Jerry take the baby back to its nest at the end of the story?

All questions and answers were videotaped. However, for this study, we extracted answers to the second question which corresponds to a "how did this happen" question (how did it happen that the egg ended up in Jerry's house?) and that elicited a PROCESS-EX.

3.4 Transcription and coding

The data was entirely transcribed and annotated using ELAN software (http://www.mpi.nl/tools/) using an annotation scheme adapted from Colletta, Kunene, Venouil, Kauffman & Simon, 2009. The annotations provided information on syntax, lexicon, discourse and co-speech gestures.

Speech transcription and coding

The speech transcription and annotation conventions were adapted from the CHILDES (http://childes.psy.cmu.edu/) and VALIBEL (http://www.uclouvain.be) conventions.

The speech was first segmented into clauses, and the number of clauses was counted. Number of clauses as a measure of the length of the linguistic productions was used instead of sentences or utterances. Sentences are a more suitable descriptive unit for written texts whereas the term 'utterances' has too imprecise a definition to be fruitfully used in corpus annotation coupled with quantitative analysis. The clause has been shown to capture the basic semantic configuration in which language operates (Gineste & Le Ny, 2002), indeed "*the clause is the grammatical unit in which semantic constructs of different kinds are brought together and integrated into a whole*" (Halliday 1989: 86).

The **clause count** allowed us to estimate the length of explanations. Besides, as explanations varied in length and content from one child to another, all subsequent measures were based on the **rate per clause** in order to compare both types of contexts and explanations.

Considering our hypotheses, we had to code for linguistic variables that would index: (a) the referential constraints proper to each context; (b) the interactional constraints proper to the instructional context; and (c) the difficulty of the task.

As for **referential constraints**, the study 1 context elicits an INSTRUCT-EX that delivers new information to the addressee on how to play the target educational game. In contrast, the study 2 context elicits a PROCESS-EX that focuses on chained events as they appeared in a short sequence from the cartoon previously viewed and narrated by the participant. Considering the **introduction of reference**, referents need to be introduced only in the first context. As a consequence, children should produce more **new information markers** such as "it is", "there is" or "there are" in the INSTRUCT-EX context compared to the PROCESS-EX context. Considering the **reference itself**, distinctive sets of **connectors** should be used in each context. For example, children should use comparatively more logical connectors (e.g.: "in order to", "otherwise", "if… then") in the INSTRUCT-EX context that favour the expression of alternatives and they should use comparatively more chronological connectors (e.g.: "then", "and then") in the PROCESS-EX context that favour the expression of temporality and series of events. Examples 1 and 2 in Appendix 1 illustrate both types of explanations (new information markers are underlined; logical connectors are underlined and in bold characters; chronological connectors are in bold characters).

Interactional constraints should be present in the instructional context as the INSTRUCT-EX must deliver accurate information to the addressee and the instructor child has to make sure his/her partner understands how to play the target educational game. In contrast, the study 2 context elicits a PROCESS-EX with no definite issue apart from answering to the experimenter's prompt that begins the interaction. In the instructional context, it is the child's additional task to monitor the interaction while verbalizing his/her explanation. As a consequence, INSTRUCT-EX should incorporate a specific set of linguistic markings including **phatic expressions** the speaker uses to capture the addressee's attention and check his/her understanding (e.g. "look", "OK?", "got it?"), as well as **modal verbs and expressions** (e.g. "you have to", "you must", "you can") that help introduce the actions the addresses will have to do while playing the game.

We argue that the intrinsic **difficulty of the task** is higher in the instructional context compared to the other context. First, the verbalizing of the PROCESS-EX is made easier by the fact that the child, during the narrative task that preceded, already recounted the chain of events he is supposed to depict to answer the 'how' question from the experimenter. In contrast, the verbalizing of the INSTRUCT-EX requires an original wording of the target game characteristics and the way to play it. Second, there are additional pragmatic constraints on the production of the INSTRUCT-EX compared to the production of the PROCESS-EX: the child instructor has the responsbility of monitoring the exchange with the child learner and he/she has to check his/her partner's understanding of the game. As a consequence, the difficulty of the task should be indexed first by the length of the production, with INSTRUCT-EX having more clauses than PROCESS-EX, and second by the presence of **on-line enunciation-process markers** such as the following (Candéa, 2000; Henry, 2005; Henry & Pallaud, 2004; Martinot, 2000, 2003, 2013):

