MULTIMODAL GESTURE-SPEECH INTEGRATION STRATEGIES AND CHILDREN’S NARRATIVE ABILITIES

Ingrid Vilà-Giménez
PhD research plan

Thesis supervisor: Dr. Pilar Prieto
Doctoral program in Translation and Language Sciences
Universitat Pompeu Fabra

June 15, 2017
# TABLE OF CONTENTS

RESUM ................................................................................................................................. i
RESUMEN ............................................................................................................................ iii
ASBTRACT ............................................................................................................................ v

1. INTRODUCTION ............................................................................................................... 1
   1.1 Object of analysis ........................................................................................................ 1
   1.2 Prior work ................................................................................................................... 2
       1.2.1 The importance of narrative abilities ................................................................. 2
       1.2.2 Cognitive and developmental benefits of co-speech gestures ......................... 5
       1.2.3 Beneficial effects of producing co-speech gestures ............................................ 9
       1.2.4 Cognitive and developmental benefits of beat gestures ................................. 13
       1.2.5 The linguistic functions of beat gestures ........................................................... 15
       1.2.6 Narrative abilities and co-speech gestures ....................................................... 19

2. GOALS OF THE DISSERTATION ................................................................................. 22

3. THEORETICAL FRAMEWORK .................................................................................... 23

4. HYPOTHESES ............................................................................................................. 26

5. EXPERIMENTAL STUDIES ......................................................................................... 30
   5.1 Study 1 ...................................................................................................................... 30
       5.1.1 Research question .............................................................................................. 30
       5.1.2 Methods ............................................................................................................ 30
       5.1.3 Expected results ............................................................................................... 33
   5.2 Study 2 ...................................................................................................................... 33
       5.2.1 Research question .............................................................................................. 33
       5.2.2 Methods ............................................................................................................ 33
       5.2.3 Summary of results .......................................................................................... 39
   5.3 Study 3 ...................................................................................................................... 42
       5.3.1 Research question .............................................................................................. 42
       5.3.2 Methods ............................................................................................................ 43
       5.3.3 Expected results ............................................................................................... 45
5.4 Study 4 ........................................................................................................... 45
  5.4.1 Research question ....................................................................................... 45
  5.4.2 Methods ...................................................................................................... 46
  5.4.3 Expected results .......................................................................................... 48
5.5 Study 5 ........................................................................................................... 48
  5.5.1 Research question ....................................................................................... 48
  5.5.2 Methods ...................................................................................................... 48
  5.5.3 Expected results .......................................................................................... 50

6. WORKING SCHEDULE ................................................................................. 51

7. SELECTED REFERENCES .............................................................................. 53

8. GENERAL REFERENCES ................................................................................. 57

Appendix A: Narrative structure of all the stories in the animated cartoons....... 71
Appendix B: English translations of the six training stories ................................. 72
Appendix C: Examples of the beat gestures from the preliminary study .............. 73
Appendix D: Images from the stimulus narrative training materials .................... 74
Appendix E: Experimental setup of Study 2 and 3 .............................................. 75
Appendix F: Rubric of the narrative scores .......................................................... 76
Appendix G: Example of a child-produced narrative .......................................... 77
RESUM

En l’àmbit de l’estudi del desenvolupament del llenguatge, les narracions dels nens han estat típicament emprades com a mesura vàlida de les seves habilitats lingüístiques (Demir, Fisher, Goldin-Meadow, & Levine, 2014; Duinmeijer, De Jong, & Scheper, 2012). Estudis recents han demostrat que els gestos icònics poden promoure el desenvolupament narratiu dels nens. Per exemple, Demir, Levine, i Goldin-Meadow (2015a) van demostrar que aquells nens de 5 anys que expressaven el punt de vista sobre el personatge d’una història mitjançant la gestualitat en les seves narracions, al cap d’un any, eren capaços d'expressar una millor estructura narrativa de la parla. Tanmateix, no tenim gaire coneixement sobre els beneficis potencials d'uns altres tipus de gestos: els anomenats “gestos rítmics”, és a dir, aquells moviments de les mans que s'associen amb la prominència prosòdica en un discurs oral. La hipòtesi que formulem en aquesta tesi és que els gestos rítmics poden beneficiar el desenvolupament de les habilitats narratives dels nens, ja que aquests gestos s’utilitzen per marcar funcions lingüístiques importants com el focus, al ritme, o l’estructura del discurs (Shattuck-Hufnagel, Ren, Mathew, Yuen, & Demuth, 2016; Dimitrova, Chu, Wang, Özyürek, & Hagoort, 2016).

Aquesta tesi investiga diversos temes relacionats amb els efectes precursor i beneficiosos dels gestos rítmics —i de la seva prominència prosòdica— en les habilitats narratives de nens de 5 i 6 anys. El primer estudi (Estudi 1) analitzarà l’adquisició primerenca dels gestos rítmics en les narracions explicades per nens de 5 i 6 anys. Es descriuràn els següents quatre aspectes: la funció pragmàtica dels gestos rítmics, les diferents formes que adopten els gestos rítmics en relació amb aquests significats pragmàtics, l’associació d’aquests gestos a l’estructura del discurs narratiu, així com la integració temporal entre els gestos rítmics i l’estructura prosòdica. També s’avaluarà la correlació que hi ha entre la producció natural de gestos rítmics de nens de 5 i 6 anys mentre narren dibuixos animats i les seves habilitats narratives —en termes de fluïdesa i estructura narrativa—. Els dos estudis següents investigaran si l’entrenament tant de l'observació de gestos rítmics (Estudi 2) com de la producció d’aquests gestos (Estudi 3) pot ajudar els nens de 5 i 6 anys a millorar les seves narracions. Els resultats de l’Estudi 2 —ja finalitzat— han demostrat que els nens que van ser exposats a la condició d’entrenament amb gestos rítmics van obtenir un guany significatiu en la qualitat de les seves narracions en termes de fluïdesa i estructura narrativa. En un quart estudi de
caràcter longitudinal (Estudi 4) es valorarà si els gestos rítmics actuen com a precursors de les habilitats narratives, i, concretament, si la seva aparició primerenca en les narracions dels nens de 5 i 6 anys pot predir les habilitats narratives (així com d'altres capacitats cognitives, lingüístiques, i socials) en un període més tardà en el desenvolupament. Finalment, un estudi d’intervenció a classe integrat en el currículum escolar (Estudi 5) avaluarà la incidència d’un entrenament de 4 setmanes basat en la gestualitat, amb gestos de la parla, en la millora de les habilitats narratives (i altres capacitats cognitives, lingüístiques, i socials) dels nens de 5 i 6 anys.

**Paraules clau:** gestos rítmics; habilitats narratives; desenvolupament narratiu; desenvolupament lingüístic
RESUMEN

En el ámbito de estudio del desarrollo del lenguaje está comúnmente aceptado que la observación de las características de las narraciones producidas por los niños constituye una medida eficaz del nivel de desarrollo de sus habilidades lingüísticas (Demir, Fisher, Goldin-Meadow, & Levine, 2014; Duinmeijer, De Jong, & Scheper, 2012). Algunos estudios recientes han demostrado que los gestos icónicos pueden estimular el desarrollo narrativo de los niños. Por ejemplo, Demir, Levine y Goldin-Meadow (2015a) demostraron que aquellos niños de 5 años que expresaban el punto de vista sobre el personaje de una historia haciendo uso de la gestualidad en sus narraciones mostraban al cabo de unos años un mayor desarrollo en la estructura narrativa del habla. Sin embargo, poco se sabe aún sobre los potenciales beneficios de otro tipo de gestos: los llamados “gestos rítmicos”, esto es, aquellos movimientos de las manos que se asocian con la prominencia prosódica en un discurso oral. La hipótesis que pretende explorarse en esta tesis propone que los gestos rítmicos pueden resultar beneficiosos para el desarrollo de las habilidades narrativas de los niños, ya que estos gestos se emplean para marcar funciones lingüísticas importantes como el foco, el ritmo, o la estructura del discurso (Shattuck-Hufnagel, Ren, Mathew, Yuen, & Demuth, 2016; Dimitrova, Chu, Wang, Özyürek, & Hagoort, 2016).

Esta tesis investiga diversos temas relacionados con los efectos precursores y beneficiosos de los gestos rítmicos —y de su prominencia prosódica asociada— en las habilidades narrativas de niños de 5 y 6 años. El primer estudio (Estudio 1) abordará el estudio de la adquisición temprana de gestos rítmicos en las narraciones elaboradas por niños de 5 y 6 años, y en él se pretenden evaluar cuatro cuestiones importantes: la función pragmática de los gestos rítmicos, las diferentes formas que adoptan estos gestos en relación con los significados pragmáticos que comunican, la asociación de estos gestos con la estructura del discurso narrativo, así como la integración temporal entre los gestos rítmicos y la estructura prosódica. También se evaluará la correlación existente entre la producción natural de gestos rítmicos por parte de niños de 5 y 6 años mientras narran dibujos animados y sus habilidades narrativas —en términos de fluidez y estructura narrativa—. Los dos siguientes estudios de la tesis investigarán si el entrenamiento tanto de la observación de gestos rítmicos (Estudio 2) como de la producción de estos gestos (Estudio 3) puede ayudar a niños de 5 y 6 años a mejorar sus narraciones. Los resultados del Estudio 2 —ya finalizado— demuestran que los niños
que fueron expuestos a la condición de entrenamiento con gestos rítmicos obtuvieron una mejora significativa en la calidad de sus narraciones en términos de fluidez y estructura narrativa. Posteriormente, en un cuarto estudio de carácter longitudinal (Estudio 4) se valorará si los gestos rítmicos actúan como precursores de las habilidades narrativas y, concretamente, si su aparición temprana en las narraciones de los niños de 5 y 6 años puede predecir las habilidades narrativas (y otras mejoras cognitivas, lingüísticas, y sociales) en un período más tardío del desarrollo. Finalmente, un estudio de intervención en clase integrado en el currículum escolar (Estudio 5) evaluará la incidencia de un entrenamiento de 4 semanas basado en la gestualidad, con gestos del habla, en la mejora de las habilidades narrativas de los niños de 5 y 6 años (y otras capacidades cognitivas, lingüísticas, y sociales).

**Palabras clave:** gestos rítmicos; habilidades narrativas; desarrollo narrativo; desarrollo lingüístico
ABSTRACT

Children’s narratives have been typically used as an ecologically valid measure of their language abilities (e.g., Demir, Fisher, Goldin-Meadow, & Levine, 2014; Duinmeijer, De Jong, & Scheper, 2012). Recent evidence has shown that representational gestures can boost children’s narrative development. For instance, Demir, Levine, and Goldin-Meadow (2015a) showed that 5-year-old children who expressed character viewpoint by gestures in their narratives improved their narrative structure in speech across ages. However, less is known about the potential benefits of other types of gestures called “beat gestures”, or hand movements associated with prosodic prominence in oral discourse. In this thesis, we hypothesise that the specific role of beat gestures as highlighters of linguistic functions associated with focus marking, rhythmic marking, and discourse structure marking (Shattuck-Hufnagel, Ren, Mathew, Yuen, & Demuth, 2016; Dimitrova, Chu, Wang, Özyürek, & Hagoort, 2016) can be key in building up narrative discourse abilities in children.

The present PhD thesis investigates several issues related to the precursor and beneficial effects of beat gestures —and their concomitant prosodic prominence— on 5- to 6-year-old children’s narrative skills. The first study (Study 1) will focus on the early acquisition of beat gestures in narratives told by 5- to 6-year-old children. Four important issues will be assessed: the pragmatic function of beat gestures within the narratives, their different hand shapes in relation to pragmatic meanings, to which parts of the narrative discourse structure they are associated with, and their temporal integration with the prosodic structure. Moreover, we will assess the correlation between the 5- and 6-year-old children’s natural use of beat gestures while narrating wordless cartoons with their narrative skills —in terms of fluency and narrative structure scores—. The next two studies of the thesis will investigate whether training 5- to 6-year-old children in observing (Study 2) and producing (Study 3) beat gestures can contribute to improving their narrative performances. Results of the Study 2 —already finished— demonstrated that children who were exposed to the beat training condition showed a significant gain in the quality of their narratives in terms of fluency and narrative structure scores. A fourth longitudinal study (Study 4) will assess the value of beat gestures as precursors of narrative skills, and specifically whether their early appearance in children’s narratives at 5-6 years of age could be predictive of long-term narrative abilities (as well as of other cognitive, linguistic, and social skills) later in
development. Finally, a classroom intervention study integrated in the school curriculum (Study 5) will assess the potential beneficial value of a four-week gestural-based training with 5- and 6-year-old children using co-speech gestures on their improvement of narrative skills (and other cognitive, linguistic, and social skills).

**Keywords:** beat gestures; narrative abilities; narrative development; linguistic development
1. INTRODUCTION

1.1 Object of analysis

This research investigates the effects of the multimodal integration between gesture and speech strategies in preschoolers’ and first graders’ development of narrative discourse abilities (5- to 6-year-old children). The thesis will assess the precursor and beneficial effects of a specific type of co-speech gestures, beat gestures, on children’s narrative skills. Beat gestures are simple rhythmic non-representational hand movements associated with prominent prosodic positions in speech, which do not reflect contextual meaning of the spoken message, but rather signal informational focus, as well as discourse structure (Shattuck-Hufnagel, Ren, Mathew, Yuen, & Demuth, 2016; Dimitrova, Chu, Wang, Özyürek, & Hagoort, 2016). Given these discourse functions of beat gestures, our main hypothesis is that they can have a potential role in building up children’s narrative discourse abilities.

The thesis will consist of five studies addressing five groups of research questions: (1) How 5- to 6-year-old children start to integrate beat gestures within their narratives, what is their pragmatic function and their typical hand shape, to which parts of the narrative discourse structure they are associated with, and whether children are able to temporally integrate their first beat gestures with the prosodic structure? And whether the natural use of beat gestures by 5- to 6-year-old children correlate with better fluency and narrative structure scores? (Study 1); (2) Does training with observing beat gestures favour 5- and 6-year-olds’ narrative discourse performance? (Study 2); (3) Does training with producing beat gestures favour 5- and 6-year-olds’ narrative discourse performance? (Study 3); (4) Could the natural and early appearance of beat gestures in narrative tasks at 5-6 years of age be predictive of an improvement of narrative abilities (as well as of other cognitive, linguistic, and social skills) at a later age? (Study 4); (5) Could a classroom intervention study with co-speech gestures integrated in the school curriculum with 5- and 6-year-old children contribute to improving their narrative skills (and other cognitive, linguistic, and social competence skills)? (Study 5).
1.2 Prior work

1.2.1 The importance of narrative abilities

Children’s discourse abilities have been typically associated with linguistic development. Narrative skills function as a powerful measurement and predictor of long-term language abilities, and specifically of children’s communication competence. Narratives are typically used as an ecologically valid measure of a child’s language abilities, and many studies use this measure as a control against which children with language disabilities can be analysed (e.g., Demir, Fisher, Goldin-Meadow, & Levine, 2014; Demir, Rowe, Heller, Goldin-Meadow, & Levine, 2015b; Duinmeijer, De Jong, & Scheper, 2012; Demir, Levine, & Goldin-Meadow, 2010). Importantly, it has been demonstrated that early acquired narrative abilities (e.g., being able to provide a well-structured narrative, contextual information, the narrator's own comments about the narrative events, etc.) are predictive of later literacy development, reading comprehension, and academic performance and success in school (Demir & Küntay, 2014; e.g., Griffin, Hemphill, Camp, & Wolf, 2004).

