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How French and British children learn to shrug:
a cross-linguistic developmental comparison of a recurrent gesture

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Abstract (150 words)

This paper presents a multimodal and form-based approach to language development grounded in situated practices and focuses on the longitudinal analysis of a composite gesture, the shrug, in two datasets of mother-child interactions in French and British English. The shrug in its full-fledged form can combine a palm-up, lifted shoulders, a head tilt, raised eyebrows and a mouth shrug (Kendon, 2004; Streeck, 2009). All formal components and functions of the two children's shrugs between the ages of 1 and 4;2 were coded within the multimodal ongoing discourse. Multiple correspondence analyses were combined to detailed qualitative analyses. Despite differences in the two children, interesting similarities in the development were captured over three periods: 1) absence is mainly expressed with palm-ups; 2) both children start using head tilts and shoulder lifts to express epistemicity and interpersonal positioning; 3) head tilts increase and each body part is more clearly associated with one function.

Recurrent gesture; shrug; cross-linguistic; language development.

As we adopt a multimodal, dynamic, and situated approach to language use in interaction informed by developmental studies, cognitive linguistics, construction grammar, gesture studies, phenomenology and embodied cognition, the use of recurrent gestures in their interactive context is particularly relevant to capture how we express meaning through the rich array of our semiotic resources.

We share with Cienki (2012) an integrative view of language and use what he calls the “dynamic scope of relevant behaviors” to capture the complexity of interactive practices. In the communities we study, for hearing adults, speech is the default medium in which they express and share their ideas. But other behaviors including non-lexical sounds, prosodic patterns, facial expressions and gestures can acquire symbolic value according to the affordances of the context. Among those behaviors, recurrent gestures are of particular interest. Recurrent gestures (Ladewig, 2014), a category of co-verbal gestures which share functional and structural similarities with emblems (Kendon, 1983), are the result of the gradual sedimentation of our sensory-motor system. They are culturally shared, grounded in conventionalized and embodied experiential frames. They stem from a condensation of experiences that have given the potential to build recurrent multimodal scripts over time and in different time frames: over the history of a community of users who share a culture and a language, over each individual’s development, and over time spent with interactional partners both moment to moment in the course of one conversation or thanks to the repetition of interactions with a variety of interactional partners. The meaning of recurrent gestures is not as conventionalized as the meaning of emblems. Despite similarities, they show differences in form which seem to

correlate with variations in meaning and function according to their context of use. Therefore, as analysts, we can only capture their form-meaning pairings thanks to their tight relationship with the other semiotic resources used in conversations (such as speech content, prosody, gaze) and thanks to the interactional context.

Analyses of children's uses of recurrent gestures in longitudinal spontaneous interactional data with a multimodal approach can give us valuable insights on their core meaning and how the variety of the form-meaning pairings are developed over time (Beupoil-Hourdel & Debras, 2017). More broadly, they help us capture the specific paths in meaning making and meaning extension of multimodal constructions (Morgenstern, 2014).

Most studies and taxonomies (Kendon, 2004) of co-verbal communication focus on hand gestures, since they are the most complex and salient articulators mobilized in the visuo-gestural mode during spoken communication. And yet, it has been shown that children and adults are also able to use and combine other body articulators (head, face, shoulders, trunk orientation) to communicate (Filhol, Hadjadj, & Choisier, 2014). The focus on the most distal body parts (the most distant from the trunk), the hands, has been criticized by Boutet (2018) who devoted his research to a kinesiological approach to gesture and sign languages that demonstrates how the physiological constraints of our bodies structure meaning and how all segments of the body, and in particular the entire upper limbs and their dynamics must be analyzed. In that regard, what we call *shrug* - a conventionally used gesture in a variety of languages including spoken English, French, German, Russian as well as in BSL and ASL (Debras, 2017; Streeck, 2009) - is especially interesting to study because of its composite nature and of the array of meanings it is associated with as it occurs in conversations. In the shrug "family" (Kendon 2004),

various combinations of movements of the hands, forearms, arms, shoulders, head, mouth associated with verbal content have been categorized according to several functions (Debras, 2017). In this paper we pursue this line of research and try to capture how children from two different language communities learn to use this composite gesture and its range of meanings and forms over time. We also develop a method in which we take the underdetermined nature of the shrug into account: being a recurrent gesture rather than an emblem, its specific meaning can only be explored in relation to its interactive context and the semiotic resources used in combination with other gestures.

In this study, we focus on the development of the shrug in two longitudinal datasets in French and British English. Before we present our data, method and analyses, we review the literature on shrugs and their use by children.

1. State of the art in shrug gesture research

1.1. The shrug as a gesture family

Observations of the role of the body in daily communicative interactions can go as far as informing the greatest artistic masterpieces (Isaacson, 2017, p. 283) such as Leonardo da Vinci's paintings. The Florentine painter and scientist shared his views in his *Treatise on Painting* (1982) and introduced his conception of the semantic functions of the human body. Gesture specialists such as Jorio (2000 [1832]), have also recurrently focused on how communicative gestures, like spoken words, consist of form-function pairings. The formal aspect is composed of physical features that express meaning in context. As Kendon explains in his analysis of Jorio's treatise, a variation in one of the physical elements of a gesture can lead to variations in meaning. Kendon (2004) thus

introduced the concept of *gesture family*, a form-meaning cluster consisting in a group of gestures that share both kinesic features - including hand shape, orientation, movement patterns - and a common *semantic theme*. In order to capture the meanings expressed by variations of gestures in a family, gestures need to be analyzed along with the stretch of discourse they are associated with and in context (as their meaning might differ according to context of use).