- Repetition of a word or a syntactic unit (e.g.: "ben *on on* a un bout de bois" "uhm we we have a piece of wood" – dyad 06, spatiality game);
- Rewording (e.g.: "ben en fait *avec le avec la* souris ben il faut appuyer sur euh le chiffre" "uhm in fact with the with the mouse you have to press on uhm the number"– dyad 18, number game);
- Filled pause (vowel pronounced at the end of a word or otherwise independently, average time between 15-20 seconds, e.g.: "il va te dire par exemple *euh* montre moi sept" "he will tell you for example uhm show me seven" – dyad 26, number game);
- Abnormal vocalic lengthening (average time between 18 and 22 seconds, e.g.: "indique-m*oi::* six billes" "show m*e::* six marbles" – dyad 16, number game);
- Lexical false start: a word begun and interrupted but which is then completed at the same syntactic spot (e.g.: "et aussi il y avait des euh *des t/ des tiers* de glace" "and also there were these uhm these l/ these levels of ice" – dyad 15, spatiality game);
- Syntactic false start: incomplete syntactic unit replaced by a different syntactic construction (e.g.: "*<et en fait il y a>* il te demande un chiffre" "<and in fact there is a> they ask you for a number" – dyad 30, spatiality game).

We expected children to show more enunciation-process markers during INSTRUCT-EX than during PROCESS-EX.

Gesture annotation and coding

Gesture annotation started with identification of the co-speech gesture units (one complete gesture - hand gestures, head gestures, shoulder shrugs) performed by each participant during the production of his/her explanation. In order to decide whether a body movement should be counted as a gesture unit, we used a method based on Adam Kendon's proposals (see Colletta, Pellenq & Guidetti, 2010). The coder took the following three criteria into account: movement, location and configuration of the gesture stroke – the gesture stroke is the meaningful part of the gesture phrase, as explained in Kendon, 2004 –, assessing each one on a 2-points scale as presented in Table 1. For a gesture to be counted as a unit it had to score 3 or more points.

Table 1. Gesture identification



Criteria	Scale	Coding
Movement	Noticeable (good amplitude)	2
	Not very noticeable	0
	Between the two	1
Positioning	In front of the speaker	2
	On the side (less noticeable by addressee)	0
	Between the two	1
Configuration	Corresponds to a precise hand(s) shape	2
	Corresponds to an imprecise hand(s) shape	0
	Between the two	1

Each gesture was then attributed a function. Building on previous classifications (McNeill, 1992; Cosnier, 1993; Kendon, 2004) we distinguished between three main categories:

- **referential gestures** (representative and deictic gestures),
- **pragmatic gestures** (discursive, framing, performative and interactive gestures),
- **word searching gestures**.

REFERENTIAL GESTURES help build the reference. This category includes deictic and representational gestures. The deictic gesture is a hand or head movement that points to an object present in the communication setting, or to the interlocutor, or to oneself or a part of the body, or that indicates the direction in which the referent is found from the actual coordinates of the physical setting. The representational gesture is a hand or body movement that represents a concrete object or a property of that object, a place, a trajectory, an action, a character or an attitude, e.g., the two hands forming an oval to represent an egg or a ball or a rapid downward movement of the hand or index finger to represent the fall of an egg or what happens when you strike a ball – these gestures correspond to the "iconic gestures" in McNeill (1992)'s classification –; or else symbolises an abstract idea, through metaphor, e.g., the right hand in a bowl shape, palm facing upward, to symbolize the

focus of discourse, a negation head movement to represent the inability or ignorance of a character – these gestures correspond to the "metaphoric gestures" in McNeill (1992)'s classification.

PRAGMATIC GESTURES help express communicative acts, frame the verbal utterance and structure discourse. This category groups performative, interactive, framing and discursive gestures. A **performative gesture** expresses a speech act (yes answer, no answer, reply, etc.) either in replacement of speech, e.g., nodding one's head in agreement; or which reinforces the illocutionary value of the speech act, e.g. head nodding accompanying an affirmative response –these gestures are part of the "pragmatic gestures" type in Kendon (2004)'s classification. An **interactive gesture** indicates that the speaker requires or wishes to verify his partner's attention or has reached the end of the speech turn or narrative, e.g., the speaker touches his partner to call on his attention; or indicates to the speaker that his interlocutor is paying attention to his speech, e.g. nodding the head while listening to the speaker. These gestures often occur with changes in gaze patterns and were respectively called "phatic signals" and "feedback signals" in Cosnier (1993)'s gesture classification. A **framing gesture** expresses the narrator's emotional or mental state while performing a speech act, e.g., shoulder shrug or facial expression that expresses the obviousness of what is being asserted, or using 'finger inverted commas' to express distance in relation to terms used – these gestures are part of the "pragmatic gestures" type in Kendon (2004)'s classification. A **discursive gesture** is a hand or head movement that helps to structure speech and discourse by accentuating or highlighting certain linguistic units, e.g., rhythmic movements (beats) accompanying the accentuation of certain words or syllables – these gestures were named "batonic gestures" in Ekman & Friesen (1964)'s classification; or marked discourse cohesion by linking clauses or discourse units, e.g. rapid flick of the hand towards the right that accompanies a connective such as 'then' or 'after', anaphoric gesture, e.g. , pointing towards a spot in frontal space which previously represented a referent in order to reactivate the same referent – these gestures correspond to the "cohesive gestures" in McNeill (1992)'s classification.