In recent years the acquisition of narrative abilities has been of growing interest, and some studies have investigated the link between early narrative abilities and later reading abilities, which have been demonstrated to be positively related to each other (Fazio, Naremore, & Connell, 1996; Feagans & Appelbaum, 1986). Demir, Levine, and Goldin-Meadow (2012:6) defined narrative skill as “an oral language skill that is argued to provide the missing link between oral language and later reading comprehension”. Early acquired narrative abilities by kindergarten children have been shown to be predictive of a better later reading comprehension as late as 7th grade (Griffin et al., 2004; Tabors, Snow, & Dickinson, 2001). It is clear that oral storytelling abilities are highly related to the acquisition of more complex linguistic features. Children’s familiarization with oral narrative structure organization of a story (i.e., temporal relations, cause-effect relations, problem-attempt-resolution sequences) has been clearly demonstrated to enhance children’s comprehension of a written text that is similarly structured (Cain & Oakhill, 2003). Also, narrative features such as causal links and evaluative devices provide evidence of later reading comprehension (Kendeou, van den Broek, White, & Lynch, 2009). Moreover, a study by Kendeou, van den Broek, White, and Lynch (2007) pointed out that children who have the ability to answer questions about real or deduced audio-visual story events at 6 years also have the ability to answer
the same kind of questions about a written text when they are 8 years of age. Similarly, school literacy success can also be predicted by the child's ability to tell a coherent story, a process that involves the acquisition of complex skills associated with communication units (i.e., story components) and how they are related and expressed (i.e., coherence and cohesion) (Naremore, Densmore, & Harman, 1995). Specifically on the Catalan language, some research has investigated the relationship between written and oral communication in children’s discourse development, and specifically how these communicative modes can influence the evolution of the discoursal use of referential expressions (e.g., *Frog, where are you?* Mayer, 1969) (López-Orós & Teberosky, 1998). The study revealed a positive effect between being involved in written language interaction and in the subsequent writing learning, and the amount of correct uses of relevant referential expressions within the discourse.

Many studies of children’s language development have demonstrated that the basic narrative abilities emerge during the preschool years and continue to improve until roughly age 12. Though infants start to create narratives from the age of three with their caregivers’ support (Peterson & McCabe, 1996), there are many abilities involved in producing a coherent and cohesive narration, and acquiring these skills requires considerable time (e.g., Berman & Slobin, 1994; Berman, 1998; Karmiloff-Smith, 1986). Despite this, Applebee (1978) claimed that is from 5 to 6 years of age when children come out with ‘true narratives’; that is, all the important features of a well-produced narrative are involved in the discourse. In such a way, Howe and Johnson (1992) pointed out that children at this age could both recognise and use the structure of a story with ease.

Some studies focusing on children’s narrative discourse structure development have shown that both 4- and 5-year-old children use the knowledge of intentional action and goal plans to encode events and achieve coherence (Trabasso, Stein, Rodkin, Park Munger, & Baughn, 1992). Four-year-old children can use the story goal plan to interpret and integrate the set of episodes and actions shown in a picture book. Children of this age start to narrate producing sentences in a temporally ordered way but, unlike 5-year-olds, who included more links between goals and actions, they did not produce causally structured stories more clearly guided by a goal plan. Thus, 5-year-old children have more knowledge of goal-directed action in narratives than 4-year-olds. Therefore, this study revealed differences between narratives produced by 3- and 5-year-old children, showing the main narrative changes at age 4. Similarly, Trabasso, Stein, and
Johnson (1989) found that 5-year-old children start to narrate actions related to a story goal when they are asked to tell a story by showing them pictures. It is not until the age of 7 when narratives with multiple episodes appear and until the age of 9-10 that they use considerably more story details and tell complete episodes (Muñoz, Gillam, Peña, & Gulley-Faehnle, 2003). Shapiro and Hudson (1991) also revealed that at 5 and 6 years of age, (i.e., first graders) children’s narratives are more structurally complex than those from preschoolers, as they include goals, plots, past tense language, and temporal connectives.

One of the essential features involved in oral discourse narrative development is narrative cohesion, i.e., the ability to convey causal and temporal relationships. A narrative emerges from oral descriptions of story goal-connected events related to story characters that are involved in the narrative (Davies, Shanks, & Davies, 2004). In this connection, significant changes are observed in narrative cohesion between 5 and 7 years of age. For example, as noted by Demir and Küntay (2014), 5-year-old children can typically link their utterances by using sequential conjunctions or discourse markers like ‘then’, ‘after’, or ‘that’, whereas older children can use more complex structures. However, these authors report that major changes in children’s narrative discourse structure and in the use of linguistic means to mark it (i.e., story-level structure or macrostructure) do occur around 5 to 6 years of age, since around that time children begin to create stories that more reliably include the main components of a story line and start to be able to refer to the story’s goals, at the same time they improve narrative coherence, another important feature to be considered in oral discourse narrative development. In contrast, 4-year-old children can narrate by combining more than two events together, but the narratives are short and the events are often out of sequence.

It has been demonstrated that first graders know how to manage the use of referential expressions, specifically the maintenance through null forms in a language such as Catalan (i.e., reference to entities that have been previously mentioned in the discourse) and reintroduction functions through noun forms (i.e., reference to entities which have not occurred in the previous discourse clause), observing an evolution of reference reintroduction from first to third grade children, at the same time that discourse became less ambiguous (Rossi, Pontecorvo, López-Orós, & Teberosky, 2000).

Concerning the development of discourse markers specifically in oral language, a study by Vion & Colas (2005) investigated how and when 7- to 11-year-old French
children use connectives while narrating comic strips, which showed either arbitrary (i.e., events presented in any order) or ordered (i.e., events presented in order) event sequences. Comic strips were also displayed in a simultaneous mode (i.e., all pictures showed in one page) or in a consecutive mode (i.e., one picture per page). Moreover, comic strips also differed between if they maintain the topic (i.e., maintained topic condition) versus if they change it (i.e., changed topic condition). The layout of the characters was also controlled. Each child was administered only one frame display mode and one type of sequence, but in both topic conditions. Findings obtained in this study showed evidence of a higher use of discourse markers in narratives elicited by pictures that were shown at once (vs. consecutive display). Connectives were greater used in ordered sequence, and temporal markers (e.g., ‘and then’, ‘when’, ‘so now’) were specifically more used in the simultaneous display mode, rather than other connectives. When events were presented arbitrarily, there was a greater use of ‘after that’ and ‘next’; whereas when they were ordered, ‘and’ and ‘after that’ were more used. Moreover, 11-year-old children produced more connectives than 7-year-olds in the arbitrary sequence narratives. When there was maintenance of the topic, 7-year-olds were provided with more temporal-link marking (vs. 9- and 11-year-olds); whereas 11-year-old children performed more causal-link marking (vs. 7- and 9-year-olds).

All in all, this past research assessed the development of children’s narrative skills and demonstrated how these abilities intimately related to higher-level linguistic abilities such as discourse organisation and reading abilities.

1.2.2 Cognitive and developmental benefits of co-speech gestures

Gesturing is an integral part of human communication and speakers of all ages often gesture when they talk. In adult speech, co-speech gestures have been demonstrated to be meaningfully integrated with speech from a semantic, pragmatic, and phonological point of view (e.g., Kendon, 1980; McNeill, 1992; Levinson & Holler, 2014; Kelly, Özyürek, & Maris, 2010). Here, we will follow McNeill's (1992) classification of gestures into iconic or representational gestures (that is, gestures that semantically code an object shape or an action movement), metaphoric (related to more abstract concepts), deictic or pointing gestures (that is, pointing gestures towards an object, location, person or event), conventional gestures (that is, gesture symbols with an arbitrary form and meaning depending on the culture’s use), and beat gestures (that
is, simple rhythmical hand movements accompanied by prosodic prominence in speech, and that do not add semantic content to the utterance, but mark informational focus of it) (see also section 3 for a review).

Recent studies have highlighted the close interface between co-speech gestures integrated with speech, language and cognitive development. Specifically, there is also good evidence that iconic gestures (which represent some kind of meaningful referent) can have a positive effect on adults’ and children’s cognitive abilities. For instance, a potential beneficial effect of spontaneous iconic and deictic gestures was found in both adults’ (e.g., Thompson, 1995; Kelly, Barr, Church, & Lynch, 1999; So, Chen-Hui & Wei-Shan, 2012) and children’s cognitive resources (e.g., So et al., 2012; Goldin-Meadow, Kim, & Singer, 1999). These authors argue that using co-speech gestures trigger a decrease of the speaker’s working memory load and enhance cognitive memory processes in language.

**Iconic (or representational) gestures** have also been demonstrated to have a positive impact on **adults’ and children’s ability to recall and comprehend information**. Thompson (1995) undertook a comparative study in which young and old adult participants listened to a varied set of spoken sentences in three conditions: speech alone, with visible speech, and a video-recording in which the speaker accompanied speech with iconic gestures. Results showed that recall was enhanced in both young and old adults by the presence of visible iconic gestures in speech. Kelly et al. (1999) conducted four experiments that confirmed the potential pragmatic role that pointing and iconic gestures could play in both understanding and remembering pragmatic speech content. Three experiments revealed the benefits of pointing gestures, by showing that a) pointing gestures accompanied with speech (vs. speech alone and gesture alone) enhanced the interpretation of the indirect requests by college undergraduates (Experiments 1 and 2); and b) that pointing gestures, integrated in speech can potentially contribute to disambiguate the meaning of the message rather than only pointing (Experiment 3). Another experiment revealed the effectiveness not only of pointing, but also of iconic gestures, remarking that the previous findings are also applicable to other types of communicative acts (i.e., descriptions of activities and events) and to other types of gestures (i.e., iconic gestures) (Experiment 4). In So et al. (2012), both adults and 4- and 5-year-old children were presented with three different lists of verbs in three conditions (speech accompanied by either iconic gestures, beat gestures, or no gestures) and were asked to recall as many of the verbs as they could.
The results showed that both groups had better recall when speech was accompanied by iconic gestures.

Some studies have dealt with the observation of co-speech gestures produced along with speech in order to prove that gesturing can contribute to boost comprehension processes in listeners as it can guide them toward the semantic content of the spoken language (Cocks, Morgan, & Kita, 2011; Hostetter, 2011; McNeil, Alibali, & Evans, 2000). Results of the study by Cocks et al. (2011) pointed out the effectiveness of iconic gestures integrated with speech in language comprehension in adults. While both older (60- to 76-year-olds) and younger (22- to 30-year-olds) adults comprehended gestures and speech in isolation (e.g., gesture only and verbal only conditions), only the younger adults got more benefits from the integration of speech and gesture (e.g., verbal-gesture condition) in comprehending information. Hostetter (2011) undertook a quantitative meta-analysis of 63 studies on the overall communicative role of co-speech gestures involving adults and/or children and found strong evidence that gestures foster comprehension in listeners. While the size of the beneficial effect was moderate overall, it varied depending on factors such as the types of meanings encoded in gesture or the semantic overlap of the gestures with speech. Our own scrutiny of the studies included in Hostetter’s (2011) meta-analysis revealed that all the gestures used in those studies were either iconic, metaphoric, or deictic gestures —none of them included beat gestures.

Concerning child development, evidence about the reinforcing meaning of representational gestures in comprehending the spoken language was reported by McNeil et al. (2000). The study demonstrated that representational gestures enhanced children’s speech comprehension when the spoken messages were complex, in contrast to the conflicting gestures, which did not enhance the comprehension of the message, and to no gestures performance.

Other studies have demonstrated that gesturing might benefit the comprehension of syntactic and/or semantic structures and other new linguistic forms. For instance, Theakston, Coates, and Holler (2014) showed that the use of abstract representational co-speech gestures which singled out the two participants in an event and the roles they played in it facilitated the comprehension of a complex linguistic structure by 3- and 4-year-old children. Similarly, toddlers (age range: 1;8-

---

1 In this instance, the complex structure was an object-cleft construction like It was the [object] frog that the [subject] man pushed (Theakston et al., 2014).
2;0) learning the meaning of the word ‘under’ in the gesture condition (e.g., iconic gesture) got better knowledge about the word’s meaning versus those toddlers who only saw photographs of objects depicting the word ‘under’ (i.e., photo condition) and those who were not shown any iconic gesture (i.e., model only condition) (McGregor, Rohlfing, Bean, & Marschner, 2009).

In the realm of second language acquisition, iconic gestures have been shown to benefit novel word learning in adults (Kelly, McDevitt, & Esch, 2009; Macedonia, Müller, & Friederici, 2011). For instance, Kelly et al. (2009) found that a brief training session with iconic gestures helped adult speakers to learn novel words in a foreign language. Macedonia et al.’s (2011) study also revealed better word novel memorisation when participants were shown words with iconic gestures rather than with meaningless gestures (i.e., touching one’s own head or touching one’s own knee).

Some studies have highlighted the positive role of gestures in enhancing abstract mathematical learning in children. For example, a study by Goldin-Meadow et al. (1999) reinforced the idea that observing nonverbal communication in a teaching atmosphere can have an influence on children’s learning of a mathematical procedure. Their study showed that the use of eight teachers’ gestures during an individually instructed math lesson guided forty-nine 8- to 11-year-old children to convey problem-solving strategies. However, only those gestures that emphasise the information expressed through speech enhanced children’s comprehension of strategies rather than those gestures which were mismatched with the message. According to the authors, nonverbal communication hand movements can be worth concerning pedagogical education, as they can reveal the attitudes and motivations of both the teacher and the student and they can also facilitate students to go deeper to the content of the given message during lessons.

Finally, there is convincing evidence that gestures are significant precursors of language development and communication, as they play a role in language processing (i.e., production and comprehension) and learning, as well as in generalising what we learn. Infants start using gestures to communicate prior to using language, and there is continuity in development between the children’s use of gestures and their linguistic development. Several studies have shown that the use of non-verbal communication by infants and toddlers facilitates the development of oral language. For example, the combination of a pointing gesture and a word (e.g., pointing at a cake while saying the words “cake”, “mommy”, or “eat”) predicts the onset of two-word utterances (Bavin,
Vilà-Giménez, I.
PhD research plan

2014; Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005; Özçalışkan & Goldin-Meadow, 2005). These gesture-speech combinations in which infants point at an object while saying, for example, the word “mommy” allow them to express sentence-like information before they convey this idea in speech (e.g., “mommy puppy”). Both children’s speech and their gestures improve with age, and likewise gestures precede and signal oncoming changes in speech, as children expand their communicative repertoire through gesture-speech combinations (Özçalışkan & Goldin-Meadow, 2005).

In sum, this section has reviewed evidence of the beneficial effects of observing co-speech gestures on language and cognitive development. In the following subsection (see 1.2.3), we focus on previous literature that deals with the beneficial effects of producing co-speech gestures on language and cognitive development. It is important to note that the majority of the gestures involved in these studies are concrete representational gestures (and in some cases metaphorical gestures) or pointing gestures; that is, gestures which involve a substantial semantic component or signal an external referent in space.

**1.2.3 Beneficial effects of producing co-speech gestures**

Effectively, children gesture spontaneously and those communicative movements are related to language development in many significant ways (e.g., Mayberry & Nicoladis, 2000, among many others). One of the other most interesting issues in recent literature is the question of how to scaffold young children’s early gesturing and whether the performance of these gestures could promote the improvement of their language and other developmental skills.

In this section, we review the beneficial effects of producing co-speech gestures in some learning and cognitive tasks. First, by gesturing people can also generate problem-solving strategies, for example in mathematics (Cook, Mitchell, & Goldin-Meadow, 2008; Goldin-Meadow, Cook, & Mitchell, 2009; Broaders, Cook, Mitchell, & Goldin-Meadow, 2007; Novack, Congdon, Hemani-Lopez, & Goldin-Meadow, 2014) or in other thinking tasks (Alibali, Spencer, Knox, & Kita, 2011; Alibali & Kita, 2010). As it has been noted, the use of spoken explanations with correlated co-speech gestures in problem-solving tasks leads children to understand notions that are not expressively
conveyed in speech, predicting knowledge change (Goldin-Meadow & Alibali, 2013; see section 7 for a review of this study).