The shrug could be considered as a gesture family as it can be enacted through a variety of form-meaning pairings. It was originally presented as being universal and innate by Darwin (1872, chapter 11¹) based on observations in shrugging in different cultures with a focus on two little girls of 16 and 18 months old (who “have inherited the shrug from their French progenitors”) and a blind and deaf woman (“she does shrug her shoulders, turn in her elbows, and raise her eyebrows in the same manner as other people, and under the same circumstances”). Darwin makes lively descriptions of the composition of the gesture: “When a man wishes to show that he cannot do something, or prevent something being done, he often raises with a quick movement both shoulders. At the same time, if the whole gesture is completed, he bends his elbows closely inwards, raises his open hands, turning them outwards, with the fingers separated. The head is often thrown a little on one side; the eyebrows are elevated, and this causes wrinkles across the forehead. The mouth is generally opened” (1872, chapter 11). Several authors (Debras, 2017; Givens, 1977; Streeck, 2009) subsequently also presented the shrug as a multicomponent gesture that involves rotating the forearms which results in the palms turning upward into palm-up open hands but also (optionally) engaging the shoulders into raising, the head into tilting sideways, the eyebrows into raising and the mouth into a

¹ Text available online as part of *the Mead project*
https://brocku.ca/MeadProject/Darwin/Darwin_1872_11.html

mouth shrug² (Morris, 1994) (accompanied by a “trumpeting” sound in French speakers). Authors have wondered whether the use of only one versus multiple components indicates different meanings or rather a scale of intensity in the performance of the posture. The different components could be deployed in various ways according to constraints in their overlap with speech (shoulder lifts are not often held, whereas palm-ups could be held over a long stretch of speech), and to the affordances of the situation (using the shoulder lift if the hands are busy, deploying a full-blown shrug with the arms and hands as widely open as possible to attract the interlocutor’s attention with a salient posture, or a very subtle mouth shrug or head tilt to transmit doubt to a third party without disturbing the speaker). Morris (1994, p. 165) suggests that each component of the shrug conveys the same meaning (various combinations of components or the full-blown version). This specific feature of the *shrug family* could be the perfect illustration of the indexical potential of gestures and of their reduced version as they are performed in situated interactions and adapted to the affordances involved in each communicative context: “the shrug’s compositional nature makes it flexible and dynamic enough to migrate to articulators that are free and available for communication in the context of use” (Debras, 2017, p. 10).

But studies both on adult and child interaction have also endeavored to identify specific patterns of body segment/meaning pairings in order to account for the variety in the actual enactment of shrugs by the same speakers in the moment by moment flow of the interaction (Debras, 2017) or by children over the course of their communicative

² Morris (1994, p.165) describes mouth shrugs as a shrug expressed with the mouth. In this facial configuration both lip corners pulled down.

development (Beupoil-Hourdel & Debras, 2017). Components of the shrugs could be used in combination or in isolation according to interactive or situational constraints.

The various meanings of the shrug family range from concrete absence or absence of activity, to absence of knowledge, uncertainty, incapacity, inaction, obviousness and affective distance (Debras, 2017) and are often related to a semantic core. Some components seem to specialize in certain subtle meanings, other components are less determined and could be used in a larger range of meanings (see Cooperrider, Abner, & Goldin-Meadow, 2018 and Debras, 2017, for a full review).

1.2. The shrug family and form-meaning pairings in adult use

The shrug has first been classified as an “emblem” (Ekman & Friesen, 1969) or a “quotable gesture” (Kendon, 2004, p. 335), meaning that it was considered as a gesture with a stable, conventionalized meaning that could be reformulated with a specific phrase in a given culture. It has been described as an “interactive gesture” (Bavelas, Chovil, Lawrie, & Wade, 1992) a “densely communicative human behaviour” (Givens, 1977), and has been categorized as “speech-handling” (Streeck, 2009), “pragmatic” (Kendon, 2004) and later as a “recurrent gesture” (Ladewig, 2014).

Use of shrugs is pervasive in adult interaction. They are presented as having a variety of meanings derived from a semantic core which remains quite hard to pin down despite several extensive studies. As such the shrug can be described as a polyfunctional gesture form (Harrison & Larrivé, 2016) with functions that share semantic features. The literature describes a network of meanings and a variety of forms and either focuses on Palm Up Open Hand gestures centered around the hands but that could also move all the way to the forearms and arms (Cooperrider et al., 2018; Kendon, 2004; Müller, 2004), or

on gestures more focused on shoulder lifts but that can spread down to the arms, forearms and hands (Debras, 2017). The latter category is mostly used to convey a set of epistemic meanings (Beupoil-Hourdel 2015; Beupoil-Hourdel & Debras 2017; Debras, 2017). After Boutet (2010), we will use the verb “propagate” to refer to the movement of the energy that flows from one segment of the body to the next.

The specific gesture or sub-group of gestures called the “palm-up” is closely linked to shrugs when it has stance-taking value (epistemic or affective). Clusters of meanings for the palm-up (or PUOH Palm Up Open Hand) as described in various papers seem to be very similar from culture to culture which invites the analyst to discern a motivated relationship between meanings (Cooperrider et al., 2018).

Kendon (2004) distinguishes meanings of palm-ups used by British and Italian speakers in terms of motion pattern. The palm lateral is described as rotating the forearms so that the palms face upward and moving the hands apart. In the palm presentational, the upturned palm(s) are moved towards the listener. These two categories thus differ in form and express different kinds of meanings but are considered as variants.

For Kendon, Palm Lateral (PL) gestures are produced when the speakers express their unwillingness or inability to intervene, ask a rhetorical question, convey an invitation to the interlocutor or what is obvious. Calbris (1990) also documents how Palm Lateral gestures in French communicate what is obvious. Those variants are presented by Kendon (2004) as associated with “non-intervention” and he mentions their affinity with shoulder shrugs.

Müller (2004) and Streeck (2009) embrace those variants together in German speakers and link them to a semantic theme. Müller’s study presents observations on palm-ups in several languages and adds an analysis of their use by Spanish speakers. She

describes this family as fundamentally grounded in the practical actions of object transfer and her analyses are based on metaphoric processes. All the variants of the gesture are associated with a single motivation. Palm Up Open Hand gestures render the objects of discourse comparable to physical objects of our everyday life and could be transferred in the same way. Streeck's study (2009) follows the same lines but he notes the affinities between Palm Up Open Hand and shoulder shrugs and makes fine analyses of how those gestures function interactively. Cooperrider et al. (2018) give an account of both Kendon's and Müller's perspectives and take up the splitting strategy introduced by Kendon. They focus on what they call the "epistemic palm-up", which is part of the family of gestures we call shrugs and analyze in the present developmental study. This family of gestures has achieved a high degree of conventionality in English but also in French as attested by Calbris (1990). The conventionalization process is also marked by its presence in the lists of emoji and GIFS (Cooperrider et al., 2018). It could be associated with its incorporation in certain sign languages as modals and interrogatives (Blondel, Boutet, Beaupoil-Hourdel, & Morgenstern, 2017; Haviland, 2015; Wilcox, 2004) and is often produced along with shoulder shrugs. The relation between Palm Up Open Hand and shoulder shrugs could either mean that they are complementary components of a highly composite gesture (Debras, 2017) or that they are interchangeable gestural synonyms (Chu, Meyer, Foulkes, & Kita, 2013). Chu *et al.* express their concern on the possibility to distinguish between the two types of Palm Up Open Hand gestures based on form and reconsider Kendon's (2004) distinction related to motion as palm-up presentational gestures do not always move laterally, according to their observations. In Gawne's study (2018) on the uses of the epistemic palm-up across India and Nepal with hypothetical, interrogative or uncertainty meanings, large variations in gesture form

(involving one or two hands, curling-in of several fingers, presence or absence of hold) are reported but no variation in motion.