The third category, WORD SEARCHING GESTURES are hand movements, often accompanied by facial expressions, performed by the speaker when encountering difficulties in verbalizing the message, e.g., tapping fingers whilst searching for words, with or without a reflective expression.

For the purpose of our study, we used gesture variables and gesture rate measures (number of strokes per clause) as an index of:
- the referential and interactional constraints proper to each context;
- the difficulty of the task.

We expected gesture rate to be higher in the instructional context compared to the other context. Unlike PROCESS-EX which is a single goal dialogue task, INSTRUCT-EX is a dual-goal dialogue task that involves not only the building of reference, but also the monitoring of the on-going interaction. Each goal should generate gestures – referential gestures for the building of reference, pragmatic gestures for the monitoring of the interaction – with as a consequence more gesture during the dual-goal task.

We expected representational gesture rate to be higher in the PROCESS-EX than in the INSTRUCT-EX, as the focus is almost exclusively on the building of reference. Conversely, we hypothesized pragmatic gesture rate to be higher in instructional explanations than in process explanations, as this latter should generate only small amounts of pragmatic markers, if at all.

Finally, we expected word searching gesture rate to be higher in the INSTRUCT-EX type as it is a dual-goal task involving an original wording (no previous enunciation). Word searching gestures should either appear together with enunciation-process markers, or find their production correlated with these markers.

Reliability

In order to establish reliability in gesture coding, in study 1, once the first coder tagged movements as gestures, she categorized them according to gesture type, in relation to the speech they accompanied. A second coder categorized 26,8% of the gestures (82 gestures out of 305) where these gestures represented both conditions (game explained and visibility) and 6 different dyads. Agreement between coders was 91%, across all gesture types. In study 2 a second coder validated the annotations made by a first coder and settled any disagreements. Inter-rater agreement on the identification of gesture units

— also in relation to the speech they accompanied — was 90% and agreement on the function attributed to each stroke was 95%.

3.5 Synthesis of our goals for this study

In the following table, we explicitly link the four hypotheses we established in section 3.2 and the measures described in the previous section.

Table 2: Synthesis of our hypotheses

Hypotheses	**Expected measures**
H1. Young children aged 6 years show competencies related to a dual-goal finalized dialogue task	More new information markers, logical connectors, and modal structures with addressee's markers in INSTRUCT-EX and more chronological connectors in PROCESS-EX
H2. At this age, a dual-goal dialogue task is more difficult than a single goal dialogue task	Longer explanations in INSTRUCT-EX More on-line enunciation process markers in INSTRUCT-EX and more Word searching gesture in INSTRUCT-EX
H3. Pragmatic constraints proper to each task show both in language and gesture	Higher gesture rate in INSTRUCT-EX
H4. Young children adapt their use of gesture resources to accomplish the task	Higher referential gesture rate in PROCESS-EX and higher pragmatic gesture rate in INSTRUCT-EX

4. Results

The analyses that follow concern linguistic variables (mean number of clauses, mean number of new information markers, of connectors, of modal structures and of enunciation-process markers) and gesture variables (mean number of gestures par explanation, of referential, pragmatic and word searching gestures). We compare the two types of explanations for each variable. As the explanations are very different and have different lengths, we tested the normality and the condition of homoscedasticity between the two datasets (INSTRUCT-EX and PROCESS-EX) for each variable: when the normality and/or Levene test were verified, we ran a parametric test. When these tests were not verified, we ran a non parametric test. For the following variables, we ran a parametric test (test T): mean number of clauses per explanation, mean number of new information markers (according to the number of clauses per text), mean number of connectors (according to the number of clauses per text), mean number of enunciation-process markers (according to the number of clauses per text), mean number of gestures per clause, mean number of referential gesture per clause and mean number of pragmatic gesture. For the following variables, we ran a non parametric test (Mann Whitney test): mean number of modal structures (according to the number of clauses per text) and mean number of word searching gesture. Concerning phatic expressions and word-searching gestures (these types of gestures are only performed in INSTRUCT-EX), we did not have enough data to perform any tests.

4.1 Linguistic analyses

Mean number of clauses per explanation

Figure 1 presents the mean number of clauses per explanation. The test T Student reveals that the Instructional explanations ($\overline{X}$ =11,06 / SD = 4,3) contain significatively more clauses than the Process explanations ($\overline{X}$ =5,47 / SD = 4,2) ($t_{(28)}$=3.584, p=0.001).