Cook et al.’s (2008) experiment revealed that only children (third and fourth graders) who learned through performing gestures in speech remembered the knowledge of the instruction better than those children who were taught in the speech only or gesture only condition in a mathematical task, showing that hand movements helped them retain more new knowledge. Goldin-Meadow et al. (2009) also showed that 9- to 10-year-old children who were asked to produce gestures in the correct gesture condition (vs. partially correct gesture condition and no gesture condition) in a problem-solving strategy during a math lesson got more efficient strategies; hence, more correct responses in the posttest after the lesson. Additionally, forcing children to gesture while explaining problem-solving strategies to math problems often provided them with new and correct solution strategies expressed in gesture in which they had not turned to before (Broaders et al., 2007). These findings also revealed that the implicit knowledge conveyed in gestures and speech enhanced children’s learning across ages, showing that children who used elicited gestures were better at resolving maths problems across ages, rather than those who were not forced to gesture.

Similar findings providing evidence that gesture production benefits on resolving mathematical problems are found in the study of Novack et al. (2014). Children of 8 to 10 years of age were trained to solve a mathematical problem either in the action condition (i.e., physical actions performed on objects), concrete gesture condition (i.e., concrete gesture performance representing that action), or abstract gesture condition (i.e., abstract gesture performance). Results clearly indicated that gestures differentiate from action in learning processes. That is, the deepest way of learning is acquired more by gesturing than by concrete hand movements that simply represent an action, leading support to the fact that gesturing not only is a physical action, but it also has the powerful role to represent abstract ideas.

Gesturing can also enhance both adults’ and children’s memory recall through learning from a mathematical task (e.g., Cook, Yip, & Goldin-Meadow, 2012; Wagner, Nusbaum, & Goldin-Meadow, 2004; Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001). In Cook et al.’s (2012) study, adult participants had to remember some letters while explaining the solution to math problems and, at the same time, producing either iconic meaningful or non-meaningful gestures. The results of the experiment demonstrated that the subjects remembered more items when meaningful iconic
gestures were produced than when either no gesture at all or non-meaningful gestures were performed. In Wagner et al.’s (2004) study, adult participants had to explain some mathematical problems in the movement-permitted condition and some in the no-movement condition while holding either verbal memory stimulus or visuo-spatial memory stimulus. Results demonstrated that adults had better recall of both the verbal and visuo-spatial items when performing gestures matched with speech. The same positive effects of gesture production on items recall with a similar experiment procedure were found in Goldin-Meadow et al. (2001) for both children and adults. Children here were asked to hold a list of words and adults a list of letters in their memory while explaining how they solved a mathematical problem in either the gesture permitted or the gesture not permitted conditions.

In science tasks, Alibali et al. (2011) reported that undergraduate students and adults who were exposed to the gesture-allowed condition got better strategies when solving a problem that required the prediction of a gear movement than those participants who were not allowed to gesture. The findings obtained by Alibali and Kita (2010) also revealed the effectiveness of gesture production when 5- to 7-year-old children solved and explained Piagetian conservation tasks. Children who were allowed to gesture were more likely to express present and perceptual information in the problem-solving explanations than those participants who were restricted from using them. Therefore, both studies lend support to the authors’ idea about how gesturing can be associated with strategies based on perceptual-motor information rather than with abstract information, as when someone gestures the simulated actions and perceptual states are activated.

On the other hand, producing gestures has also been shown to significantly help both adults and children to retain and create new knowledge more fluently. Beilock and Goldin-Meadow (2010) carried out two experiments that consisted in solving and explaining the Tower of Hanoi task (TOH) with gestures. Gesturing during the task positively influenced the later speech performance; that is, gestures helped participants to change thought, adding action information to their mental representations of the task. Results supported evidence to the idea that gestures can have an effect on changing participants’ mental representations in explaining the TOH tasks. Moreover, the two experiments conducted by Kirk and Lewis (2017) with 8- to 11-year-old children demonstrated the effects of spontaneous gesture production (Experiment 1) and gesture encouragement (Experiment 2) on generating creative novel uses for everyday items in
a divergent-thinking task. Both spontaneous gestures and encouraging gestures that children produced helped them to both think and to create ideas more fluently. Interestingly, Kita’s (2000) experiment showed that gesture performance facilitated the selection and organisation of visuo-spatial information (e.g., to describe a set of action or a range of objects) into units that are congruent with the sequential order of the speech. These results prompted the Information Packaging Hypothesis (Kita, 2000; see section 3 for a review).

Concerning learning words in a second language, Tellier (2008) analysed the impact of producing iconic gestures on second language word memorisation with twenty French children (mean age 5;5). The children were taught eight English words in two conditions, the no-gesture condition, in which words were taught accompanied by pictures, and the gesture condition, which words were taught accompanied by gestures that were to be reproduced by children tested in this group. Results showed that participants were able to memorise more words in the latter condition than in the former. Similarly, Macedonia, Bergmann, and Roithmayr (2014) found that older children (mean age 11;2) learned foreign vocabulary items when they were asked to imitate the pedagogical agents’ gestures related to the word’s semantic content, such as object shape or its function (i.e., perform the referential gesture while they are learning, vs. the audio-visual baseline and observation conditions).

All the above-mentioned studies showed that producing some type of meaningful gestures in learning tasks allow us to predict later performance consequences, both in knowledge, learning, and/or thought change. Introducing actions into speaker’s mental representations by gesturing results in thought change processes (e.g., Beilock & Goldin-Meadow, 2010). All in all, these results evidence the importance of body language and, specifically, hand movements in human non-verbal communication. Gestures are bodily actions that give us access to speech information and thus can lead changes in thought processes, affecting both thinking and speaking. They reveal implicit knowledge, which could be expressed by gesturing, and its consequences of boosting learning processes.

In comparison with the large body of literature on the positive impact of representational (that is, meaningful) co-speech gestures, much less is known about the beneficial effects of both observing and producing beat gestures. To our knowledge, little effort has been devoted to assessing the effectiveness of beat gestures (e.g., manual rhythmic non-representational gestures associated with prosodic prominence in speech).
on language and cognitive development, and specifically on skills such as information recall, language comprehension, discourse organisation, as well as narrative proficiency. In our view, the basic tenets of the embodied cognition (Ionescu & Vasc, 2014; Kita & Özyürek, 2003), and grounded-cognition paradigms (Barsalou, 2008, 2010) (see section 3 for a review of these theories) can motivate the potential beneficial role of beat gestures in cognitive and linguistic processing. In the next section we review this body of literature.

1.2.4 Cognitive and developmental benefits of beat gestures

Previous research has provided some insight into the cognitive and developmental benefits of rhythmic non-representational beat gestures. Similarly to the positive impact of referential gestures (see 1.2.2 and 1.2.3), in general beat gestures seem to have a positive effect on adults’ and children’s ability to recall information (e.g., So et al., 2012; Austin & Sweller, 2014; Igualada, Esteve-Gibert, & Prieto, 2017; Llanes-Coromina, Vilà-Giménez, Kushch, Borrás-Comes, & Prieto, under revision; Kushch & Prieto, 2016). In So et al.’s (2012; see 1.2.2) study, only adults (and not preschool children) displayed better recall scores when words were accompanied with beat gestures compared with no gesture. Notwithstanding these results, three recent studies have reported that beat gestures also improve word recall in children (Austin & Sweller, 2014; Igualada et al., 2017; Llanes-Coromina et al., under revision). First, Austin and Sweller (2014) found that both beat gestures and iconic gestures (i.e., co-speech gestures) facilitated the recall of given spatial directions in 3- to 4-year-old children in a between-participants design (speaker using no gestures, beat gestures, or representational gestures). Similarly, when Igualada et al. (2017) asked 3- to 5-year-old children to retell a list of to-do things that was presented with or without beat gestures, they found that recall was significantly better in the former condition. The recent study by Llanes-Coromina et al. (under revision) corroborated that beat gestures positively influence information memorisation and comprehension within a contrastive discourse by preschool children. Therefore, in general, the evidence suggests that both children and adults benefit from the presence of these co-speech gestures when having to recall

---

2 Target contrastive items were presented in three conditions: non-prominent speech (L*), prominence in speech alone (L*+H*), and prominence in both speech (L*+H) and gesture (beat gestures).

3 Narrative discourses were presented either with prosodic prominence and no beat gestures (i.e., no-beat condition) or with prosodic prominence and beat gestures (i.e., beat condition) in target words within the story.
information. Moreover, the study by Kushch, Igualada, and Prieto (under revision) also reflects the benefits of beat gestures in second language word learning. The results of this study revealed that beat gestures together with prosodic prominence were the optimal combination for second language novel vocabulary learning.

While some studies have addressed the potential role of beat gestures on information recall, very little research has addressed the potential role of beat gestures in discourse comprehension processes (e.g., Llanes-Coromina et al., under revision). To our knowledge, only another study (Macoun & Sweller, 2016) has dealt with the effects of beat gestures on narrative comprehension by children, and with negative results. Macoun and Sweller (2016) investigated the effects of four gesture conditions (e.g., iconic, deictic, beat gestures, or no gesture) on preschoolers' (between 3.25–5.58 age range) narrative comprehension and recall of information. In their experiment with a between-subjects experimental design, children were asked to listen to the same discourse in one of the four gesture conditions. Results showed that whereas iconic and deictic gestures provided benefits in comprehending and recalling information in narratives, the other two conditions (e.g., beat gestures and no-gesture) did not have a beneficial effect. Nevertheless, we think that there might be a reason behind the null results found for beats. While beat gestures in Macoun and Sweller's study were exclusively associated with focused positions, we think that if we use the whole potential of naturally produced beat gestures by associating them with important discourse markers (e.g., ‘after’, ‘then’, etc.), a beneficial effect might be observed. Following Igualada et al. (2017) and Vilà-Giménez, Igualada, and Prieto (under revision), we understand beat gestures as pragmatic gestures which highlight important information in oral narratives (e.g., focused words and discourse markers). Moreover, Macoun and Sweller's study does not provide examples of which kind of beat gestures were used. The authors define beat gestures as non-meaningful gestures that do not provide additional information (p. 69 and p. 71). Following this, it might be that beat gestures were produced as artificial hand gestures associated with focused positions. Thus, we believe that it would have been necessary to conduct a previous production study which served as the basis for analysing the common form of beat gestures produced in narratives.

Interestingly, recent investigations using event-related potentials (ERPs) (i.e., a method of measuring brain activity during cognitive processing) or functional magnetic resonance imaging (fMRI) in adults have provided evidence of the cognitive advantages
of beat gestures on speech processing, showing their integration with the language system (Holle et al., 2012; Biau & Soto-Faraco, 2013; Wang & Chu, 2013; Biau, Fernández, Holle, Avila, & Soto-Faraco, 2016). These studies have revealed the influence of beat gestures on speech comprehension (Biau & Soto-Faraco, 2013) and on speech perception (Hubbard, Wilson, Callan, & Dapretto, 2009) as compared with the null effects found for other potential visual highlighters of speech (e.g., prosodic emphasis, a moving visual stimulus, nonsense movements, etc.) without a communicative intention in mind. In general, these studies interpret the positive results found for beat gestures as an attentional effect that activates language-related areas instead of just stimulating the visual-perception areas of the brain. That is, beat gestures seem to trigger a cognitive advantage to language development, because of their relationship with the neural substrate of speech.

The studies reviewed in this section reveal that beat gestures might have beneficial effects on comprehension and recall processes. However, little is known about the relationship between the development of beat gestures and other language abilities. To our knowledge, only one study has shown the positive effects of beat gestures on speech production (see Lucero, Zaharchuk & Casasanto, 2014 and section 7 for a review of this study). The effectiveness of beat gestures on production may result from wide principles of motor action (see section 3).

Furthermore, as far as we are concerned, we do not have evidence of any study that has dealt with the precursor and beneficial significant effects of beat gestures on the acquisition of children’s short-term and long-term narrative skills, and with the general question about whether the use of these gestures could benefit the development of narrative discourse production. In the following section we motivate why we think that beat gestures can be beneficial in boosting narrative abilities in children.

1.2.5 The linguistic functions of beat gestures

As noted above, beat gestures are simple rhythmic (e.g., rapid flicks of the fingers or hand) non-representational (i.e., non-referential) gestures that are associated with prominent prosodic positions in natural discourse. On the temporal side, studies about gesture-speech integration have demonstrated that beat gestures naturally occur in tight synchrony with prosodically prominent positions in speech (e.g., McNeill, 1992; Yasinnik, Renwick, & Shattuck-Hufnagel, 2004; Esteve-Gibert & Prieto, 2014; see
Cole 2015 for a prosody review), and it has also been shown that listeners perceive a word as more prominent if it is accompanied with a visual beat (Esteve-Gibert & Prieto, 2014; Krahmer & Swerts, 2007).

On the semantic side, McNeill (1992) argued that non-referential gestures (i.e., beat gestures) appear to be connected to discourse organisation. He also mentioned that beat gestures have an important function in discourse, as they highlight the temporal locus of important information expressed by the speaker compared to information which is not considered to be relevant in the context. Following Kendon’s (1995, 2004, see section 3 for a review) gesture typology, beat gestures could also be defined as pragmatic gestures which do not have a contextual meaning but “express aspects of utterance structure, including the status of discourse segments with respect to one another, and the character of the “speech act” or interactional move of the utterance” (Kendon, 1995:247). Kendon (1995) also referred to beat gestures as “rhetorical”, since they show information about the rhetorical purpose of the discourse (see section 3 for a review). Graziano (2014) carried out a study about the pragmatic gestures produced by 4- to 10-year-old children while performing a narrative task. Results showed that the Palm Addressed gestures, such as the Palm Presentation and the Palm with a Lateral Movement in children’s narrative were found to plan and structure the discourse, as well as to control the rhetoric of the discourse (i.e., how language is used to organise, construct meanings, etc.). Thus, in our view we should not neglect the pragmatic value of beat gestures, which help encode discursive functions in oral interactions.

Two of the central properties of narrative performance are (1) **narrative structure (cohesion and coherence)** (e.g., Demir et al., 2014; see 1.2.1 for a review of narrative development) and (2) **narrative oral fluency** (e.g., Alibali, Evans, Hostetter, Ryan, & Mainela-Arnold, 2009). With respect to narrative structure, we first hypothesise that beat gestures act as highlighters of discourse structure, and thus that their use could help to improve the quality of children’s narratives (e.g., their narrative structure scores). According to McNeill (1992), a beat gesture may be associated with discourse markers, marking the introduction of a new character, summarising the action, introducing new themes, etc. In this sense, our idea lends supports to Shattuck-Hufnagel et al.’s study (2016), from which they claim that beat gestures have been typically associated with focus marking, rhythmic marking, and discourse structure marking (see section 7 for a review of this study). Along the same lines, Dimitrova et al. (2016) also highlighted the function of beats as nonverbal indicators of information focus of the
message in language comprehension. Thus, beats should be considered to be associated with focused information and target discourse structure anchoring points. The fact that beat gestures perceptually enhance focus and discourse structure, functions that have typically been linked to prosody (Loehr, 2012; Wagner, Malisz, & Kopp, 2014) makes them good candidates to promote abilities related to structuring and focalising information in narratives.