A large number of other studies make comments on the use of palm-ups and shoulder shrugs in various cultures in repertoires of co-speech gestures, in sign languages and home-signing (see Cooperrider et al., 2018 for a review), but there are very few systematic cross-cultural quantitative analyses or detailed formal descriptions that would enable us to capture specific form-function variants.

Some studies focus on specific components of what we call the shrug. The shoulder lift is generally described as contributing to indicate a speaker's distance or disengagement among British adult speakers (Debras, 2013), a speaker or signer's ignorance or uncertainty (Tennant & Gluszak Brown, 1998: 180 for ASL signers), non-intervention (Kendon, 2004: 275), or non-assertiveness (Givens, 1977). Morris (1994) focuses on the facial shrug and calls it a disclaimer. The literature also indicates associations between components and specific meanings. The palm-up flip can function as a stance marker in spoken American English as well as in American Sign Language (Shaw, 2013). The head tilt, usually in combination with raised eyebrows expresses conditionals in both ASL and BSL (Sutton-Spence & Woll, 1999; Valli & Lucas, 2000). In spoken French, head tilts indicate perspective shifts (Maury-Rouan, 2011). Debras (2013) observed that mouth shrugs are related with the expression of indetermination, the palm-up component is closely linked with actional-attitudinal shrugs expressing helplessness, while multiple components combined to form a fuller-fledged shrugging posture are connected with the expression of affect.

In Debras (2017), a more specific study applying the exploratory statistics method of correspondence analysis (Glynn, 2014), using the software R as a way of identifying

form-meaning patterns in shrugging variants is presented. The formal variant of the shrug performed with the face only is highly related with the expression of epistemic indetermination. The use of forearm(s) supine visually perceived as palm-up shrugs patterns with the expression of dynamic modality (i.e., inability, inaction). A fuller realization of the enactment (lateral head tilt + shoulder lift + forearm(s) supine) tends to pattern with the expression of affect, i.e., expressions of indifference or rejection.

A network of related meanings is therefore reported in several languages and cultures. There seem to be conceptual links between them and a core meaning (Jurafsky, 1996) that could be attributed to the family as a whole as proposed by authors focusing on adult language (Debras, 2017; Cooperrider et al. 2018) as well as in child development (Beupoil-Hourdel & Debras, 2017). Those studies thus lead the way for our own focus on developmental trends according to children's motor, cognitive and linguistic skills in form-meaning pairings within the shrug family.

1.3. The shrug family and form-meaning pairings in child use

A number of recent studies have shown that shrugs are commonly produced by children using French, English and French Sign Language (Beupoil-Hourdel & Debras, 2017; Blondel et al., 2017) starting in their early second year of life.

Findings by Beupoil-Hourdel (2015), Beupoil-Hourdel & Debras (2017) and Blondel et al. (2017) in longitudinal data, show that concrete absence (of an object, a person or an activity) precedes absence of knowledge in French, English and French sign language. Beupoil-Hourdel & Debras (2017)'s study illustrates how certain components of the composite gesture in which they include Palm Up Open Hand and shoulder shrug as well as head tilt, are used more frequently for certain meanings. They showed that in

one British girl's data, reference to absence was more often associated with the hands – palm-up and extension of the forearm, while affective stance (“I don't care” or “too late”) with shoulder lifts, and epistemic stance with head tilts.

Graziano's study (2014) has a more developmental perspective but on older children. It focused on the emergence of Palm Up Open Hand gestures in Italian children aged 4 to 10 and highlighted a specific developmental trend. The Palm Up Open Hand are categorized as “Palm with a Lateral Movement” (epistemic meanings) and “Palm Presentation” (presentational meaning). Graziano found that Palm Up Open Hand lateral were present with “crystallized expressions” such as “I don't know” from the beginning of her data as they are highly standardized and very frequent in conversation. Children could learn this gesture from adults who use it sometimes even as a substitute for speech. Palm presentations were not used by children until later ages and beginning around 6. Those gestures are less likely to be used by adults without speech, especially when addressing children. The older children used both categories similarly to adults. Graziano connects the later use of the presentational gesture to the child's socio-cognitive development and meta-discursive competence: the capacity for planning, structuring, controlling one's discourse.

Previous studies on shrugs and Palm Up Open Hand have thus highlighted a variety of uses of those gestures but they have not analyzed the developmental path of the various forms and functions in very young children. In this paper we focus on how form/function pairings evolve in longitudinal data and whether there are variations between children speaking two different languages. This study is centered on identifying stable form-meaning pairings of the components of the shrug, used alone or in combination. We extend the method based on Multiple Correspondence analyses used in

Beaupoil-Hourdel & Debras (2017) and deploy it over time. We thus uncover a developmental pattern according to the children's age and native language in two longitudinal datasets of child-adult interactions during the children's first four years. We combine this quantitative analysis to detailed qualitative analyses to highlight the subtle interweaving of semiotic resources children deploy interactively with their care-takers.

2. Approach, Data and Method

2.2. Approach

Our research in child language acquisition is characterized by our attempt to capture how children become competent interlocutors as they learn to deploy the various semiotic resources at their disposal in relevant ways by co-adapting to their conversational partners in various situations and environments. Children's use of speech and gesture differs from adults and dynamically changes over time. We thus study children's multimodal communicative expression in longitudinal data with an ethnographic approach in line with Kendon's call for studies of use in context inspired by Efron (1941/1972) and Wundt (1921/1973). We take into account how children's communicative profiles are shaped by their local environment (family home) and their micro-cultural norms. Through children's everyday interactions in their ecological circumstances, our aim is to understand both how language is "experienced" (Ochs, 2012) and how experience is "language" in situated activities, with a multimodal approach to what we call language which includes verbal content and its prosody, facial expressions, posture, gesture as well as gaze (Morgenstern, 2014) according to a dynamic deployment of the "scope of relevant behaviors" (Cienki, 2012) in relation to multiple factors such as

age, context, affordances of the situation or interlocutors. When we analyze children's gestures in interaction, we seek to understand what the modality of gesture affords its child users as a means of communication among the other semiotic resources at their disposal and as their motor, cognitive and social skills evolve in time. For this study, we endeavored to base our coding on the formal components of the shrug family identified in the literature with the following overarching research question in mind: Can we identify stable form-meaning pairings of composite recurrent gestures within and/or across speakers, situations and languages? Do those form-meaning pairings evolve over the child's cognitive, motor and linguistic development? Are those pairings different in speakers of different languages?