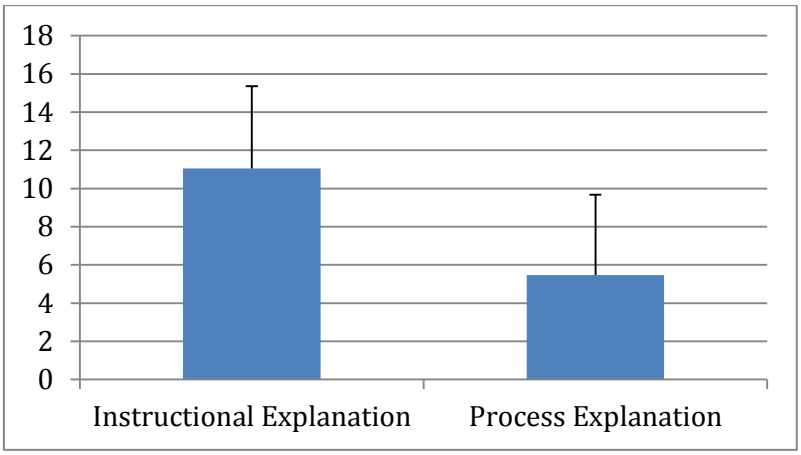


Figure 1. Mean number of clauses per type of explanation

Children produce more clauses during instructional explanation than during process explanation.

Mean number of new information markers

Figure 2 presents the mean number of new information markers per clause. The test T Student reveals that the difference between the mean number of new information markers per clause in the instructional explanations ($\bar{X}$ =0,21 / SD = 0,01) and the process explanations ($\bar{X}$ =0,025 / SD = 0,007) is significant ($t_{(28)}$=4.897, p=.000).

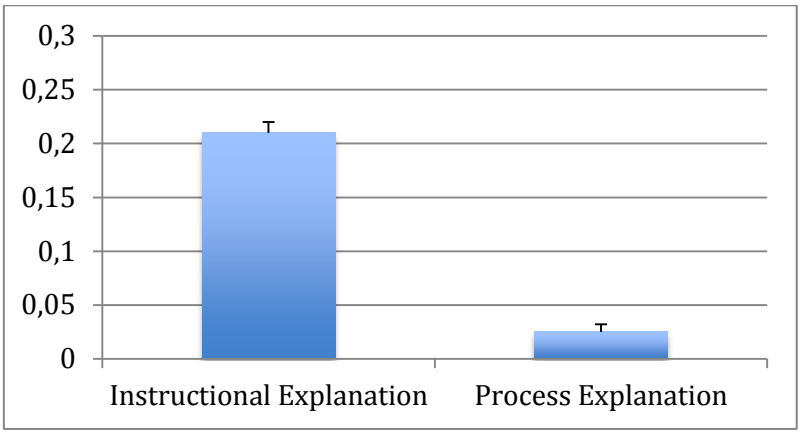


Figure 2. Mean number of new information markers per clause

Children produce more new information markers in the instructional explanation than in the process explanation.

Mean number of connectors

The test T Student reveals the difference of proportion of connectors per clause in the instructional ($\bar{X}$ =0,92 / SD = 0,04) and process explanations ($\bar{X}$ =0,85 / SD = 0,03) is not significant ($t_{(28)}$=0.52, p=0.191).

Qualitative analyses reveal that during instructional explanation, children used comparatively more logical connectors (21%) than chronological connectors (16%), whereas during process explanation, children used comparatively more of the latter (39%) than logical connectors (14%). Together with logical connectors, discourse structure markers such as 'ben' et 'alors' (well), 'en fait' (so), 'voilà' (you see) were produced in higher quantity in instructional explanation (28%) than in process explanation (5%).

To sum up on connectors, the principal difference is the use of structural markers of conversation and logical markers that characterize instructional explanation.

Mean number of modal structures

Figure 3 presents the mean number of modal structures (verbs, adverbs) per clause. The Mann Whitney test reveals that the difference between the mean number of modal structures per clause in the instructional ($\bar{X}$ =0,139 / SD = 0,01) and the process explanations ($\bar{X}$ =0,05 / SD = 0,01) is significant (U=59.50, p=.026).