Secondly, we hypothesise that the rhythmic properties of beat gestures (which basically help highlight the rhythmic properties of speech) might contribute to improving fluency measures. Importantly, since beat gestures are typically associated with prominent prosodic positions in speech, we can consider that they are also intrinsically related to rhythm marking in speech. McNeill (1992, 2005) defined beats for their rhythmicity, which is considerable in making more visible timing and speech prosody. Because of this, it is reasonable to conjecture that beat gestures might help in boosting fluency in speech, since they mark out the rhythm of the discourse. Indeed, there is evidence that individuals who are more fluent in their second language use more beat gestures accompanying the speech than those individuals who are less fluent (Nicoladis, Mayberry, & Genesee, 1999).

Lucero et al. (2014) emphasised the beneficial role of beat gestures as facilitators of word production (see Models of gesture and speech production subsection in section 3 and section 7 for a review of this study). The authors conducted two experimental studies. In Experiment 1, they asked participants to produce target words related to some given definitions in three different conditions (i.e., iconic gesture condition, beat gesture condition, and no gesture instructed condition). Results showed that beat gestures boosted word production, also showing greater reaction time scores. Also, in Experiment 2, the same procedure was followed with four other gesture instruction conditions (i.e., no gesture instruction, bimanual beat, right hand beat, and left hand beat) and the findings revealed that the bimanual beat instruction helped participants to produce words faster (i.e., greater RTs) than in the other conditions. Therefore, concerning the differences between beats and iconic gestures in word production, results showed that using beat gestures helped speakers to produce words more easily than using iconic gestures. According to the authors, “beat gestures should be less cognitively taxing for the speaker” (p. 898), as, in contrast to representational gestures such as iconic gestures, beats are simple rhythmic hand movements that appear more repetitively during a discourse.
The positive role of beat gestures in lexical access has been compared with that of representational gestures. In Beattie and Coughlan (1999), sixty undergraduate students either prevented to use gestures or allowed to produce them freely were presented with a set of twenty-five definitions of target words and were asked to say the word that matches each definition. Moreover, TOT states (i.e., tip-of-the-tongue state, e.g., when the speaker knows the target word but he or she can not actually remember it at that moment) were also controlled by a group of five judges, who had to identify, from eighty produced retrieval attempts, the target word correctly from the speaker’s performed gesture, focusing on iconic gestures, beat gestures, and self-adaptors (i.e., self-touching movements not connected to the speech). Results showed that complex iconic gestures play a role in lexical access, and judges were able to identify lexical items from TOT states at a far above chance level. However, not all the gestures associated with lexical access were purely iconic gestures and there is not strong enough evidence to prove that their presence enhanced the finding of the right target word. Similarly, Ravizza (2003) conducted three experiments, which demonstrated that meaningless or non-iconic movements (i.e., tapping) (vs. participants who were asked to not move) help recall more items in both the TOT and DK (don’t know states or not in a TOT state) equally (Experiments 1 and 2), showing no significant differences between them. In contrast with these findings, participants who were asked to be still were better at letter fluency tasks (i.e., generate as many words as possible starting with the given letter) than those in the tapping condition. Nevertheless, the authors argue that the effectiveness of movements could be only manifested in limited situations, when the lexical item not only has been selected but also has not been totally activated. In accordance with Lucero et al. (2014), the authors hypothesise that it may be that both language and motor production processes (i.e., movements and lexical search) boost the activation of some neural areas involved and shared between both speech and movement. All in all, and in relation to these previous obtained findings, Nicoladis (2007) also pointed out that the use of gestures by bilingual speakers could somehow be seen as strategies that enhance their speech production across languages; that is, speakers transfer their language production not only by speaking, but also by gesturing.

Recent studies have shown that rhythmic training is relevant for the development of literacy skills in children with typical development (Tierney & Kraus, 2013; Bonacina, Cancer, Lanzi, Lorusso, & Antonietti, 2015). Kirk and Lewis (2017) also found that gesture is associated with fluency; in this study the number of gestures
performed was correlated with higher fluency scores. Along the same lines, preliminary results of three studies carried out by Brodsky and Sulkin (2011) showed a) how handclapping songs promoted movement, language and cognitive and social skills, more specifically, contributed to first graders’ academic performance; b) how second graders who handclapped songs were spontaneously benefited in the development of cognitive skills; c) how a handclapping songs intervention boosted second and third graders’ developmental skills not related to music. Concerning the restriction of gesture’s use, some studies have revealed that prohibiting speakers to gesture did not help them achieve fluent speech (i.e., more pauses, slow speech and more disfluencies) (Graham & Heywood, 1975; Rauscher, Krauss, & Chen, 1996; Morsella & Krauss, 2004). François, Grau-Sánchez, Duarte, and Rodriguez-Fornells (2015) pointed out the importance of a rhythmic entrainment in speech production also in different speech-impaired populations. All in all, we believe that the rhythmic properties of beat gestures can promote both production and linguistic abilities.

The studies included in this PhD dissertation aim to assess the relationship between the use of rhythmic beat gestures, and the improvement of children’s narrative performances (specifically, their speech fluency and narrative structure characteristics). We propose that reinforcing beat gestures within oral narrative discourse can represent an effective scaffold for children’s narrative performance. In conclusion, there is little evidence on the relationship between the development of beat gestures and the development of narrative abilities, as well as on the effectiveness of beat gestures as boosters of narrative performance. In the following subsection we revise the literature on the relationship between narrative abilities and co-speech gestures.

1.2.6 Narrative abilities and co-speech gestures

Gestures in general can play an important role in narrative discourse development. Colletta et al. (2015) investigated multimodal narrative development in 5- and 10-year-old French, American and Italian children’s narratives of a wordless cartoon, and pointed out that gesture and speech go by hand; that is, children’s gestures related to the narrative organisation develop at the same time children’s narratives become more complex. Sekine and Kita (2015) also pointed out the co-development of speech and co-speech gestures through elicited narratives in 3-, 5- and 9-year-old children, as well as in a group of adults, in terms of sentence and discourse level. Two
main important findings were reported, namely (a) two-handed gestures with a two-handed stroke were predominant in 3-year-olds rather than in 5- and 9-year-olds, who produced gestures with a single-handed stroke and a simultaneous stroke; and (b) in contrast to children, adults packaged information related to landscape elements both in clauses and in two-handed gestures, and used both gesture and speech when referring to previous or subsequent elements. Regarding speech-gesture integration abilities, Alibali et al. (2009) examined gesture-speech integration in a narrative task through their own generated coding system, and showed that 5- to 10-year-old children produced more non-redundant gestures (i.e., “gestures with codable meanings that were non-redundant with the accompanying speech, both at the word level and at the clause level”, p. 9, and e.g., “he tried to push the bar up with a push gesture on tried would be coded as non-redundant at the word level but redundant at the clause level”, p. 10) than those produced by twenty college students in their narratives, when retelling a cartoon story. All in all, though children showed to be less redundant than adults, results suggested that patterns of gesture-speech integration change as language develops.

Importantly, iconic gestures have been shown to be predictors of narrative abilities in development. In the longitudinal study by Demir, Levine, and Goldin-Meadow (2015a; see section 7 for a review of this study), 5-year-old children who expressed character viewpoint in iconic gestures in narrative production improved their narrative structure in speech across ages, in contrast with those children who did not produce character viewpoint gestures at the same age. Additionally, both children with early brain injury who had difficulty in structuring narrative and typically developing children were more likely to produce well-structured narrative retellings when the storyteller performed story-relevant gestures while speaking (Demir et al., 2014; see section 7 for a review of this study).

Nevertheless, as far as we know, the studies on the high-level effects of gestures such as semantic and syntactic comprehension, language learning as well as narrative abilities have exclusively involved representational or metaphorical gestures. To our knowledge, little is known about the precursor and potential beneficial effects of beat gestures on the acquisition and development of children’s narrative skills. Concerning gestures as harbingers of change in language development, even though there is much more evidence about representational gestures, to our knowledge, little is known about

---

4 Following McNeill’s (1992) classification, character-viewpoint gestures show first-person perspective, as the gesturer assumes the role of the character by enacting the character’s actions.
beat gestures. Mayberry and Nicoladis (2000) reported that gesturing is associated with language development and stressed the fact that further research is needed in language and gesture development with children older than 2 years of age. They carried out a longitudinal study with French-English bilingual 2- to 3 and half-year-old children, in which they assessed the relationship between gesture performance and language development. Their findings showed that both iconic and beat gestures, but not pointing gestures, were significantly correlated with the French and English children’s language development. Moreover, they also found that children start producing iconic and beat gestures at the same time they start performing the first utterances. This study provides a first indication that beat gestures might play a prominent role in children’s language development.

The last gestures that emerge in language communication are beat gestures. However, the literature on the acquisition of these gestures within narrative discourse is very scarce and has primarily focused on how children gesture with beats while they are narrating. McNeill (1992) argued that the production of beat gestures emerges at a later stage, e.g., around 6 years of age. Shattuck-Hufnagel et al. (2016) (see section 7 for a review of this study) showed that, during narrative and explanation discourses, nine 5- to 7-year-old typically developing Australian English children produced beats with a well-defined stroke phase that resembled those performed by adults, and these beats were closely related to the organisation of speech. The study contained two tasks: a story-retelling task and a planning task. In the narrative task, children were asked to watch a two-minute movie clip and then narrate the story to their mother, who had been distracted. At the end, the mother had to complete a picture-puzzle based on the video. In the planning task, both the mother, who had to elicit information from her child, and the child were encouraged to plan a “fantasy” family holiday trip to any destination with the money that they were supposed to have to won in the lottery. Results demonstrated that children at both ages produced more beat gestures (i.e., non-referential gestures) in the narrative task than in the explanation task.

Despite the fact that the early appearance of beat gestures in bilingual children as young as 2.5/3 (Nicoladis et al., 1999; Mayberry & Nicoladis, 2000) have been reported, beats in discourse have been demonstrated to emerge later, at around 6 and 10 years old (Colletta, Pellenq, & Guidetti, 2010; Blake, Myszczyszyn, Jokel, & Bebiroglu, 2008). Through a longitudinal study with five French-English bilingual children of 2.5-3 years of age, Nicoladis et al. (1999) investigated how the combination of language
and cognitive development could affect gesture development and found that beats were performed in more complex and longer utterances, suggesting that the development of beats is related to language development. Colletta et al. (2010) carried out a narrative task with French-speaking children of ages between 6 and 10, and adults. Results showed that the average of non-representational beats with a discursive function (e.g., accompanying connectors, highlighting important linguistic units, or performing anaphoric functions) and of gestures with a framing function (e.g., those which express the speaker’s emotions, e.g., his face when he is surprised) increased significantly across ages, while the average of representational gestures did not, and that adults were significantly more likely to perform non-representational gestures than children (i.e., discursive and framing gestures). These results are consistent with the idea that the evolution of gestures in discourse development and narrative production co-develops with age, and that children between 6 and 10 years of age start to produce discursive gestures with a functional meaning in narratives.

2. GOALS OF THE DISSERTATION

The current PhD thesis has the primary goal to investigate how the multimodal strategies provided by gesture-speech integration are related to typically developing children’s narrative discourse abilities, and more specifically, how they can be used to improve their narrative skills. Also, an important part of this thesis is to provide a developmental overview of the use of beat gestures along early narrative development.

A total of five empirical studies will be included in the PhD thesis. The following research questions will be addressed in each study: (1) Study 1: A set of complementary questions will be asked about the early production of beat gestures by children, as follows: (1.1) what is the pragmatic function of those 5- to 6-year-old children’s performed beat gestures; (1.2) which form do these beat gestures adapt by their hand shapes; (1.3) to which parts of the narrative discourse structure are beat gestures associated with; (1.4) how are beat gestures temporally coordinated with the prosodic structure of the narrative discourse; (1.5) finally, is the frequency of the natural appearance of beat gestures correlated with children’s narrative discourse abilities (i.e., fluency and narrative structure scores); (2) Study 2: whether the observation of beat gestures in a brief narrative discourse training has a positive impact in 5- to 6-year-old children’s narrative performance; (3) Study 3: whether promoting the production of
beat gestures in 5- to 6-year-old children has positive effects on their narrative discourse performance in a brief narrative discourse training; (4) **Study 4**: whether 5- and 6-year-old children who produce beat gestures naturally in their narratives do indeed gain higher narrative scores (i.e., fluency and narrative structure scores) (and other cognitive, linguistic, and social skills) in their narratives across the ages; and (5) **Study 5**: does the performance of co-speech gestures and specially beat gestures in a 4-week classroom intervention study with narratives also boost 5- and 6-year-olds’ narrative skills (as well as other cognitive, linguistic, and social skills)?

Our general hypotheses are the following: (1) multimodal gesture-speech integration strategies, and specifically the use of beat gestures, will successfully promote children’s short-term and long-term narrative performances; (2) the acquisition of beat gestures and their use in narrative tasks can represent a milestone in narrative development; and (3) the frequency of use of beat gesture production can be a predictor of better language scores and also narrative performance, as well as school academic performance.

### 3. THEORETICAL FRAMEWORK

**Gesture-speech integration theories**

Language and gestures are deeply intertwined in human communication. McNeill (1992) classified gestures into iconic (representational) and metaphoric, deictic (or pointing), conventional gestures, and beat gestures. Iconic gestures bear a close relationship to the semantic content of the segments of speech they accompany, as they depict properties of an object, action, or scene; thus, their meaning is given by context (e.g., as a speaker says “He bends it way back”, his/her hand appears to grip something and pull it back). Although metaphoric gestures are similar to iconic gestures, they refer to an abstract concept (e.g., a cupped hand that suggests begging accompanying a question, “I wanted to ask you something”). Deictic gestures are used to indicate an object, event, or location and are performed with the pointing finger (e.g., pointing at a pencil while saying, “Can I borrow that, please?”). Conventional gestures are conventionalized signs; that is, culturally shared symbols with an arbitrary meaning and form. An example will be the common sign for “OK”, which can be expressed by a thumb-up or by touching only the first and the thumb fingers. Beat gestures are simple rhythmic (e.g., rapid flicks of the fingers or hand) non-representational (i.e., non-
referential) gestures that are associated with prominent prosodic positions in natural discourse. Even though McNeill (1992) points out that beats do not reflect contextual meaning as representational gestures do, he also states that beat gestures remark “the word or phrase they accompany as being significant […] for its discourse pragmatic content” (McNeill, 1992:15). For more details about the properties of beat gestures, see 1.2.5.

Gestures can be also understood by their substantive function (i.e., referential gestures that convey utterance content, literally or metaphorically) or by their pragmatic function (i.e., pragmatic gestures) (Kendon, 1995:247, 2004); that is, “any of the ways in which gestures may relate to features of an utterance’s meaning that are not a part of its referential meaning or propositional content” (Kendon, 2004:158). Kendon (2004) classified gestures depending on whether they play a performative, modal, or parsing pragmatic function. Gestures that have a performative function show the speech act that the speaker is conveying (e.g., expressing a question, a refusal, etc.). When gestures adopt a modal function they indicate how the discourse should be interpreted (e.g., speaker’s attitude/stance associated with the message, such as certainty), and gestures with a parsing function are those that highlight the structure of the spoken discourse (i.e., punctuating or marking some aspects or units), without referring to the content of the message. All in all, we can refer to those gestures as “rhetorical, since these gestures seem to indicate the part an utterance plays, or the part a component of it plays, as a move within an interactional situation” (Kendon, 1995:277).

Models of gesture and speech production

In this subsection we briefly review several concrete hypotheses that identify the existence of a cognitive process that supports spontaneous co-speech gestures and that corroborates the relationship between the speech production processes and the gesture performance. As contended by Kita and Özyürek’s (2003) model of speech and gesture performance, there are speaking and spatio-motoric processes in the interface representation through which gestures are produced. That is, there is spatial and motoric information about the referent that is processed in the speech production process; hence, gestural contents are shown to be determined by various processes. Gestural representation is shaped by the on-line interaction with the speech formulation process,
as it is shown that speech production and gesture production are interrelated and that its relationship underlies the cognitive processes involved.