In order to answer those questions, we follow some of the assumptions of the ToGoG form-based approach (Müller, Bressemer & Ladewig, 2013) in which a close analysis of the form of the movement gives us a starting point for our analysis of gestures' meaning. We adhere to the idea that articulatory effort displayed in gestures is communicative and that gestures are "movement excursions" (Kendon, 2004), that they may take on some of the linguistic functions of vocal units or complement them and become part of the syntactic structure of the multimodal utterance (Ladewig, 2012; Cienki, 2016), which is perfectly in line with our perspective on children's multimodal development (Morgenstern, 2014). In order to describe and analyze the gestural component of multimodal constructions, we need a "form-based" approach to gesture in which principles govern gestures' potential for "languaging" (Linell, 2009) and according to which formal differences will be pertinent for meaning variations. Boutet's (2008, 2010) allocentric formal and kinesiological approach to gesture integrates gesture in language and accounts for the structuring role of the body in language practices. The

materiality of the body has the potential to mold our environment, our tools, our objects, the spaces we inhabit (Leroi-Gourhan, 1993). For Boutet, the structuration of those artefacts is tightly associated to praxic gestuality which are in continuity with symbolic gestures. Referents are not considered as being mainly associated to gestures through the human ability to build analogies, but their meaning is directly shaped by gesture and its dynamics. Gesture units are described on the basis of their formal characteristics and physiological constraints rather than on imagistic iconicity. Because the articulators used to perform gestures are much more visible and thus accessible than those used to produce sound (only the acoustic effects of sound are perceivable outside accentuated lip movements), Boutet (2010) has proposed to adopt a bottom-up approach based on both our perception and our knowledge of physiological processes. Gesture is analyzed as movement that flows from one body part (a segment) to the next. The trunk of the body is used to construct the reference of the various body parts as either proximal (closest to the trunk), or distal (furthest to the trunk). The distal or proximal nature of segments in motion permeates gestures with meaning rooted in experience. As far as the upper limbs are concerned, when several segments are set in motion, if the flow that links one segment to the next “propagates” (is spread) from the shoulder to the tip of the fingers, the flow is called “proximal-distal”, if the flow “propagates” from the hands to the shoulder, it is called “distal-proximal”. However, if the movement is only located in one body part (the hand, the shoulder, the head...), then there will be no apparent flow. The nature of the flow structures the meaning of the gesture. In this paper, we will not dive into quantitative analyses of the flow, but we will focus on the importance of which segments are in motion during the performance of the shrugs we have annotated in the data and whether specific segments are linked to specific meanings. By analyzing children’s shrugs throughout their

development in time (in our longitudinal data), we can retrieve their formational features, observe processes of segmentation of gestural movements and their meaning as well as processes of schematization that link the variants of the shrug “family”. The gestures we analyze in our data are very often used along with speech and contribute to confirm that language is inherently multimodal and that it develops in children via multimodal constructions.

2.2. Data

Our data is part of the *Paris corpus* (Morgenstern & Parris, 2012) and consists of two longitudinal datasets, of a French girl, Madeleine, and a British girl, Ellie, in interaction with the adults around them in their family home (most often the mother). They are both raised by upper middle-class working parents with academic training. They were video recorded from one to four years old every month for one hour.

The two little girls’ language development was analyzed in a number of studies, especially negation (Beupoil-Hourdel, 2015; Beupoil-Hourdel, Morgenstern, & Boutet, 2015; Morgenstern et al., 2018) but Madeleine was also focused on for a large variety of topics in language development synthesized in Morgenstern & Parris (2017) including pointing (Morgenstern, 2014; Morgenstern et al., 2016). Their speech develops smoothly and rapidly but they each engage in different multimodal pathways during their everyday interactions (Morgenstern et al., 2018).

2.3. Method

This type of longitudinal interactive data, our own involvement in the data collection and analysis for the past decade and our familiarity with the participants and

the situations allow us to annotate the various kinesic features of the gestures identified by their meaning based on context and speech in addition to form.

Our method for this paper involves a very precise identification and annotation of all occurrences of shrugs, their components and their function in context. The coding was done in EXCEL with some qualitative analyses in ELAN to study the use of gestures and their coordination with speech. We also used PRAAT to account for the synchrony between gestures and prosody and to conduct qualitative analyses on a selection of extracts. As mentioned previously, the shrug can originate in various segments of the body, it can migrate from one body articulator to the next, it can be performed with a single segment or can be deployed in time and propagate over several segments. We adopted a bottom-up, form-based approach (Müller et al., 2013) to identify and interpret shrugs and their components in context in the videotaped longitudinal data. We followed Boutet (2010)'s hypothesis that the formal complexity of a gesture could be spatially organized in a hierarchy of components, consistent with the relative anatomic position of the articulators mobilized. We systematically annotated all occurrences of at least one shrug component. The data was coded by the first author and regularly discussed with the second author in the framework of a PhD dissertation (Beupoil-Hourdel, 2015). The adults surrounding the two little girls used shrugs in a variety of contexts throughout the data. The segments we coded for each shrug in the data were: Palm-up with one or two hands with a supination movement and more or less extended fingers; whether there was a shoulder lift, a head tilt, raised eyebrows and a mouth shrug. All the components were not necessarily present as sometimes the participants did a palm-up with a supine hand gesture on both hands but did not produce a shoulder lift or a head tilt for instance.

All the occurrences of the children's and adults' shrugs were coded in the two datasets indicating their formal components as well as their function in the multimodal ongoing discourse. After describing the form of the gesture, its function was labeled taking into consideration the context of interaction, the immediate previous utterance and the feedback and recast provided by the co-speaker.