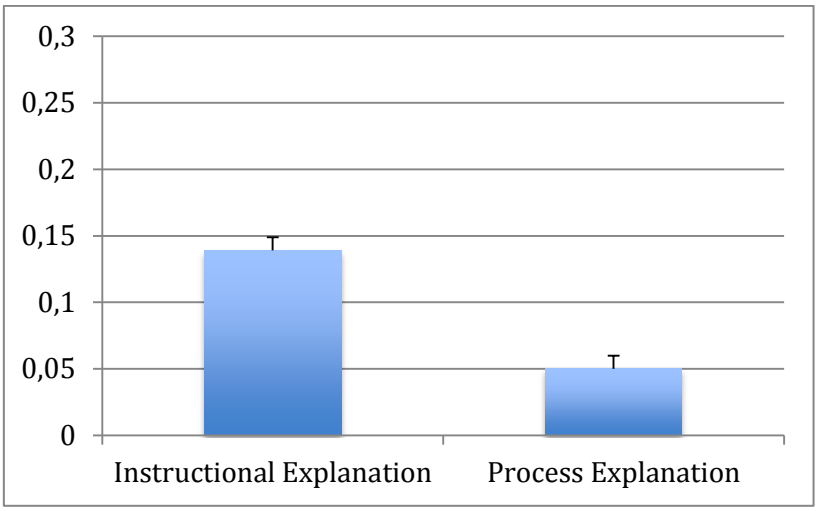


Figure 3. Mean number of modal structures per clause

Children produce more modal structures in the instructional explanation than in the process explanation.

Mean number of enunciation-process markers

Figure 5 presents the mean number of énonciation process markers per clause. The Mann Whitney test reveals that the difference between the mean number of enunciation process markers per clause in the instructional ($\bar{X}$ =0,06 / SD = 0,05) and the process explanations ($\bar{X}$ =0,33 / SD = 0,49) is significant (U=181.50, p=.003).

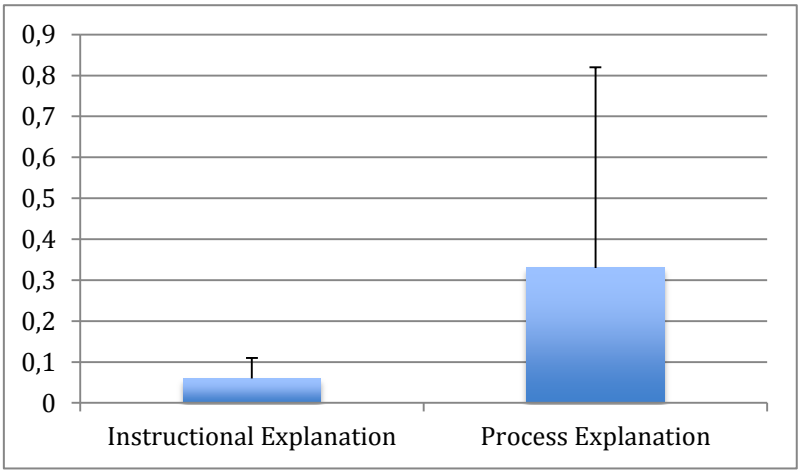


Figure 5. Mean number of enunciation process markers per clause

Children produce more on-line enunciation process markers in the process explanation than in the instructional explanation.

4.2 Gesture analyses

Mean number of gestures per clause

The test T Student reveals the difference of proportion of gestures (all gesture types: referential, pragmatics (discursive, interactive, performative and framing) and word searching) per clause in the instructional ($\bar{X}$ =0,58 / SD = 0,5) and process explanations ($\bar{X}$ =0,86 / SD = 0,6) is not significant ($t_{(28)}$=-1,322, p=0.197).

Referential gestures

Figure 6 presents the mean number of referential gestures per clause. The test T Student reveals the difference of proportion of referential gestures per clause in the instructional ($\bar{X}$ = 0,26 / SD = 0,3) and process explanations ($\bar{X}$ = 0,67 / SD = 0,51) is significant ($t_{(28)}$=-2.514, p=0.018).

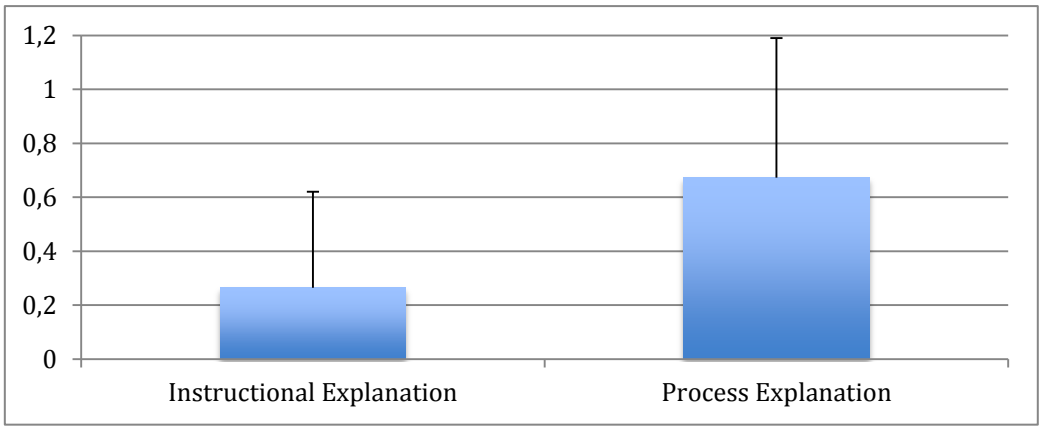


Figure 6. Mean number of referential gesture per clause

Children produce significantly more referential gesture in process explanations than in instructional explanations.