On the other hand, the **Information Packaging Hypothesis** formulated by Kita (2000) states that gestures underlie visuo-spatial representations that helps the speaker to select, package and organise the visuo-spatial information in speech (see also Alibali, Kita, & Young, 2000); that is, to verbalise perceptual or motor knowledge. Thus, gesturing plays a role not only in speech production but also in cognitive processes. Another theory consistent with the Information Packaging Hypothesis and that shows that gesturing is also part of the conceptual planning of speech is the **Lexical Retrieval Hypothesis** (Krauss, Chen, & Gottesman, 2000) which claims that gesturing may help speakers to access to the items involved in the mental lexicon, suggesting that gesturing helps speaking process (e.g., Beattie & Coughlan, 1999; Ravizza, 2003) and also speech production in bilingual speakers (e.g., Nicoladis, 2007).

Building on these ideas, the model of **Gesture-As-Simulated-Action Framework** holds that gestures emerge from an embodied cognitive system in which gestures reflect simulations of action and perception (i.e., movements performed without a communicative intention) that support language thinking (Hostetter & Alibali, 2008).

While the theories above highlight the function of iconic gestures in remarking speech perceptual information (e.g., Alibali & Kita, 2010) and that gesturing with representational gestures enhances speaker’s ability to convey their conceptual speech planning into speech units (Kita, 2000), little is known about the role of beat gestures. Following up on the empirical findings reported in section 1.2.3, we hypothesise that producing beat gestures can also activate the perceptual and motor system. As reported by Lucero et al. (2014:901) (see section 7 for a review), “beat gestures might cause speakers to find words more quickly simply because they are motor actions: not because they are gestures, per se”; thus, the authors suggest that gestures are a kind of motor action with communicative functions.

**Embodied and grounded cognition**

As was noted before (see section 1.2.3), previous research that has been devoted to the benefits of gesture production on language processing is motivated by the

These two theories show evidence of the fact that both the body movements and the mind are influenced by each other in cognitive processes. On the one hand, the grounded-cognition theory relates cognition to modal simulations, situated actions, and bodily states, supporting the claim that co-speech gestures are an important form of embodiment in language, as producing them enhances retrieving words (e.g., Krauss, 1998) and, in general, comprehending speech (e.g., Alibali, Heath, & Myers, 2001; Kelly, 2001; Valenzeno, Alibali, & Klatzky, 2003). On the other hand, the embodied cognition paradigm suggests that body physical actions, considering perceptual and motor systems, impact human cognition. Concerning this embodied approach, as Madan and Singhal (2012:3) contend, “motor output is integral to cognition, and the converging evidence of multiple avenues of research further indicate that the role of our body in memory processes may be much more prevalent than previously believed” (see Casasanto, 2009, 2011). However, as Wellsby and Pexman (2014) point out, further research addressing embodied theories of language development is needed. Importantly, the authors state the implication of embodiment processes in learning. Kiefer and Trumpp (2012) have already demonstrated that embodiment can be positively used to obtain higher levels of reading, writing, or to improve memory for events, conceptual memory for objects and for numbers, as such cognitive processes are shaped by perceptual and motor modalities (see Borghi & Caruana, 2015).

4. HYPOTHESES

Based on the review of the literature discussed in the previous sections, in what follows we outline the hypotheses that will be related to the experimental studies included in this thesis (see 5.1.1, 5.2.1, 5.3.1, 5.4.1, and 5.5.1) for the specific research questions of each study).

1) Experimental study 1

This study investigates the early acquisition and natural performance of beat gestures in 5- to 6-year-old children in a narrative task. The first general aim of the study is to analyse the pragmatic function of these gestures, as well as their hand shape
and to which parts of the narrative discourse structure and temporal prosodic structure they are associated with. Our hypothesis is that children will produce beat gestures with different forms that will be related to a discourse pragmatic function, lending support to Kendon’s gesture typology (Kendon, 1995, 2004). Moreover, we expect beat gestures to adopt simple hand shapes, such as that ones reported by Graziano (2014) (e.g., Palm Presentation and Palm with a Lateral Movement). Also, our hypothesis is that beat gestures will be associated with prosodically prominent positions in the discourse and will serve to highlight important components of the discourse in child speech (Kendon, 1995, 2004; McNeill, 1992; Graziano, 2014). Beats are expected to mark informational focus, the rhythm of speech, as well as discourse structure (McNeill, 1992; Shattuck-Hufnagel et al. 2016). Thus, we expect beat gestures to be associated with prosodic prominence positions in speech that enhance the speaker’s attention to the narrative discourse, such as informational focus or discourse markers.

The second aim of the study is to test the potential correlation between the natural production of beat gestures in 5- to 6-year-old children’s narratives, and general narrative abilities such as speech fluency and narrative structure. Even though many studies reported the beneficial role of referential gestures in both adults’ and children’s language processing and learning (see Goldin-Meadow & Alibali, 2013 for a review; see 1.2.2), further research is needed to test the role of beat gestures in language development. Our hypothesis here is that children who produce more beat gestures (and also iconic gestures) within their narratives will get higher narrative skill measures.

2) Experimental study 2

This study examines the impact of observing beat gestures performed in a brief narrative discourse training on the retelling performance of 5- and 6-year-old children. Our question is whether a brief between-subjects training session with beat gestures can contribute to improve children’s overall narrative performance scores measured in terms of discourse structure and fluency in a subsequent narrative discourse production task.

Our motivation for the role of beat gestures in narrative scaffolding is twofold: (a) first, since beat gestures highlight important linguistic functions associated with focus marking, rhythmic marking, and discourse structure marking (Shattuck-Hufnagel et al., 2016), it is reasonable to conjecture that beat gestures can help to build up narrative structure skills, since they mark out the important information and the
organisation of a discourse; (b) second, beat gestures have been independently shown to have a positive influence on fluent speech production (e.g., Nicoladis et al., 1999; see also references in 1.2.3 about co-speech gestures production). Therefore, we expect that training children with narratives produced with beat gestures will be more effective than training them with narratives produced without beat gestures in enhancing their ability to produce oral narratives.

3) Experimental study 3

In line with the results obtained in the Study 2 and following Goldin-Meadow et al.’s suggestions about the potential benefits of gesture production in problem-solving strategies and explanations (e.g., Goldin-Meadow et al., 2009; Cook et al., 2008; Alibali & Kita, 2010; see 1.2.3) and in other cognitive resources related to language (e.g., Lucero et al., 2014; Kirk & Lewis, 2017; see 1.2.3), the aim of this study is to investigate the effects of promoting the production of beat gestures on 5- to 6-year-old children’s narrative discourse performance in terms of discourse structure and speech fluency. The design of the experiment will be the same as in the previous experiment, e.g., a between-subjects brief narrative discourse training task (see section 5.3 below). We hypothesise that encouraging the production of beat gestures will also have positive effects on the short-term children’s narrative discourse performances. Moreover, in accordance with the grounded or embodied cognition paradigms (see section 3 for a review) and since gestures represent an embodied way to highlight some aspects of language, we expect that actively involving sensory-motor perceptive and production processes through the use of beat gestures will trigger an increase in attentional networks and thus benefit the coding of linguistic information.

4) Experimental study 4

After having described beat gestures in natural elicited narrative discourses and to test whether a short training with beat gestures and narratives enhances children’s narrative performances, this study examines whether the frequency of the natural use of beat gestures in narratives produced by 5 and 6-year-olds could be a predictor of later improvement of narrative skills (i.e., fluency and narrative structure scores) in language development (as well as of other cognitive, linguistic, and social competence skills), at 6-7 and 7-8 years of age. Our hypothesis is based on the results obtained in Demir et
Vilà-Giménez, I.  
PhD research plan

29

al.’s longitudinal study (2015a), which has provided evidence about the precursor effects of 5-year-old children’s use of representational gestures expressing character viewpoint on later narrative structure scores. We expect that children who produce beat gestures naturally in their narratives will have a higher proficiency in narrative abilities (e.g., fluency and narrative structure scores) than those children who did not significantly produce beat gestures. Moreover, we expect that the early appearance of beat gestures in narratives at Time 1 will contribute to improve other children’s cognitive, linguistic and social competence skills measures. This study is expected to lend support to the hypothesis that beat gestures serve a pragmatic function and highlight the informational structure and discourse structure (McNeill, 1992; Kendon, 1995, 2004; Shattuck-Hufnagel et al., 2016).

5) Experimental study 5

In line with previous findings, the main objective of this study is to assess the results of a classroom intervention study which aims at testing the effects of embodiment that could promote longer-term narrative skills. Having referred to all the previous studies about the potential beneficial role of gestures in children’s language learning and development (see 1.2.2, 1.2.3 and 1.2.4), the main research question of this study is whether a classroom intervention program based on encouraging the production of co-speech gestures during narratives can play a significant role in favouring children’s narrative skills (as well as other cognitive, linguistic, and social competence skills).

In order to determine the generalised effects of active gesturing incorporated into the school curriculum, the experimental group will undergo a four-week classroom intervention which will include a set of narrative tasks in which they will be encouraged to gesture (see Goldin-Meadow & Alibali, 2013, for a review of gesture’s role in learning and communicating; see also section 7 for a review of this study). By contrast, the control group will go through the same tasks but will not be encouraged to produce gestures. The instructor will gesture naturally in both groups. Even though we expect positive effects in both groups, as all children will be involved in narrative production tasks in a four-week classroom intervention, we also expect that children who will be encouraged to gesture during the narrative tasks in the classroom will obtain better narrative scores, as well as other better language scores (as well as other cognitive,
linguistic, and social skills scores) than those children who will not be encouraged to gesture. Both short-term and long-term measures of narrative performance will be collected.

5. EXPERIMENTAL STUDIES

5.1 Study 1

5.1.1 Research question

This study has the goal of assessing the acquisition of beat gestures in 5- and 6-year-old children’s first developmental period. The following specific research questions will be tested: What is the pragmatic function of early produced beat gestures in 5- and 6-year-old children’s narratives? What are the hand shapes of these early beat gestures in relation to these pragmatic meanings? With which parts of the discourse are these beat gestures associated? Are beat gestures temporally integrated with the prosodic structure and with the overall discourse structure of the narratives? Finally, we will also investigate whether the frequency rate of appearance of beat gestures in children's narratives correlates with their narrative discourse skills. E.g., do children who produce more beat gestures also get higher scores in their narrative measures (e.g., fluency and narrative structure scores)?

5.1.2 Methods

Participants

Ninety-four children (45 boys and 49 girls) who already participated in Study 2 and 3 from Girona (Catalonia) will be analysed in this study. All of them were typically developing children with no prior history of communication disorders in themselves or within their families. The children were recruited from six different schools and some of them were tested at their home.5

---

5 Twenty-four children were from the Escola Casa Nostra and five from the Escola Can Puig, both in Banyoles, seven were from the Escola Bora Gran in Serinyà, eleven were from the Escola Pública Joan Bruguera, twenty were from the Escola Dr. Masmitjà, twenty-six from the Escola Montjuïc, these three in Girona, and four children were tested at their home.
Materials

The data for this experiment are the 188 narratives produced by children in the pretest for Studies 2 and 3. Materials consisted of four different animated cartoons (approximate length 41-50 s) about a small mouse and his friends, characters with which the child subjects were previously unfamiliar. The cartoons had no dialogue or narration. Two of these cartoons featured a single main character, whereas the other two featured two, but all followed the same structure, which is schematically illustrated in figure 1 (see also Appendix A to see the rest of the wordless cartoons). First, some initiating event presented a goal or challenge to the protagonist. This provoked an action on the character’s part, which led to a particular outcome, whether successful or not (the structure was based on the narratives used in studies such as Demir et al., 2014, and Demir et al., 2015a). The first shown cartoon was one that featured one character, the second cartoon one that featured two.

<table>
<thead>
<tr>
<th>Initiating event: After the mouse has inflated the inflatable apple tree, he sniffs an apple.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: The mouse wants to take an apple from the tree.</td>
</tr>
<tr>
<td>Attempt: The mouse picks an apple from the tree.</td>
</tr>
<tr>
<td>Outcome: The tree deflates automatically so the mouse can not eat the apple.</td>
</tr>
</tbody>
</table>

Figure 1. Narrative structure of one of the cartoon stories, with a still from the animated cartoon at left.

Experimental procedure

The participants were individually tested in a quiet classroom at their school and the whole task lasted approximately 5-10 minutes. The children were videotaped during the whole task.

The child was seated facing a laptop computer and the experimenter, who explained what was going to happen. The child then put on headphones and watched two cartoons, the first one featuring only one character, the second featuring two (see figure 2).

---

6 The cartoons used in this study were taken from the online animations available at http://www.wdrmaus.de and were also used in studies such as Demir et al. (2014) and Alibali et al. (2009).
After each clip, the child was asked to stand up and retell the story to the experimenter, who pretended not to have watched the video previously. If the child did not respond readily, he or she was prompted with a question like “Em pots explicar la història?” (“Can you tell me the story?”). The task was presented like a game, since the experimenter had several pictures in her hand from which she had to choose the picture that was most closely related to the story that the child was retelling. The retelling continued until the child indicated that he or she had finished or stopped for more than 10-15 seconds without clearly ending the narrative and had no further comment when the experimenter asked “I, què més?” (“Anything else?”). At this point, the experimenter gave positive feedback such as “M’agrada molt com expliques la història, així puc endevinar quin dibuix és!” (“I like the way you told the story very much, so I can easily guess which picture it is!”).

**Coding**

The resulting 188 video-recordings (94 children × 2 retellings) of the each child’s pretest performances from the Study 2 and 3 will be analysed according to the gesture performance and prosodic structure. With respect to gesture coding, we will assess the number of beat gestures children performed and which pragmatic function they adopt within the narrative discourse, as well as which hand shape these beats present in relation to their pragmatic function. Moreover, we will examine in which parts of the narrative discourse structure they are associated with, and also their temporal association with the prosodic structure within the discourse. As for narrative performance measures, narratives will follow the coding for fluency and narrative structure scores (see Coding subsection in 5.2.2 to see the coding system).

---

7 We will follow the MIT Gesture Studies Coding Manual http://web.mit.edu/pelire/www/manual/ (Shattuck-Hufnagel et al., 2016).
5.1.3 Expected results

This study aims at assessing the early acquisition and performance of beat gestures in 5- to 6-year-old children’s narratives. To our knowledge, research has been devoted to the early production of representational gestures, but not many studies have assessed the early production of beat gestures in children’s narrative discourse (e.g., Colletta et al., 2010; Shattuck-Hufnagel et al., 2016). First, we expect that not all the children will perform natural beat gestures, as it has been demonstrated that children as young as 6 years old already produced beat gestures (Shattuck-Hufnagel et al., 2016). Concerning our hypotheses (see section 4), we believe that those naturally performed beat gestures within children’s narratives will have a pragmatic function and will be associated with the prosodic structure and with the narrative structure of the speech (McNeill, 1992; Kendon, 1995, 2004; Shattuck-Hufnagel et al., 2016). Moreover, as for the last research question, we hypothesise that beat gestures will be positively correlated with children’s narrative skills because of their precursor effects in language development.

5.2 Study 2

5.2.1 Research question

The main research question of Study 2 was to test whether training 5- to 6-year-old children in observing beat gestures could contribute to improving their narrative performances (e.g., fluency and narrative structure scores).

This study was carried out in collaboration with Dr. Alfonso Igualada (Universitat Oberta de Catalunya – Universitat Pompeu Fabra) and the thesis supervisor, Dr. Pilar Prieto. This experiment was conducted between the months of May and June 2016, and the results have been completely analysed (see sections below). Currently it is under revision for the journal Developmental Psychology.