The functions were coded in the context of the multimodal utterances. They were labeled after Debras (2017) and presented in Beaupoil-Hourdel & Debras, 2017: 1) absence (either absence of the object or of the activity which both involve a change of state of the child's environment that could be glossed by "gone" or "done"), 2) affective (indifference, rejection, powerlessness, inaction, obviousness) and 3) epistemic (speaker's level of uncertainty). The categories are mutually exclusive but even with the context of production, some forms remained difficult to categorize. The data was blind coded by two coders and every issue raised by each coder was solved collectively.

We coded a total amount of 331 shrugs in the children's productions (233 for Madeleine and 98 for Ellie). We adopt a developmental perspective, but the number of shrugs produced by the child in each session is too scarce to make relevant monthly quantitative analyses. In order to capture developmental trends and form-meaning pairings on enough occurrences, we separated the longitudinal data into three periods according to the two little girls' proficiency with gestures. The three periods for each child are coherent with their multimodal developmental pathways into language (Beaupoil-Hourdel, 2015, p.190-193; Blondel et al. 2017, p. 165). The three periods correspond to qualitative changes in the use of the two little girls' communicative system (see table 1). The first period begins when both Ellie and Madeleine produce their first shrug in the data. Ellie uses representational and recurrent gestures early in the data

(Beupoil-Hourdel, 2015) whereas Madeleine is verbally precocious. During period 1, Ellie predominantly uses gestures while Madeleine is already primarily verbal. However, both the little girls' gestures are often produced in isolation and are “syncretic” (this feature refers to their holistic, gestalt nature, and to children’s general expression of an array of forms and functions). During period 2, Madeleine’s speech becomes more complex and she starts using a larger range of gestures with more formal variants but few occurrences. Ellie’s speech development is quite impressive, and her use of gestures stabilizes. During period 3, both little girls combine speech and gesture in more complex multimodal constructions. All their gestures develop into co-speech gestures (Beupoil-Hourdel, 2015, p. 191-192).

	Madeleine			Ellie		
	Ages	Number of shrugs ³	Duration of the recordings analyzed	Ages	Number of shrugs	Duration of the recordings analyzed
Period 1	1;10-2;05	37	7 hours	1;04-1;11	34	8 hours
Period 2	2;06-2;10	59	5 hours	2;00-2;07	13	8 hours
Period 3	2;11-4;02	137	7 hours	2;08-4;02	51	13 hours

Table 1: Developmental periods in Madeleine and Ellie’s data

The statistical method to capture the form-meaning pairings was applied and tested in Beupoil-Hourdel (2015), Debras (2017) as well as Beupoil-Hourdel & Debras (2017). We used the same exploratory statistics method of multiple correspondence analysis (Glynn, 2014) and multifactorial statistics (Desagulier, 2017), with the software R as a way of identifying form-meaning patterns in shrugging variants. Running a

³ The number of occurrences depends on the context of production. The use of natural and spontaneous data cannot ensure that a fixed number of shrugs will be produced every month by Ellie and Madeleine. This is the reason why the number of occurrences changes from one child to the other and from one period to the next.

multiple correspondence analysis (MCA) in R with the FactoMineR library (Lê, Josse, & Husson, 2008) provided us with a spatial representation of statistical form/function patterns and correlations in the data. Glynn (2014, 443) explains that Multiple Correspondence Analysis is used to “identify patterns of association and dissociation” in complex categorical data. It “is an exploratory tool that helps one find which usage-features co-occur with other usage-features, giving a map of their overall patterning. Assuming that one is adopting a cognitive or functional approach to language, these usage-patterns can be interpreted as grammatical description, operationalised in terms of relative frequency” (Glynn, 2014, 444). In our data, this technique presents the association and dissociation between the shrug components and the functions they express.⁴

We present the results for each child for each period and illustrate our findings with qualitative analyses of specific video extracts using both the transcriptions and the video data. Video extracts used in the present article are available online in a non-profit scientific data archive that provides perpetual URLs.⁵ The format of the transcriptions adapts standard conventions from Conversation Analysis to enrich the material with pictures from the data and the software we use for annotation. Our enriched transcription format aims at providing a dynamic multimodal view of the data in a similar overall perspective as the transcription system initially developed by Jefferson (Sacks, Schlegloff & Jefferson, 1974, p. 731-733) enriched later by Goodwin (2017, p.17-20).

⁴ See Glynn (2014) for a step-by-step explanation of how to use correspondence analysis for exploratory research of complex categorical data.

⁵ All video extracts analyzed in this article can be viewed online by clicking on the following link <https://www.ortolang.fr/market/corpora/shrug/?path=%2F>

3. Quantitative and qualitative analyses

3.1. Ellie's use of shrugs

Ellie is an English-speaking girl whose communicative system develops through the use of body actions and more and more symbolic gestures. When her spoken productions become more fluent, her productions combine visual and vocal modalities (Beupoil-Hourdel et al., 2015). Ninety-eight shrugs were coded in the child's data and twenty-five in the mother's data. For this study we focused on the child and mother's shrugs and did not code the grandmother's gesture production⁶.

As illustrated in table 2, Ellie produced her first palm-ups at age 1;04 and they were predominant during period 1. The components of the gesture were self-oriented as the child was mostly making contact with the world around her. During the second period, shoulder lifts appeared at 2;00 and lateral head tilts at 2;03. Ellie used them extensively during period 3, once she had started producing other-oriented shrug components (see also Beupoil-Hourdel & Debras, 2017). The variety of components and combination of components increased as the child got older. Though the number of head tilts increased and was present in over 30% of her shrugs, she was far from using the 80% present in her mother's shrugs over the same period. We did not code any occurrence of a mouth shrug in Ellie's productions in the data. Her mother produced two mouth shrugs throughout the data, one occurrence was combined with a headshake and the other with a shoulder lift and a head tilt.

	Ellie			Mother		
	Period 1 [1;04-1;11]	Period 2 [2;00-2;07]	Period 3 [2;07-4;02]	Period 1 [1;04-1;11]	Period 2 [2;00-2;07]	Period 3 [2;07-4;02]
Palm-up + head tilt	0	0	1	0	0	0
Head tilt	0	4	9	0	4	16

⁶ In most videos, the grandmother is the observer holding the camera.