Pragmatic gestures

Figure 7 presents the mean number of pragmatic gesture per clause (for this analysis, we included only discursive and interactive gestures because the rate of performative and framing gestures were too low). The test T Student reveals that the difference in rate of pragmatic gesture per clause in instructional explanations and process explanations is significant ($t_{(28)}$=3,990, p=0.000).

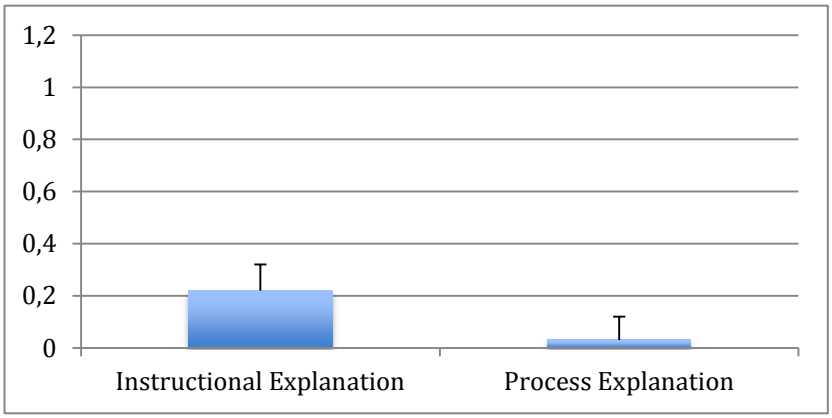


Figure 7. Mean number of pragmatic gesture per clause

Children hardly produce any pragmatic gesture in the process explanation ($\bar{X}$ = 0,03 / SD = 0,09) as compared to the instructional explanation ($\bar{X}$ = 0,22 / SD = 0,1).

5. Discussion

Analyses were run to verify our general hypotheses. Table 3 shows each hypothesis, the expected measures associated with it and the results of each measure. Results revealed that the type of explanation (Instructional versus Process) had an effect on several variables measured. Most variables, both linguistic and gestural varied significantly according to the type of the explanation.

Hypotheses	**Expected measures**	**Results**
H1. Young children aged 6 years show competencies related to a dual-goal finalized dialogue task	More new information markers, logical connectors, and modal structures with addressee's markers in INSTRUCT-EX and more chronological connectors in PROCESS-EX	Confirmed except for connectors but there are differences in logical connectors
H2. At this age, a dual-goal dialogue task is more difficult than a single goal dialogue task	Longer explanations in INSTRUCT-EX More on-line enunciation process markers in INSTRUCT-EX	Partly confirmed for linguistic measures
H3. Pragmatic constraints proper to each task show both in language and gesture	Higher gesture rate in INSTRUCT-EX	Infirmed, although both types of explanation were bimodal
H4. Young children adapt their use of gesture resources to accomplish the task	Higher referential gesture rate in PROCESS-EX and higher pragmatic gesture rate in INSTRUCT-EX	Confirmed

Taking the results in order, linguistically, instructional explanation is characterized by a greater rate of new information markers and modal structures, and this partially confirms our hypothesis H1. Firstly, as predicted it makes sense that there is a greater rate of new information markers in the instructional explanations as that content was not previously narrated (whereas the content of the process explanations was already narrated). Secondly, children produce significantly more modal structures in the instructional explanation versus the process explanation. This result can be attributed to the socio-interactional characteristic of instructional explanation. If a speaker knows he is explaining in order to instruct so that an addressee understands enough to be able to carry out the instructed process on his own at a future time, this is clearly an additional constraint as compared to simply recounting a process so that it is understood without further action. That said, we did not have enough phatic expressions to run any comparitive tests and perhaps these monitoring skills are what children are developing. In addition, it is not obvious a child feels responsible for the adult understanding what the child narrates in a responsive context with the adult monitoring the interaction. Regarding logical connectors, although we expected that their rate would be higher in Instructional explanation, there were only comparatively more logical connectors (e.g. "in order to", "otherwise", "if… then"). Perhaps then, what really distinguishes explaining an instruction versus explaining a process in terms of connectors is the necessity in the first case to speak about task objectives and consequences of both desired and undesired actions within that task; this is consistent with the idea that explaining as instruction has a social interactional component in addition to a simple referential task. The unexpected difference on the use of discourse structure markers between the two types of explanation, with children using them quite a bit in the instructional explanation (28%) compared to the process explanation (5%), adds consistency to this last view. Continuing our discussion of type of connector that may distinguish our two types of explanation, since chronological connectors favour the expression of temporality and the relating of series of events, it makes sense that there should be more of them in process explaining (30), as opposed to instructional explaining (24). However, the difference in the raw numbers for our data is not striking. As shown in the data, children who perform the instructional explanation also use chronological connectors to mark the various stages of the game their addresse is about to play next.