5.2.2 Methods

Participants

Forty-seven children (25 boys and 22 girls) from the Girona area of Catalonia participated in the study. All of them were typically developing children with no prior history of communication disorders in themselves or within their families. Three of the
original participants were excluded from the final analysis (two girls and one boy), for the following reasons: one child did not produce any utterances at all during either pretest or posttest; technical problems occurred during the pretest recording session of the second child; and the third child was accidentally shown the same two stories in both pretest and posttest segments. Thus, the results of this study are based on data from the remaining 44 participants (mean age = 5.94; SD = 0.57).

The children were preschoolers and first graders of four different schools. The parents were informed about the main goal of the experiment and signed a form allowing their children to participate in the experiment and be video-recorded in the process. Moreover, since the experimental tasks were all going to be administered in Catalan, caregivers filled out a language exposure questionnaire (Bosch & Sebastián-Gallés, 2001) to ensure that all participating children were coming from a context in which Catalan was the predominant language of daily use. The results of the questionnaires showed that the 44 children were exposed to Catalan daily on average about 90% of the time (M = 90.50; SD = 9.06).

**Materials**

The experiment consisted of three parts: a pretest, a training session, and a posttest. The pretest and posttest materials consisted of four different animated cartoons (approximate length 41-50 s) (see Materials subsection in 5.1.2 to see the structure of these cartoons). The training session involved the use of 24 video-recordings in which two adults female storytellers told different stories. In twelve of these recordings, the storytellers used beat gestures for emphasis and in the other twelve they did not. Each training story was about an animal that lived on a farm and followed a narrative structure similar to that seen in animated cartoons. An English translation of one of these stories is shown in (1) (and translations of all six are reproduced in Appendix B).

(1) *Once upon a time, a duck* was walking to school. *Suddenly,* it started to rain, and the duck didn’t have an *umbrella.* In the end, he came up with a *solution:* he put his hood on his head to protect himself from the rain.

---

8 Twenty-four children were from the *Escola Casa Nostra* and five from the *Escola Can Puig,* both in Banyoles, eleven were from the *Escola Pública Joan Bruguera* in Girona, and seven were from the *Escola Bora Gran* in Serinyà.
The preparation of these video-recordings was a fairly elaborate process. Before recording the final audio-visual stimuli for the training session, we carried out a preliminary study intended to ensure the ecological validity of our materials. In this preliminary study, two female preschool teachers were asked to perform a dramatic reading of five stories (which were similar in form to the stories ultimately used in the recordings—explained below) as if speaking to a group of young children. Then, with reference to the MIT Gesture Studies Coding Manual⁹, we analysed the type and location of the beat gestures the two speakers had spontaneously used. The two most frequently occurring types of beat gestures used by the speakers were a palm-up movement of the hands outwards at waist level (see Appendix C, left panel), and a movement of the hands inwards towards the waist, with palms facing the body, fingertips of the two hands sometimes touching (see Appendix C, right panel). Both hand movements were typically associated with a head nod, a widening of the eyes, and a raising of the eyebrows. Interestingly, in our preliminary study, while the open-palm outward gesture accompanied either focal content words (e.g. ‘duck’, ‘rain’, ‘umbrella’ in (1) above)¹⁰ or discourse markers such as metadiscursive (‘once upon a time’, ‘suddenly’, ‘in the end’), temporal (‘before’, ‘until’), contrastive (‘but’), causal (‘because’), consecutive (‘therefore’, ‘that way’), or conditional connectors (‘otherwise’),¹¹ the inward gesture occurred only with focal content words. We therefore decided that in the subsequent recordings of stimulus materials we would use the outward movement to emphasise discourse markers and the inward movement to mark focal content words stimuli (explained below).

For the final video materials, six stories were created along the lines of those used in the preliminary study, each one featuring a farm animal that is confronted by a challenge that it must somehow resolve (see Appendix B for English translations of all six stories). The six stories were expressively read off a teleprompter by the same two preschool teachers from the preliminary study, in two different conditions, one with accompanying beat gestures and the other without, for a total of 24 stories. When they read a story in the no-beat condition, the narrators were asked to use child-directed

---

¹⁰ Content words are words with lexical meaning, typically nouns, verbs, adjectives, or adverbs. In this study, the stroke phase of beat gestures was typically associated with the content words.
¹¹ Discourse markers are “sequentially dependent elements which bracket units of talk (...). Sometimes these units are sentences, but sometimes they are propositions, speech acts or tone units (...). Markers occur at the boundaries of units as different as tone groups, sentences, actions, verses, and so on (...)” (Schiffrin, 1987). Our classification and analysis of discourse markers were based on Portolés (1998).
speech but not produce any beat gestures. In the beat condition, they were also asked to use child-directed speech, but to use an outward-directed beat gesture whenever they said a discourse marker and an inward-directed beat gesture when they said a focal content word, both of these elements being highlighted in boldface on the teleprompter text they were reading. Moreover, we also asked the two narrators to use child-directed speech with non-exaggerated facial gestures in a consistent way across items in the two conditions, which basically consisted of using a smiling face.

Furthermore, the two narrators were trained to produce the target items with exactly the same prosody in both the beat and the no-beat conditions. After they had practised, each narrator recorded two versions of each of the six stories in the two conditions (6 stories × 2 conditions × 2 versions) (see Appendix D), and the recordings were carefully monitored by the authors and the audio-visual technicians.

After the recording session, in order to confirm that each narrator had consistently used the same prosody across no-beat/beat conditions, the audio tracks were acoustically analysed using Praat (Boersma & Weenink, 2016). In terms of their prosodic content, first the target words were prosodically coded using Cat_ToBI (Prieto et al., 2015). The H and the L target F0 points in every pitch accent were manually coded, as were the starting and end points of the target accented syllables and target words. Similarly, a set of three automatic measures were obtained for the whole speech fragment, namely the average pitch, average duration, and average intensity. A set of seven GLMMs were performed to assess the difference between the following prosodic measures across the two conditions: (a) pitch range, meaning the distance between the minimum and maximum pitch of L+H* pitch accents; (b) the duration of the target accented syllables; (c) the duration of the target words; (d) the mean pitch of the whole narrative; (e) the mean duration of the whole narrative; and (f) the mean intensity of the whole narrative. In all analyses, Condition was set as fixed factor, and a random intercept was set for both Speaker and Narrative. No statistically significant effects of Condition were found for any of the three prosodic variables, namely pitch range (results either in Hertz: $F(1, 179) = .001, p = .977$; or in semitones: $F(1, 179) = .092, p = .761$), accented syllable duration ($F(1, 202) = .865, p = .353$), or target word duration ($F(1, 126) = .006, p = .938$). As for general phonetic measures covering each full discourse, no significant effect was found for mean pitch in Hz ($F(1,20) = .001, p = .972$), mean duration of the discourse ($F(1,20) = .003, p .865$), or mean intensity of the discourse ($F(1, 20) = .028, p = .868$). Thus, as expected, all measures yielded non-
significant differences across no-beat/beat conditions. All recordings were carried out in an experimental laboratory at the Universitat Pompeu Fabra and edited using the AVID video-editing programme (Avid Technology, Inc., 2016).

**Experimental procedure**

The study used a between-subject pretest–posttest design which is schematically illustrated in figure 3. First, matched random assignment was used to assign children to one of the two conditions (no-beat or beat) to make sure that the mean ages of the two treatment groups were equivalent (no-beat: $M = 5.86$, $SD = 0.56$; beat: $M = 6.01$, $SD = 0.58$).\(^\text{12}\)

The experiment was organised in the following way. First, in the pretest, the child was asked to watch two animated cartoons and then tell the story of what had happened to an experimenter (see Experimental procedure subsection in 5.1.2 for this narrative task procedure).\(^\text{13}\) This part was followed by the training session, in which the child was shown six videotaped stories in one condition (i.e. no-beat or beat). Finally, in the posttest the child repeated the same task as in the pretest, but with two other cartoons. For each condition, a total of eight counterbalanced versions were created in which the order of the pretest and posttest cartoons, the six training stories and the two narrators alternated.

\(^{12}\) Twenty-one out of the 44 children were tested in the no-beat condition and 23 in the beat condition.

\(^{13}\) All children’s pretest narratives will be also analysed in Study 1.
The participants were individually tested in a quiet classroom at their school and the whole session lasted approximately 20-25 minutes. The children were videotaped in all phases of the task (see Appendix E for a diagram of the experimental setup).

The experimental procedure was the same for both pretest and posttest (see Experimental procedure subsection in 5.1.2). The same four cartoons were used for all the children, two in the pretest and two in the posttest, but they were shown in different orders, always maintaining the cartoons in the same pairs.

After the pretest, the child again put on the headphones and watched six videos showing the two narrators telling a total of six stories. The same set of six stories were shown to each child, in the same condition for each child, but the children were shown them in different orders of story and narrator.

**Coding**

The resulting 176 video-recordings (44 children × 4 retellings) of the children’s pretest and posttest performances were analysed according to a speech-coding scheme adopted to measure a variety of aspects related to the quality of the children’s narratives.

**Narrative structure scores**

To obtain a measure of overall narrative structure, we used a modified version of the coding system applied by Demir et al. (2014) and Demir et al. (2015a), which in turn is based on Stein and Glenn’s (1979) approach to narrative structure in children. According to this approach, the organisational quality of a child’s narrative can be measured by four main features namely an animate protagonist, temporal structure, causal structure, and goal-directed action. Each feature is considered to be a prerequisite for the next, and thus narratives with more of these features are rated more complex than stories with fewer of them. The rubric we used to score the narratives produced by child participants is shown in Appendix F. A child’s narrative was rated as a “complete goal-based narrative” and received the highest score if it showed signs of causal and

---

14 See Measures section on page 819 in Demir et al. (2014); and Narrative structure in speech subsection on pages 6-7 in Demir et al. (2015a). After some pilot work, this narrative coding system was adapted so that it would conform to the structure of the stories used in our own study. First, our stories only included one goal-attempt-outcome sequence, in contrast to those used by Demir et al. (2014), which included multiple episodes with multiple goal-attempt-outcome sequences. Moreover, we also felt that a description of the goal or the attempt to achieve the goal indicated greater narrative sophistication and hence a higher score than telling the outcome of the story, in contrast to Demir et al. (2014). Finally, we decided that the more detailed a story was, the higher the score it should receive.
temporal structuring and specified the initiating event or challenge facing the protagonist, his/her consequent goal, how he/she attempted to achieve the goal, and eventual outcome of that attempt. An example of a scored narrative can be seen in Appendix G.

**Fluency scores**

Fluency scores were assigned to each narrative by combining a numerical score with a holistic judgment. First, a score from 0 to 5 following the scoring system applied in Alibali et al.’s (2009) proposed coding. These authors rate fluency according to the number of disfluencies, which may be filled pauses (“um”, “uh”), the repetition of immediate words (“it was, it was raining”), repairs (“he was at the beach, the mountains”), or fresh starts (“and then this, then…”). In our study, the maximum rating of 5 was given when the child produced one disfluency or none at all. A rating of 4 was assigned when the child had from 1 to 2 disfluencies in his or her speech; a rating of 3 was assigned when there were 2 or 3; a rating of 2 when there were 3 or 4; and a rating of 1 when there were 4 or 5. Finally, the minimum rating of 0 was given when the child produced more than 5 disfluencies or could not remember anything about the story. The final score assigned depended on the scorer’s general perception of the fluency conveyed by the narrative in a holistic sense. For instance, if a child produced 2 disfluencies and the general perception was of good fluency a score of 4 was given; if the child produced 2 disfluencies but the overall perception was of weak fluency, a score of 3 was given.

**5.2.3 Summary of results**

The results section is divided into two different subsections, one for narrative structure scores and the other for fluency scores. Two Generalized Linear Mixed Models (GLMM) (West, Welch, & Galecki, 2007) were run using SPSS Statistics 23.0 (SPSS Inc., Chicago IL) with these two dependent variables.

---

15 It should be noted that in retelling the cartoons children occasionally remembered that some object or animal had been involved but could not quite remember which one. In such cases, we counted this as a successful retelling only if the object they named was similar in kind to the object in the cartoon—for example, if the child referred to the mouse as a “squirrel”.

In order to assess the potential effects of the beat training condition on children’s narrative structure abilities, we ran a GLMM with the overall narrative structure ratings as a dependent variable, training Condition (two levels: no-beat and beat) and Test (two levels: pretest and posttest) and all their possible interactions as fixed factors, and Subject and Item (i.e. the four stories used in the pretest and posttest) as random factors. Pairwise comparison post hoc tests were carried out for the significant main effects and interactions.

The results of the GLMM analysis showed a main effect of Condition ($F(1, 172) = 8.041, p < .01$), with higher narrative structure scores in the beat condition ($p < .01$) than in the no-beat condition, and Test ($F(1, 172) = 19.691, p < .001$), with posttest narrative structure scores better ($p < .001$) than pretest scores.

A significant interaction between Condition and Test was found ($F(1, 172) = 4.705, p < .05$), indicating that narrative performances differed depending on the condition and the test. Post hoc analyses revealed that while beat and no-beat conditions did not significantly differ in the pretest part ($p = .467$), they did so in the posttest, with greater narrative scores in the beat condition ($p < .001$) than in the no-beat condition. By contrast, considering differences in terms of condition, post hoc analyses revealed significant differences between pretest and posttest scores in the beat condition, with better narrative performances in the posttest ($p < .001$) than in the pretest. Crucially, no significant differences between pretest and posttest were found in the no-beat condition ($p = .119$). Therefore, the results show that participants who undertook the beat training condition obtained higher narrative structure scores in the posttest than in the pretest part while participants who had training without beat gestures did not.

Figure 4 shows the mean overall narrative structure scores (from 0 to 6), broken down by training condition (no-beat vs. beat) and test (pretest vs. posttest). The graph shows how the posttest narrative structure scores in the beat condition outperformed those in the no-beat condition.
Fluency scores

To check for the potential effects of the beat training condition on children’s narrative discourse fluency, a GLMM was conducted with overall fluency ratings as a dependent variable, training Condition (two levels: no-beat and beat), Test (two levels: pretest and posttest), and all their possible interactions as fixed factors, and Subject and Item (the four stories) as random factors. Pairwise comparison post hoc tests were carried out for the significant main effects and interactions.

The results of the GLMM analysis revealed a main effect of Condition ($F(1, 172) = 21.288, p < .001$), with more fluent narratives in the beat condition ($p < .001$) than in the no-beat condition, and a main effect of Test ($F(1, 172) = 4.494, p < .05$), showing that narratives were performed with more fluency in the posttest ($p < .05$) than in the pretest. However, the interaction between Condition and Test was found to just barely approach significance ($F(1, 172) = 3.006, p = .085$). The post hoc analyses indicated a significant difference between the fluency scores in the pretest and posttest in the beat condition, with better scores in the posttest ($p < .01$), but not in the no-beat condition. Significant differences between the beat and no-beat conditions were also obtained in relation to the test, with greater fluency scores in the beat condition than in
no-beat condition in both the pretest \((p < .01)\) and the posttest \((p < .001)\). Thus, the results showed that participants who were assigned to the beat training condition produced posttest stories with higher fluency scores than pretest stories, whereas the participants in the no-beat training group did not.

Figure 5 shows the mean fluency scores from 0 to 5, broken down by training condition (no-beat vs. beat) and test (pretest vs. posttest). The graph shows how the posttest fluency scores in the beat condition outperformed those in the no-beat condition.