Shoulder lift + head tilt	0	0	7	0	1	1
Shoulder lift	2	5	23	0	0	1
Palm-up shoulder lift	1	2	0	0	0	
Palm-up	31	2	11	0	0	1
Mouth shrug	0	0	0	0	0	1
Mouth shrug + shoulder lift + head tilt	0	0	0	0	0	1

Table 2. Distribution of components of the shrug in Ellie and her mother's data

These form-based analyses over three periods, were complemented by our functional coding. Because of the complexity of associating a large range of forms and a variety of functions, we used exploratory statistics as a way of identifying correlations. We ran a multiple correspondence analysis (MCA) in R with the FactoMineR library (Lê, Josse, & Husson, 2008) for each developmental period. To do so, we created an input table in a spread sheet with two columns: one column for the components of the shrug and a second column for the function it serves in interaction. The data in the input table is treated by *R* as numerical information and is then transformed into “a graphic display in which each row and each column is represented as a point in a Euclidean space” (Desagulier, 2014, 169). *R* thus provided us with a spatial representation of statistical patterns and associations in the data, as shown in Figures 1, 3 and 5. To read a MCA map, Desagulier (2014, 169) explains that one needs to understand that the plot is built along two axes, whose intersection corresponds to the average profile of all the points in the cloud. Therefore, all the points which are close to the intersection of both axes are not strongly associated with any pattern. Patterns can be distinguished if one or several forms and functions create a cluster in a distant region in the map. The software also presents a portion of the data on only two dimensions. These dimensions correspond to the portion of the data that is visible on the map. The map is a two-dimensional representation of the multi-dimensional system of interaction between the variables; it is therefore often not

possible to get an overview of the whole data on one map (Perdoncin & Mercklé, 2014). The dimensions are selected according to their eigenvalues presented with the percentage on each axis. “The eigenvalue of a dimension measures how much information is present along the axis of that dimension” (Desagulier, 2014, 170). The first axis represents 66.67% of the inertia, and the second axis represents 33.33% of the inertia. In Figure 1, correlations between the forms and functions (red triangles) are visible when gesture tokens (blue dots) are close together and create a cluster. On the map, blue dots (i.e., gesture tokens) that are close to each other have a similar set of features. The figures are ID numbers for a particular gesture. Red triangles (i.e., features) that are close to each other tend to co-occur in gestures. Triangles and blue dots along with the ID numbers are plotted thanks to the FactomineR library in R and nothing can be deleted from the output graph.

Figure 1 presents the gesture tokens coded during period 1: for each gesture coded, its form (palm-up, shoulder lift) and function (epistemic, absence, affective) are presented. We observe that the tokens of palm-ups and shoulder lifts are located in two distinct areas on the map. This shows that the forms are distinct from one another. Palm-up form feature and absence function feature often co-occur in gestures. The plot also shows that there were not enough occurrences (blue dots) of affective and epistemic functions to observe any correlation with either palm-ups or shoulder lifts: we can only see one blue dot (number 20) near “epistemic” and only two dots near “shoulder lift” and “affective”. At this period, the average profile of the dots in the cloud consists mostly in the use of palm-ups to express absence and this is shown on the map because there is a cluster near the intersection of the axes and because the association that emerges from the input data is the use of one specific form (palm-up) to express one specific function

(absence). During this period, Ellie’s use of shrugs is limited to one form mobilized in the context of absence.

Figure 1 shows some striking correlation between palm-ups and the expression of absence. We indicated this form-function pairing by adding a red oval on the map. Indeed, during this period, Ellie systematically uses palm-ups to convey absence of an object (that could be glossed as “all gone”) or of an activity (“all done”).

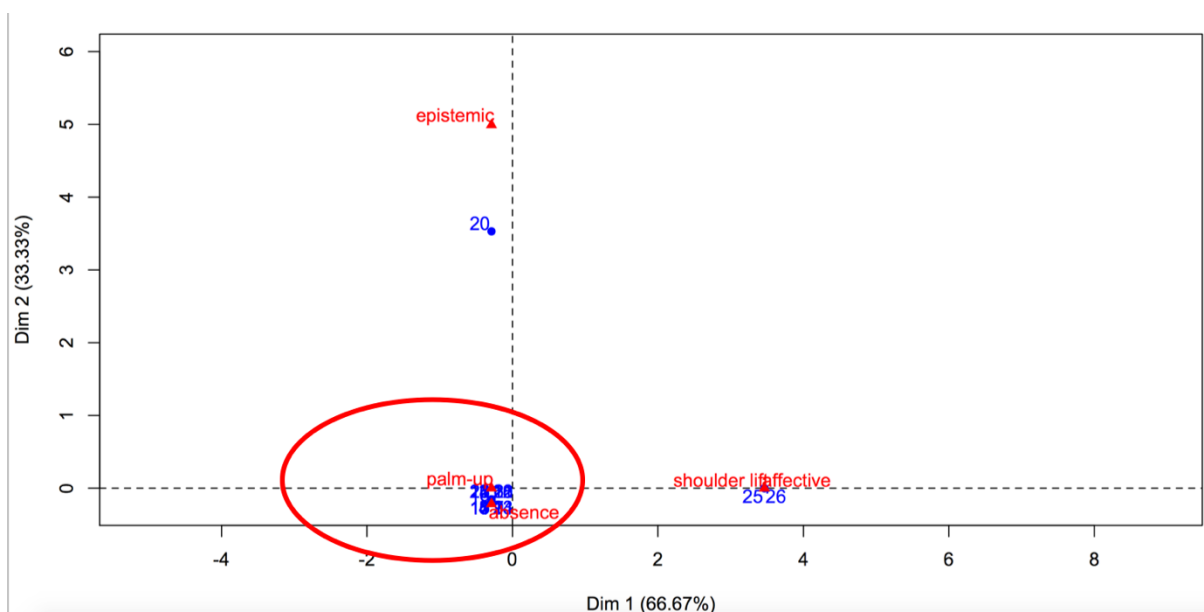


Figure 1. Multiple Correspondence Analysis (MCA) factor map showing the distribution of form and function in Ellie’s data. Period 1⁷. Blue dots represent gesture tokens and red triangles are the coded features (gesture components and functions).

Example 1 illustrates Ellie’s use of the palm-up to express what we call “absence”.

(1) Ellie 1;09 – “Elmer Gone” (Beaupoil-Hourdel, 2015, p. 318-319)

⁷ To obtain this map, we used two libraries in R: *FactoMiner* (Lê et al., 2008) and *dynGraph*.

Ellie was just offered a children's book about Elmer, the multicolored elephant.

- 1- Mother: what's Elmer Ell(ie), Ellie?⁸
- 2- Ellie: *((gives her grandmother the book))*⁹
- 3- Ellie: Elmer gone.¹⁰
Shoulder lift (Figure 2) [absence]
((looks at the book))
- 4- Grandma: Elmer gone?