Hypothesis H2 was partly confirmed as regards to linguistic measures. Children produce more clauses during instructional explanation than during process explanation. This is an argument in favor of the communicative situation of our instructional explanation being more difficult to handle than the communicative situation of our process explanation because there are two tasks (referential and socio-interactional) to manage instead of just one (referential). On the other hand, these results - the fact that children produced more clauses during instructional explanation - can be also interpreted as children

being more talkative in this task. Indeed, having a concrete goal (i.e. to help the peer understand the game) might motivate the child explainer to speak more during the interaction. In addition, if the child learner's expressed motivation to understand the content, this might have influenced the child explainer's effort to explain. We also expected there would be more on-line enunciation process markers in instructional explanation since children doing instructional explanation had to put their explanations into words for the first time whereas children doing process explanation had already spoken about the process in another task. But this was not the case. Rather, we found more of these markers in children doing process explanation. A reason for these unexpected results could be found in the sub-categories of such markers. We made a distinction between 6 types of enunciation process markers that may be grouped into 3 broader categories: - rewording the speech content (with or without any change); - giving oneself some additional time (whether within a filled pause or by lengthening some syllable), - interrupting the speech string (whether on a word or on a longer syntactic unit). Considering their respective proportion, rewordings seem to happen more often during instructional explanation (56%) than during process explanation (39%), while pausal phenomena and interruptions happen more often in process explanation (61%) than in instructional explanation (44%). Children who explain an instruction could be more inclined to do rewording in order to make their explanation more explicit to their addressee, focusing on accuracy rather than on correctness. On the other hand, children who answer a process explanation in response to an adult's prompt may focus more on correctness than on accuracy, which would explain the higher proportion of pauses and interruptions during explanation. These are hypothetical presumptions considering the limited available data. Yet, if they were to be proven correct on a larger set of data, we would have to reconsider the so-called 'difficulty' of discourse tasks in this study as well as on a more general ground. On a related note, in analyses carried out solely on the instructional explanation data (including more explanations than those taken into account for this study), we found that each time a child performed a word-searching gesture, he or she simultaneously verbally used an enunciation process marker, but the reverse was not true (Mazur-Palandre & Lund, 2013). Taken together, these results call for a closer look at the interaction between the types of enonciation markers and their accompanying gestures within different types of discourse.

Let us now consider our results on children's co-verbal gestures. A look at the gesture types gives us results that could be viewed as incompatible with what the on-line enunciation process markers tell us. Notably, if word-searching gestures occur, it is only during instructional explanation[1]. This indicator pleads for a higher difficulty level of instructional explanation as children search more for their words with gestures. Interestingly enough, word-searching gestures may be viewed as the gestural equals to rewordings. Although statistic results come to contradictory results, a more refined view of enunciation process markers with both rewordings and word searching gestures as indexes of search for accuracy leads to results that are more on line with our expectations. As discussed just above, a follow up study should investigate older children and adults performing similar explanation tasks in order to check for developmental issues around enunciation process markers and their accompanying gestures.

Before we look at the results concerning other gesture types, let's take a look at our results on the mean number of gestures per clause according to explanation type (hypothesis H3). We expected that there would be a higher rate of gestures during instructional explanation due to its dual-goal nature and therefore due to each goal generating gestures (both the building of reference and the monitoring of the on-going interaction). But this was not the case. However, one must consider the following; both types of context generate a similar quantity of gesture in children production, thus confirming other work on language and gesture production among gesture studies (Colletta, 2004). Why the dual-goal instruction task does not generate more gesture remains an unanswered question in the context of our study ? Here again, a follow up study should investigate older children performing similar explanation tasks in order to check for developmental issues.

On the other hand, significantly more referential gestures were produced during process explanation (hypothesis H4). It would seem that the referential component of process explanations is stronger than the referential component of instructional explanation in this data set in that significantly more referential gestures are produced during process explanation. The difference in the reference itself can

[1] Statistic tests could not be run because there were so few word searching gestures. However, the fact that this type of gesture appeared only in one type of context (INSTRUCT-EX) is potentially hypothesis building and leads to discussion..

potentially explain this result. The instructional explanation situation had a smaller amount of different referents than the process explanation situation. In the former, the same referents are used repeatedly during rendundant actions. In the latter, however, there is a succession of different referents that appear chronologically and are linked together causally.