![Figure 5: Mean fluency scores from 0 to 5, broken down by training condition (no-beat vs. beat) and test (pretest vs. posttest). Error bars represent confidence intervals.](image)

5.3 Study 3

5.3.1 Research question

The main research question of Study 3 was to test whether training 5- to 6-year-old children in producing beat gestures can contribute to improving their narrative performances (e.g., fluency and narrative structure scores).

The data for the experiment was collected between the months of February and March 2017, even though the results have not been analysed yet (see the calendar section below in section 6).
5.3.2 Methods

Participants

Fifty-three 5- and 6-year-old children (23 boys and 30 girls) from Girona (Catalonia) participated in the study. All of them were typically developing children with no prior history of communication disorders in themselves or within their families. Three of the original participants were excluded from the final analysis (two boys and one girl), for the following reasons: technical problems occurred during the pretest recording session of the first child; and the other children were not totally involved in the task and did not totally produce the narratives. Thus, the results of this study are based on data from the remaining 50 participants.

The children were preschoolers and first graders from two different schools, and some of them were tested at home. The parents were informed about the main goal of the experiment and signed a form allowing their children to participate in the experiment and be video-recorded in the process. Moreover, since the experimental tasks were all administered in Catalan, caregivers filled out a language exposure questionnaire (Bosch & Sebastián-Gallés, 2001) to ensure that all participating children were coming from a context in which Catalan was the predominant language of daily use.

Materials

The experiment consisted of three parts: a pretest, a training session, and a posttest. The pretest and posttest materials used to conduct this study were the same as the ones used in Study 2 (see Materials subsection in 5.2.2; and Materials subsection in 5.1.2 for a further description). However, for the training part, only half of the narratives were used (6 stories × 2 narrators) (see Materials subsection in 5.2.2), e.g., the ones produced with beat gestures in target positions within the story.

Experimental procedure

The study was carried out in a between-subject training paradigm with a pretest and a posttest design, schematically illustrated in figure 6, under two experimental conditions (e.g., gesture non-encouraged condition and gesture-encouraged condition). First, matched random assignment was used to assign children to one of the two

16 Twenty were from the Escola Dr. Masmitjà, twenty-nine from the Escola Montjuïc, both in Girona, and four children were tested at their home.
conditions (gesture non-encouraged condition and gesture-encouraged condition) to make sure that the mean ages of the two treatment groups were equivalent (25 children per each condition).

The participants were individually tested in a quiet classroom at their school and the whole session lasted approximately 25-30 minutes. The children were videotaped in all phases of the task and the same experimental setup as in Study 2 was adopted (see Appendix E).

The experimental procedure was the following. The pretest\(^{17}\) and the posttest parts were conducted identically as in the Study 2 (see Experimental procedure subsection in 5.2.2, and in 5.1.2 for the entire explanation of the narrative task). However, in contrast with Study 2, in the training session, children were only shown the six videotaped narratives which were performed with beat gestures. For each condition, a total of eight counterbalanced versions (alternating the order of the pretest and posttest cartoons, the training stories, and the narrators) were created. In both conditions, children were asked to watch each story and at the same time pay attention to how the narrator was moving her hands, “Mira la grangera, com mou les mans quan t’explica la història” (“Look at the farmer, how she moves her hands when she is telling you the story”). After each child was shown each short narrative, the experimenter gave him or her some instructions depending on the condition. In the gesture non-encouraged condition, children were just asked to retell the six stories without gesture instructions. By contrast, in the gesture-encouraged condition, children were asked to retell the six stories while producing hand movements, as they had just observed from the narrator: “Has vist que la grangera movia molt les mans durant tota la història? Doncs explica’m la història igual que la grangera movent molt, molt, molt les mans durant tota la història. Recordes com ho feia, recordes que deia “hi havia una vegada, un ànec…?” (“Have you seen that the farmer moved her hands a lot during all the story? So now, tell me the story in the same way as the farmer did, moving a lot, lot, lot your hands during all the story. Do you remember how she did it? Do you remember that she said: “hi havia una vegada, un ànec...? (Once upon a time, there was a duck...?)”). The experimenter stressed the fact that the farmer moved her hands during the narratives, and in the instruction she performed the corresponding beat gestures on discourse markers and target words (i.e., performed beat gestures on “hi havia una vegada”, “un ànec”).

---

\(^{17}\) All children’s pretest narratives will be also analysed in Study 1.
Currently, we are coding the children's pretest and posttest narratives for fluency and narrative structure scores using the same coding system as in Study 2 (see Coding subsection in 5.2.2).

5.3.3 Expected results

Taking into account the results obtained in Study 2 and all the positive previous findings about gesture production (see section 1.2.3), we expect that children who were encouraged to produce beat gestures during their narratives will obtain higher fluency scores and higher narrative structure scores in their posttest narratives. Therefore, we hypothesise that encouraging the production of beat gestures will also have positive effects on the short-term narrative discourse performances.

5.4 Study 4

5.4.1 Research question

The main research question of this longitudinal study is to test whether the early and natural appearance of beat gestures in 5- to 6-year-old children’s narratives can be predictive of an improvement in narrative and language abilities (and other cognitive, linguistic, and social competence skills) at a later stage of development (when children are 6-7 years old, and 7-8 years old).
This study will be carried out in collaboration with Dr. Özlem Ece Demir-Lira, who is currently part of the Goldin-Meadow Laboratory (Department of Psychology), in the University of Chicago. The proposal of this study has been also prepared during my three-month research stay at the University of Chicago from March to June 2017.

### 5.4.2 Methods

#### Participants

The same ninety-four children (45 boys and 49 girls) who will be analysed in Study 1 (Time 1) will also be tested in this longitudinal study in Time 2. All of them were typically developing children with no prior history of communication disorders in themselves or within their families.

#### Materials

The experiment will consist of a longitudinal study with a narrative task, taken at two time points (Time 1 and Time 2), and several linguistic, social, and cognitive measures taken at Time 2.

The narrative task already performed at Time 1, will be also performed at Time 2. Materials for the narrative task will be the same four wordless cartoons as in the other studies (see Materials subsection in 5.1.2 to see the structure of these cartoons).

To get measures of children’s language skills at Time 2, we will use the following tests. A syntax comprehension test (Huttenlocher, Vasilyeva, Cymerman & Levine, 2002) adapted to Catalan language, in which the experimenter will read a sentence to each child and he or she will be asked to point to the picture that corresponded to the sentence; the task included both simple and multi-clause sentences. A vocabulary test, in which the experimenter will ask the child to point at the picture that corresponds with a word, and reversed, to tell the word that depicts the picture (Saborit & Julián, 2005). A memory span task (Henry, Messer, Luger-Klein, & Crane, 2012; Igualada et al., 2017), which will be measured in terms of the maximum number of words from the list produced by the experimenter that the child can recall (i.e., two, three, four, and so on, words list length). The procedure continues until the child can no longer succeed in recalling all the words in the list. Once the child’s apparent limit is reached, he or she will be asked to repeat three lists of the same length to confirm that
this word count is indeed the limit of their memory span.\textsuperscript{18} All words that will be used in the memory span task appear in the \textit{Spanish-language MacArthur–Bates Communicative Development Inventories} (CDIs) of 16-30 months (López-Ornat et al., 2005).

Furthermore, we will also test elements of social competence at Time 2, which include peer play cooperation and self-regulation (see Nicolopoulou, Cortina, Ilgaz, Cates, & De Sá, 2015:14-15). In the first one, children’s cooperation will be observed through the rating used in Nicolopoulou et al.’s (2015) study, the Penn Peer Interaction Scale, developed by Fantuzzo et al. (1995). In this rating, the observer will rate the child’s behaviour by evaluating play disruption (e.g., if the child does not behave well, fights with others, etc.), play disconnection (e.g., if the child refuses to play and is not involved in the task, etc.), and play interaction (e.g., if the child behaves well, shares things, helps others, etc.) in settings that involved children’s play interaction and cooperation. In the self-regulation assessment, the observer will assess children’s behaviour in situations that involve self-regulation by another rating used by Nicolopoulou et al. (2015), adapted from Olson and Kashiwagi (2000), evaluating self-inhibition (e.g., being patient in waiting for his/her turn, accepts assigned roles, etc.) and self-assertion (e.g., having contact with others, able to ask to borrow things, etc.).

\textit{Experimental procedure}

The longitudinal study will be administered in the following way. First, at Time 2 children will complete the narrative task with two of the randomly assigned wordless cartoons (see \textit{Experimental procedure} subsection in 5.1.2 for the entire explanation of the procedure of the narrative task at Time 1). To get linguistic, cognitive and social competence measures, a set of tests will be administered to children also at Time 2.

\textit{Coding}

Both the narratives performed in Time 1 and in Time 2 (e.g., 188 narratives by 94 children x 2 times) will be coded in terms of fluency scores and narrative structure scores, and gesture performance, specially focusing on beat gestures. For each narrative, we will also measure the number of clauses and the different word types and word tokens. Specifically, to test whether the appearance of beat gestures in narratives in Time 1 contribute to improve narrative abilities at Time 2, as well as other cognitive,\textsuperscript{18} According to Duinmeijer, De Jong, & Scheper (2012), children’s narrative performances are correlated with cognitive skills such as attention and memory.
linguistic, and social abilities, we will run a set of regression analyses to test how much variance of narrative skills at Time 2 (as well as the other skills) is predicted by the appearance of gestures in narratives at Time 1.

5.4.3 Expected results

We expect that beat gestures have a precursor value in the development of children's narratives across ages and that their early appearance is also positively related with later linguistic, cognitive, and social skills.

5.5 Study 5

5.5.1 Research question

The main research question of this study is whether a four-week classroom intervention study promoting the use of co-speech gestures in narratives can boost children’s narrative short-term and long-term discourse skills, as well as other cognitive, linguistic, and social skills.

5.5.2 Methods

Participants

Data from a minimum of sixty 5- to 6-year-old children will be gathered for this study. All of them will be typically developing children with no prior history of communication disorders in themselves or within their families.

Materials

The experiment will be designed as a classroom intervention study with a pre-intervention, post-intervention (Time 1), intervention phase, and post-intervention (Time 2) after two months. The pre- and post-intervention (Time 1 and Time 2) materials will contain the four wordless cartoons as in the other studies (see Materials subsection in 5.1.2 to see the structure of these cartoons) and a set of language, cognitive, and social tests (see Materials subsection in 5.4.2 for an explanation of each test).

The classroom intervention program will consist of a set of narrative activities
and tasks adapted to the 5- and 6-year old children. We will present these activities in a book format, which will be presented to the teachers. We will use a set of narrative tasks, which have been proven to work for this age group. For example, Nicolopoulou et al. (2015) observed that activities combining voluntary storytelling with group story-acting, carried out as a regular part of the preschool curriculum, can promote the abilities of preschool children from low-income and otherwise disadvantaged backgrounds in three major areas that contribute to their readiness for success in formal education: narrative and other oral language skills, emergent literacy, and social competence.

**Experimental procedure**

Children will be randomly assigned to one of the two experimental conditions, namely no-gesture encouraged condition and gesture-encouraged condition, building a specific number of groups depending on the number of children who will be possible to test.

The intervention period will last four weeks (2 or 3 hours a week, depending on the school/time). All classroom participants in both conditions will be individually pre- and post-tested in terms of linguistic and cognitive and social measures, covering narrative skills (see Experimental procedure subsection in 5.1.2 to see the entire explanation of the narrative task), vocabulary, cognitive abilities, and elements of social competence (play cooperation and self-regulation assessment) (see Experimental procedure subsection in 5.4.2). Pre-intervention and post-intervention measures will be administered to each child individually in a quiet room adjacent to their classroom by the experimenter. Observational measures (e.g., cooperation or self-regulation) will be observed in the classroom by the experimenter.

During the intervention part, children will be asked to participate in a variety of narrative tasks. For example, one of them could consist of watching every day a different story from one of the two narrators (see Materials subsection in 5.2.2) performed with beat gestures in target words within the narrative discourse. After having watched the audio-visual story, children will be asked to complete several tasks related to the narrative, in groups or individually. Children in the no-gesture encouraged training condition will only be asked to participate in the activities and the instructor will be trained to use his or her hands naturally. By contrast, children in the gesture-encouraged condition will be encouraged to produce gestures during all the tasks in
which they should collaborate, and the instructor will be trained to produce and to encourage them to produce gestures while speaking or narrating. All conditions will be conducted with different groups of children at the same school.

Children will be asked to repeat the same narrative task and language measures tests they were exposed to in both the pre-intervention and post-intervention (Time 1) two months after (Time 2) they have undertook the classroom intervention. This will allow us to assess any existing long-term effects on children’s narrative skills (and on other cognitive, linguistic, and social competence skills).

**Coding**

We will assess all children’s narrative scores (i.e., fluency and narrative structure scores) and language (and other cognitive, linguistic, and social competence skills) measures in the pre-intervention and post-intervention (Time 1 and 2) measurements to assess any short- and long-term effects of the intervention on children’s narrative skills development (and on language development in general). Concerning the intervention phase, the sessions will be video-recorded and we will check that children and the instructor performed all the activities according to the guidelines for each of the two conditions. We will ask each teacher for the children’s obtained marks in exams they will take after the classroom intervention. This will allow us to assess whether the intervention can also positively influence children’s academic performance.

**5.5.3 Expected results**

We expect that children who will be exposed to the classroom training under the gesture encouraging experimental condition (vs. children in the no-gesture encouraged condition) will have higher scores in their short- and long-term narrative abilities, as well as they will also reveal more gains in their language skills (and other cognitive, linguistic, and social skills) after the intervention.
6. WORKING SCHEDULE

**March - June 2017**

- Data collection for Study 3 (already gathered)
- Three-month stay abroad at Goldin-Meadow Laboratory (Department of Psychology, University of Chicago); Host: Dr. Susan Goldin-Meadow.
- Paper revision of Study 2 for the journal *Developmental Psychology*
- Writing and submission of PhD research plan
- Poster presentation at the conference *Language as a form of Action*. Institute of Cognitive Sciences and Technologies (ISTC): Roma (Italy), June 21-23. Title: Do beat gestures help preschool children to recall and understand discourse information? Authors: Llanes-Coromina, J., Vilà-Giménez, I., Kushch, O., Borràs-Comes, J., & Prieto, P.

**July 2017**

- Oral presentation of the PhD research plan
- Poster presentation at the conference *14th International Congress for the Study of Child Language* (IASCL). Université Lyon: Lyon (France), July 17-21. Title: The effectiveness of a short training with beat gestures in improving children’s narrative discourse skills. Authors: Vilà-Giménez, I., Igualada, A., & Prieto, P.
- Poster presentation at the conference *14th International Congress for the Study of Child Language* (IASCL). Université Lyon: Lyon (France), July 17-21. Title: Prominence in speech and gesture help preschoolers to recall and comprehend information. Authors: Llanes-Coromina, J., Vilà-Giménez, I., Kushch, O., Borràs-Comes, J., & Prieto, P.
- Attendance to the course *The use of eye-tracking in language acquisition research* by Tom Fritzsche (University of Postdam), organised by IASCL
- Analysis of the data collected for Study 3

**September 2017 to December 2017**

- Poster presentation at the conference *Architectures and Mechanisms of Language Processing* (AMLaP). Lancaster University: Lancaster (UK), September 7-9. Title: The positive effect of observing and producing beat gestures on children’s narrative abilities. Authors: Vilà-Giménez, I., Igualada,
A., & Prieto, P.

• Poster presentation at the conference *Architectures and Mechanisms of Language Processing* (AMLaP). Lancaster University: Lancaster (UK), September 7-9. Title: Do beat gestures and prosodic prominence enhance preschoolers' recall and comprehension of discourse information? Authors: Llanes-Coromina, J., Vilà-Giménez, I., Kushch, O., Borràs-Comes, J., & Prieto, P.