Figure 2. Ellie's gesture complementing the spoken utterance "Elmer gone"

In this example, interestingly enough, Ellie's body is fully engaged in expressing absence, as if her whole being were immersed in this multimodal construction combining a recurrent gesture and a spoken production. Boutet's kinesiological approach (2008) is confirmed by this instance of emphatically performed gesture: the shrug produced by

⁸ The numbers before the speaker are used to number the turns.

⁹ In the transcription, actions are placed between double parentheses and written in italics.

¹⁰ In the transcription, speech is underlined where a shrug occurs. The gesture is then mentioned below and written in Arial Font and in bold. The function coded for the gesture is mentioned between square brackets.

Ellie in synchrony with the spoken production “Elmer gone” originates on the hands and forearms, propagates all the way to the shoulders in a distal-proximal flow. The arms go so much backwards, much more than they conventionally would in adult communication, that the gesture ends with a shoulder lift. For Boutet, palm-up and shoulder lift are not different gestures. They are linked by proprioception as they share physiological constraints which enable the movement to propagate from one segment onto the other. Those shared constraints explain why they can be used to express similar meanings in context. This example is primarily perceived as an instance of palm-up with the two hands performing a supination movement and with extended fingers. However, the forearms are rotating, and there is an extensive movement of abduction of the arms that propagates into shoulder lifts.

During period 2, as illustrated in figure 3, there are very few occurrences, however we can distinguish three areas with three clusters: the shoulder lift with affective meaning; the head tilt with epistemicity and the palm-up with absence.

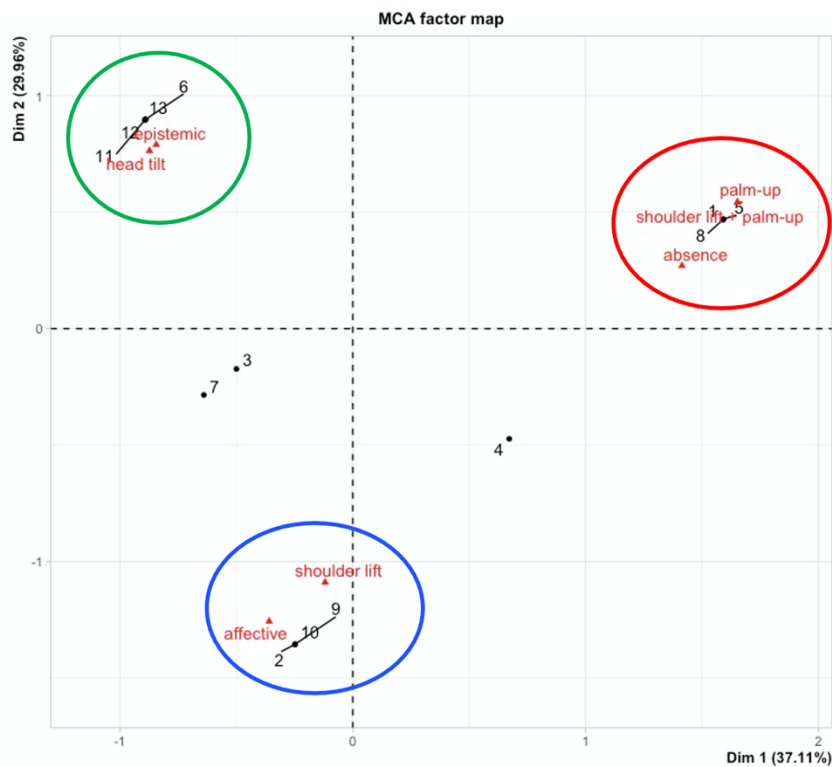


Figure 3. Multiple Correspondence Analysis (MCA) factor map showing the distribution of forms and functions in Ellie's data. Period 2

Example 2 illustrates that Ellie's gestural system may be changing. Whereas during period 1, her gestures were performed very visibly and emphatically, especially palm-up gestures (31 occurrences of palm-ups out of 34 shrugs coded, table 2) that tended to propagate all the way to the shoulders and were enacted with both hands and arms, in this extract, Ellie uses only her shoulders to refuse. In period 1, the gestures were visible and distal and most frequently involved the hands whereas in period 2, Ellie's system may be shifting towards the use of proximal gestures performed on the shoulders and head. In example 2, the gesture is less distal than in period 1 and the child dissociates the movement of her hands and the movement of the shoulders.

(2) Ellie 2;05 – “no” + shoulder lift

Ellie is playing tea parties with her grandmother. Ellie picks pink wooden pearls only and pretends they are food to eat. The grandmother holds a pink pearl in her hand, puts it back into the jar and chooses an orange one.

1- Grandmother: Is this the right color?

((Hands in an orange pearl to Ellie.))

2- Ellie: *((Looks at the pearl))*

3- Ellie: n::::::::: no! *((creaky voice))*

shoulder lift (Figure 4) [affective]

4- Mother: where’s that one going to go then Ellie?



Figure 4. shoulder lift synchronized with a long “no” performed with a creaky voice.

In (2) Ellie rejects the grandmother's offer with her body and speech. The grandmother offers an orange pearl to Ellie and in doing so, she seems to have willingly triggered a rejection, as she has noticed that the child had only picked up pink pearls. During period 1, Ellie engaged her hands in her rejections, by pushing away objects, but in this sequence, we observe that she does not touch the object and that her movements are more proximal and borne by other segments than the hands like the shoulders and head. The use of the shoulder lift both conveys rejection and disalignment in the interaction. Not using her hands to push the orange pearl away and thus not touching it, works as a strategy for the child to disregard the object, to show disengagement and to keep focused on her own project. She re-centers onto her own body and freezes her action as a way to pause and reject the offer. In this sequence, the gesture is dynamically intersubjective. Ellie's gesture is quite long (0.940 seconds) in line with her spoken utterance. She first produces the phoneme <n> without the vowel <o> /əu/ (0.810 seconds) and then she produces the vowel and ends her utterance using creaky voice (1.195 seconds). Multimodally, her rejection lasts 2.015 seconds while it is conveyed with symbolic forms only (as opposed to pushing away which would have been an action). Her use of creaky voice is also interesting as studies have shown that English speakers resort to this prosodic strategy at the end of their utterances when they try to enact distant positioning towards the content of their own utterance (D'Onofrio, Hilton, & Pratt, 2013). The authors also observed that a creaky voice enables a speaker to express negative evaluations towards another person or an event and helps the speaker disengage from the interaction. With the combination of visual and vocal elements, Ellie manages to make her rejection salient and last longer. The length of her multimodal utterance as well as the combination of visual and vocal resources enable Ellie to reject the grandmother's offer

and to indicate that it does not correspond to the project the child and the grandmother are involved in.