In summary, we have shown that instructional explanation and process explanation show differences in both the linguistic and gestural material child speakers use to carry them out. It thus follows that the verbal and nonverbal behavior of children of our study reflect different cognitive and discursive demands that are asked of them, depending on which explanation type they perform. The fact that children respond to these demands by differing their behavior shows their abilities to make gestural and verbal choices in keeping with the specificities of the task's context of production. Children thus speak and move differently in ways that are consistent with the constraints of the context of explanation production. That said, the children giving instructional explanation could improve the monitoring of their addressee (for example with an increased use of phatics) in order to ensure building of a shared understanding.

These results therefore also allow us to reflect upon the possible consequences for teaching. For example, the pragmatic abilities involved in socio-interactional goals of human interaction could be explicitly taught to young children who are developing them. Becoming aware of the fact that an explanation needs to be formulated so that an addressee can understand it and also realizing that one needs to check for an addressee's comprehension are important parts of a child's pragmatic development.

Finally, it also follows that our results have wider implications for the study of pragmatics in general. First, they confirm the relevance of studying multimodal indicators as they reflect speakers' reactions to discourse context and second, given what we know about adults, they confirm the relation between how multimodal language in children develops and how children of different ages may react to different discourse contexts. In future work we will gather data from other age groups in order to track the evolution of these pragmatic abilities. These results also allow us to reflect upon the possible consequences for teaching. For example, the pragmatic abilities involved in socio-interactional goals of human interaction could be explicitly taught to young children who are developing them. The French school, at all levels, does not favour spoken langage learning at the same level as learning reading and writing. Spoken language learning in the French nursery school is often limited to the production of expected words, sentences and tentative narratives within an interaction format that is monitored by the teacher (Simon, Colletta, Lepoire, Prevost, Sautot et Vuillet, 2009). Spoken language learning in primary and secondary school does not fare any better. When planning pedagogical sequences involving language learning with their students, teachers favor monologue types of discourse such as reports, naratives and arguments rather than the practice of debates and of interactions in a format that can be organized and run by the students themselves.

Becoming aware of the fact that an explanation needs to be formulated so that an addressee can understand it and also realizing that one needs to check for an addressee's comprehension are important parts of a child's pragmatic development.

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APPENDIX 1

(1) Example of an INSTRUCT-EX (// is a clause marker and <> signifies on-line enunciation-process markers):

[alors en fait c'est un jeu // t(u) as une euh balle // t(u) as des briques // et en fait et ben tu cliques sur la souris une fois // et avec un morceau d(e) bois en fait tu fais bouger avec la souris t(u) as un morceau d(e) bois sur l'écran et tu le fais bouger // <et ben en fait l(e) but c'est que ça tombe> en fait *tu dois* essayer qu(e) ça tombe pas euh // <s/> euh dessous // <et> en fait et ben euh le but c'est que tu exploses euh les briques // **et puis après** // et ben **quand** tu as fini // et ben tu as deux zèbres // puis <s/> **si** t(u) as bien aimé // t(u) as un zèbre bleu // tu cliques sur le zèbre bleu <**si** t(u) as pas très bien aimé> // **si** t(u) as pas aimé et ben <tu> (il) y a un zèbre rouge et ben tu cliques sur l(e) zèbre rouge // et t(u) as fini **après**]

Translation: "so in fact it's a game, you have um a ball, you have bricks, and in fact um you click on the mouse once and with a piece of wood in fact you make it move with the mouse, you have a piece of wood on the screen and you make it move and um in fact the goal is that it falls in fact you

have to try to make it not fall um um under and in fact um the goal is that you explode the bricks and then after and um when you are done and um you have two zebras and i if you liked to play then you have a blue zebra you click on the blue zebra and if you didn't really like to play if you didn't like it um you there is this red zebra and um you click on the red zebra and you are done after that"

(2) Example of a PROCESS-EX:
[heum:: pa(r)ce que l'oeuf // à chaque fois il tombait sur quelque chose ça s(e) cassait // **et après** y avait la f:: fleur // heu elle/ s(e) cassait cassait cassait // **et après** elle s'est tordue // et **comme** l'oeuf i(l) s'est retombé sur la feuille // et tellement qu'elle était un peu trop // elle était légère la la porte // elle a poussé **et** c'est arrivé chez la souris]

Translation: "because the egg, every time it fell on something it would break, and then the flower, it broke broke broke, and then it got twisted, and because the egg fell on the flower, it was so, so light the door, it opened then it (the egg) entered the mice place"