• Analysis and writing of Study 3
• Proposal preparation of Study 4 in collaboration with Dr. Özlem Ece Demir-Lira (currently member of the Goldin-Meadow Laboratory, Department of Psychology in University of Chicago).

**January 2018 to March 2018**

• Gestural analysis and narrative analysis of the narratives of Study 1 (total of 188 narratives produced by 94 children).

• Writing of Study 1

**April 2018 to May 2018**

• Data collection for Study 4. Control data from the 94 children who participated in the Study 2 and 3 and were analysed in Study 1 will be gathered in Time 2 in order to test their narrative abilities and other cognitive, linguistic, and social skills.

• Attendance to the congress *Speech Prosody 2018* in Grenoble (France). May 15-18, 2018.

• Attendance to the congress *International Society for Gesture Studies (ISGS)* in Cape Town (South Africa).

**June 2018 to July 2018**

• Analysis of Study 4

• Attendance to the congress *LabPhon16* in Lisboa (Portugal). June 20-22, 2018.

**September 2018 to December 2018**

• Writing of Study 4

• Proposal preparation of Study 5 (intervention study)

**January 2019 to March 2019**

• Data collection of Study 5. The classroom intervention study integrated in the school curriculum will be run with 5- to 6-year-old children. Control data from
each child will be gathered before and after intervention (Time 1).

**April 2019 to May 2019**

- Data collection of Study 5 (post-intervention test after two months, Time 2)
- Analysis and writing of the Study 5

**June 2019 to July 2019**

- Writing of the PhD dissertation

**August 2019**


**September 2019**

- PhD dissertation defense

---

7. SELECTED REFERENCES


Demir et al. (2014) tested fifty-three typically developing children (mean age = 5.10 years) and nineteen children with pre- or perinatal unilateral brain lesion (mean age = 6.0 years) in order to assess how different types of narrative elicitation tasks can scaffold children’s narrative performance. Specifically, the authors examined how four different elicitation formats (e.g., wordless cartoons, auditory, no gesture, and gesture) can predict better narrative skills. Results of this study showed that both typically developing children and children with pre- or perinatal unilateral brain produced more well-structured (e.g., narrative scores) stories when their narratives were elicited with the audio-visual modality with performed co-speech gestures (i.e., stories told by a narrator using co-speech gestures, providing auditory and visual information). Moreover, these results were obtained after controlling for differences in narrative length (number of clauses) and diversity of word types in children’s narrative retellings.
Demir et al. (2015a) carried out another study about the contribution of co-speech gestures in children’s improvement of their narrative skills. To test whether children’s narrative structure in speech improved across ages, the authors conducted a longitudinal study with thirty-eight children tested at age five, six, seven and eight. Children were administered a narrative production task once a year, four time between the ranges of ages. At each session, each child was asked to retell a wordless cartoon. Moreover, children were also asked to complete a syntax comprehension test (Huttenlocher et al., 2002) to test their basic language skills at age 4;6. All in all, results revealed that children gained narrative proficiency across these ages in terms of narrative structure. Specifically, children who expressed character’s viewpoint by gesturing at age 5 told more well-structured stories when they got older than children who did not perform these gestures at the same age. Moreover, it is important to note that perspective expressed in speech by 5-year-old children was not significantly associated with narrative scores at later ages. This study is also in line with our expectations about the precursor effects of co-speech gestures and specifically about the role that beat gestures can play in relation to the improvement of a narrative discourse.


In this review article, Goldin-Meadow and Alibali (2013) clearly elucidated what is the role of gesturing and its contribution to human communication and to language processing and learning. They divide the explanation about the effects of gestures into main four points: a) gesture’s role in language processing; b) gesture’s role in language learning and beyond; c) gesture’s role in creating language; and d) gesture’s role in the clinic and the classroom. This paper is of great interest for my thesis, as it reports a summary of how non-verbal communicative hand movements
which are fully integrated with speech affect human communication and language processing, such as learning or thinking, as well as how they could be integrated in clinical assessment and in the classroom, as gestures can be regarded as a magnificent tool for both teachers and learners.

Lucero et al. (2014) carried out two experiments focusing on beat gestures and their relationship with boosting and improving speech production. In Experiment 1, thirty-six adult participants were asked to produce different target words that were related to some definitions either in the iconic gesture condition (i.e., participants were asked to depict the word with their hands as they searched a word that matched the definition), the beat gesture condition (i.e., participants were asked to perform a beat gesture), or the no gesture instruction condition (i.e., any given reference to gesturing). Results from this experiment revealed that participants in the beat gesture instruction condition produced more words with ease. Reaction times in the beat gesture condition were greater than in the iconic gesture and no gesture instruction conditions, and reaction times in the iconic gesture condition were significantly higher than in both beat gesture and no gesture instruction condition.

In Experiment 2, the authors focused on the results obtained by beat gestures in enhancing word production. Thirty-two participants were administered the same but expanded materials and tested in the same procedure, but under four gesture instruction conditions, namely no gesture instruction, bimanual beat, right hand beat, and left hand beat. Results showed that participants who undertook the bimanual beat instruction were significantly better at word production in terms of RTs (i.e., faster RTs in word production), rather than in the right hand beat or no gesture instruction conditions. Reaction times in the left hand beat instruction condition were not significantly different from those in the bimanual beat condition. According to these findings, the authors suggested that left hand beats, more than right hand beats, have a neural connectivity with the right-hemisphere circuits implicated in language processing. This study also demonstrated the motor action effects of beat gestures,
which are linked to the theories of embodied and grounded cognition. Moreover, in both Experiments 1 and 2, lexical accuracy was not different between conditions.

This study lends support to our hypothesis about the potential positive impact of beat gestures in boosting fluency scores in children’s narratives.

**SHATTUCK-HUFNAGEL, S., REN, A., MATHEW, M., YUEN, I., & DEMUTH, K. (2016).**

Shattuck-Hufnagel et al. (2016) focused their study on the description of beat gestures in both adult and children speech, focusing on the phase structure (i.e., as defined as the main stroke phase and optional phases accompanying each stroke: preparation, pre- or post-stroke hold, and recovery) of these non-referential gestures.

The first sample of the study included six adult speakers performing an academic lecturer. Results of these analyses showed that non-referential beat gestures had some of the mentioned optional phases that referential gestures also have, such as the preparation movements, pre- or post-stroke holds, and recovery, suggesting that those gestures may be related to the prosodic structure of the discourse.

The second sample consisted of a story-retelling task and a planning task both performed by nine children (mean age = 6;3 years). Results showed that children as young as 6 performed 26% of beat gestures in their story-retelling tasks, 42% of which are accompanied by prosodic prominence in speech, indicating emphasis or contrastive focus. Moreover, beat gestures were found to be more frequent in the children’s narratives (i.e., story-retelling task) than in their planning-task (i.e., children’s explanations). However, authors also reported that some of these non-referential gestures were also performed during pauses. In conclusion, this sample provides us with important data about children’s repertoire of gestures, in which beat gestures seem to be produced with a well-defined stroke phase and additional phases. This study provides some evidence that children at age 6 can produce beat gestures, and that these are already connected to the prosodic and narrative organisation of the discourse.
8. GENERAL REFERENCES


## Appendix A: Narrative structure of all the stories in the animated cartoons

<table>
<thead>
<tr>
<th>Cartoon</th>
<th>Initiating event</th>
<th>Goal</th>
<th>Attempt</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>After the mouse has inflated the inflatable apple tree, he sniffs an apple.</td>
<td>The mouse wants to take an apple from the tree.</td>
<td>The mouse picks an apple from the tree.</td>
<td>The tree deflates automatically so the mouse can not eat the apple.</td>
</tr>
<tr>
<td>Sculpture</td>
<td>The mouse and elephant find a sculpture but the elephant accidentally knocks it over with his trunk.</td>
<td>The mouse and elephant want to repair the sculpture.</td>
<td>The mouse and elephant turn the sculpture into a slide.</td>
<td>The mouse and elephant slide down the slide.</td>
</tr>
<tr>
<td>Socks</td>
<td>The wind keeps blowing the socks off the clothesline.</td>
<td>The mouse wants to hang up the socks so they won’t get blown off the line.</td>
<td>The mouse unties the clothesline, passes it through the socks, and reties it.</td>
<td>When the wind blows again, the socks no longer blow off the line.</td>
</tr>
<tr>
<td>Clamshell</td>
<td>The mouse and elephant are walking on the beach and find a large clamshell. The mouse tries unsuccessfully to open the clamshell.</td>
<td>The mouse wants to open up the clamshell.</td>
<td>The mouse tries unsuccessfully to open the clamshell with his foot so the elephant helps him with his trunk.</td>
<td>The mouse and elephant each use one half of the clamshell as a hat.</td>
</tr>
</tbody>
</table>
### Appendix B: English translations of the six training stories

<table>
<thead>
<tr>
<th>Story</th>
<th>English Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st story</td>
<td><strong>Once upon a time, a duck</strong> was walking to school. <strong>Suddenly</strong>, it started to <strong>rain</strong>, and the duck didn’t have an <strong>umbrella</strong>. <strong>In the end</strong>, he came up with a <strong>solution</strong>: he put his hood on his <strong>head</strong> to protect himself from the rain.</td>
</tr>
<tr>
<td>2nd story</td>
<td><strong>Once upon a time, a rabbit</strong> went for walk in the mountains. <strong>Suddenly</strong>, some <strong>cows</strong> started to walk towards him and he was scared. <strong>In the end</strong>, he found a <strong>solution</strong>: he stood <strong>still</strong> behind a tree <strong>until</strong> the cows left.</td>
</tr>
<tr>
<td>3rd story</td>
<td><strong>Once upon a time</strong>, there was a <strong>horse</strong> that was hungry. <strong>Suddenly</strong>, he realised that there were no <strong>biscuits</strong> in the cupboard, <strong>because</strong> he had eaten them all. <strong>In the end</strong>, he thought of a <strong>solution</strong>: he made biscuits in the <strong>oven</strong>.</td>
</tr>
<tr>
<td>4th story</td>
<td><strong>Once upon a time</strong>, there was a <strong>hen</strong> that was sleepy. <strong>Suddenly</strong>, she fell asleep on the <strong>sofa</strong>, <strong>but</strong> her <strong>alarm clock</strong> woke her up. She had forgotten that the following day was her <strong>birthday</strong> and that she was planning to buy <strong>candles</strong> to celebrate it. <strong>In the end</strong>, she found a <strong>solution</strong>: she bought some <strong>enormous</strong> candles and was <strong>therefore</strong> able to celebrate her birthday.</td>
</tr>
<tr>
<td>5th story</td>
<td><strong>Once upon a time, a pig</strong> was playing football in the park. <strong>Suddenly</strong>, he realised that it was <strong>late</strong> and he had to go back <strong>home</strong>, <strong>because</strong> otherwise his <strong>mother</strong> would get angry. <strong>In the end</strong>, he thought of a <strong>solution</strong>: he took a <strong>shortcut</strong> to get home. <strong>That way</strong>, he managed to not arrive late and his mother did not get angry.</td>
</tr>
<tr>
<td>6th story</td>
<td><strong>Once upon a time, a cat</strong> was staying at his grandparents’ house in summer. <strong>Suddenly</strong>, he remembered that he had to do his <strong>homework</strong>, <strong>because</strong> otherwise his <strong>grandparents</strong> wouldn’t wait for him to go to the beach. <strong>In the end</strong>, he came up with a <strong>solution</strong>: he did the homework <strong>before</strong> his grandparents arrived, and <strong>that way</strong> he was able to go to the <strong>beach</strong>.</td>
</tr>
</tbody>
</table>
Appendix C: Examples of the beat gestures from the preliminary study

Examples of the most frequently performed beat gestures from the preliminary study. Left panel: the outward hand movement. Right panel: the inward hand movement.
Appendix D: Images from the stimulus narrative training materials

Still from a stimulus training video showing one of the two storytellers telling one of the six stories in two conditions. Top panel: story being told in the no-beat condition. The narrator refrains from making gestures as she tells the story. Bottom panels: story being told in the beat condition. Bottom left: the outward movement beat gesture. Bottom right: the inward movement beat gesture.
Appendix E: Experimental setup of Study 2 and 3

The child was seated facing a laptop computer on which the pretest, training, and posttest videos were shown but stood in front of the experimenter to talk after each pretest and posttest video segment. The experimenter sat in front of the child to interact with her/him but could not see the screen of the laptop. The video camera was located behind the shoulder of the experimenter to record the child’s behaviour when either sitting or standing.
### Appendix F: Rubric of the narrative scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Features of the narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><strong>A narrative with no structure</strong>. It does not even contain a descriptive sequence; the story is not remembered.</td>
</tr>
<tr>
<td>1</td>
<td><strong>A descriptive sequence</strong>. This is a narrative that includes the physical and personality characteristics of an animate protagonist with no mention of a sequence of actions (i.e. no temporal structure).</td>
</tr>
<tr>
<td>2</td>
<td><strong>An action sequence</strong>. This is a narrative with actions described in a temporal order (actions follow one another in time) but in which the actions are not causally organized (i.e. if there was one event causing the following event or events, the story was categorized as an action sequence).</td>
</tr>
<tr>
<td>3</td>
<td><strong>A reactive sequence</strong>. This contains actions that are temporally and causally organized but does not include either the protagonist’s goal(^\text{19}) and/or the attempt to achieve the goal. The outcome is always mentioned here.</td>
</tr>
<tr>
<td>4</td>
<td><strong>An incomplete goal-based narrative</strong>. This includes temporal and causal structure, a goal statement and/or description of an attempt to achieve the goal, but no information about the outcome.</td>
</tr>
<tr>
<td>5</td>
<td><strong>A goal-based narrative</strong>. This includes not only temporal and causal structure as well as a goal statement, description of an attempt to achieve the goal, and the final outcome.</td>
</tr>
<tr>
<td>6</td>
<td><strong>A complete goal-based narrative</strong>. This contains not only temporal and causal structure but also all the main features noted above. Moreover, the story is fleshed out with details including the initiating event.</td>
</tr>
</tbody>
</table>

---

\(^{19}\) The goal of the protagonist was regarded as correctly described if the child interpreted it with a mental state verb, stated intention explicitly (e.g., “he wants to pick an apple”) or implicitly (e.g. “he was fed up with the clothes always falling on the ground”); or by explicitly describing the discovery of a solution (e.g., “he/they found a solution, he/they had an idea”, etc.).
Appendix G: Example of a child-produced narrative

Below is a transcript of a child retelling one of the cartoon stories from the posttest task. The English translation which follows is marked-up to allow for scoring in terms of narrative structure.

Child: Hi havia una vegada, un esquirol que volia penjar la roba, però feia tant de vent que no podia penjar els seus mitjons, i a sobre estaven tots trencats. I va trobar una solució. Va desfer un fil i va començar a posar els mitjons, i després ho va tornar a enganxar al fil, i ja va poder que s’assequessin els mitjons.

English translation: [Once upon a time, a squirrel wanted to hang up the clothes GOAL], [but it was windy and he couldn’t hang up his socks, and they were all worn out. INITIATING EVENT] [And he found a solution. He untied the clothesline, passed the socks through it, and then retied it. ATTEMPT TO ACHIEVE THE GOAL] [And he got the socks to dry. OUTCOME]

Here the child tells a complete, temporally and causally structured story, as all the linguistic elements are well linked. Regarding the narrative structure items that constituted scoring points, the child mentioned the initiating event, the goal of the protagonist, the attempt to achieve this goal, and the outcome of this attempt (these items have been separated by square brackets). Moreover, the retelling includes significant detail. Thus this particular retelling received the maximum score of 6.