During period 3, the same correlations are captured with a larger number of occurrences (Figure 5).

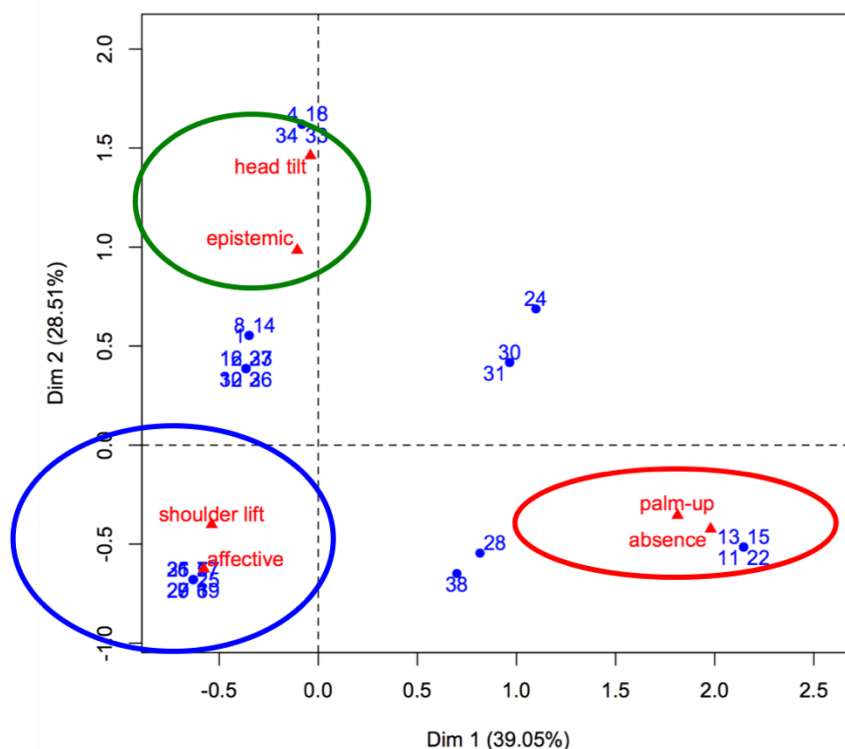


Figure 5. Multiple Correspondence Analysis (MCA) factor map showing the distribution of form and function in Ellie's data. Period 3

The next example illustrates the increase in use of shoulder lifts and head tilts performed without the engagement of the arms and hands to express Ellie's stance.

(3) ELLIE 3;03 – “light blue, dark blue and pink” head tilt + shoulder lift
(Beupoil-Hourdel, 2015, p. 319)

1- Mother: turn around. What are those?

- 2- Mother: the spotty boxes.
- 3- Mother: are they red?
- 4- Ellie: pink!
- 5- Grandma: is your favourite colour.
- 6- Ellie: pink is my favourite colour and blue.
- 7- Grandma: and blue, you like blue.
- 8- Ellie: xxx.¹¹
- 9- Grandma: I'm glad you like blue. Which blue do you like best?
- 10- Ellie: light blue.

shoulder lift and tilt (Figure 6) [affective]

11- Grandma: light blue

12- Ellie: dark blue.

Right shoulder lift (Figure 7) [affective]

13- Ellie: and ... pink

Head tilt (Figure 8) [affective]



Figure 6. shoulder lift and tilt synchronized with “light blue”

¹¹ “xxx” is a convention used when the spoken production is not understandable.



Figure 7. shoulder lift synchronized with “dark blue”



Figure 8. head tilt synchronized with “pink”

In example 3, Ellie is trying to say that BOTH pink and blue (all types of blues) are her favorite colors. Her grandmother then asks “which blue do you like best?” and might want to explore whether or not the child has a favorite blue. Ellie produces her answers with a shoulder lift and a head tilt and seems to disengage from having to make a very specific choice.

In example 4, Ellie deploys all her multimodal skills in her pretend play with her grandmother.

(4) ELLIE 3;03 – “Marmalade” shrug (Beauvoir-Hourdel, 2015, p. 386-389)

1- Grandmother: will you make me some toast and marmalade, please?

2- Ellie: I can't because I haven't got any.

head tilt (figure 9) [absence]

[...]

3- Grandmother: but what can you make me? Can you make me something toasted please?

4- Ellie: yeah. We:::::’ve got ((*pause*)) Jam!

Palm-up, shoulder lift and tilt (Figures 10a, b, c)

Raises her fist to the sky [epistemic]



Figure 9. head tilt synchronized with “got”

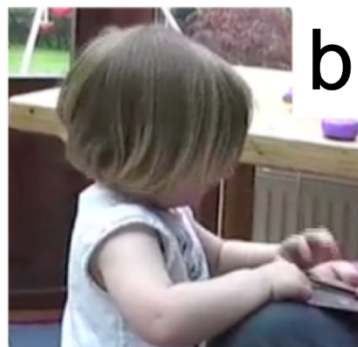
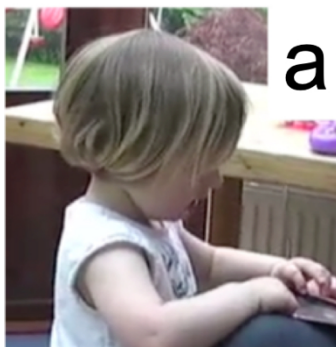


Figure 10. Ellie's gesture sequence combined with "we've got jam"

Example 4 illustrates how after 3;00 Ellie can use gesture and speech with different specialized functions. If we listen to her utterance without viewing it, we simply find out what the child and her grandmother can have on their toast (jam) and Ellie's enthusiastic prosody. If we quickly view the video without the sound, we see a head tilt, a palm-up and a lifted fist. But a closer look at her gestures, and their timing, in the spoken context as well as inside the interactive process, yields more insight about the child's thinking process and her search to find a satisfactory answer to her grand-mother's request for breakfast food. Just before she produces her multimodal utterance, Ellie seems to reflect on the issue as she tilts her head to her right side and breaks visual contact with her grandmother, she gazes at her hands and flips her wrists, positions her palms upward. She then lifts her index, smiles, looks at her grandmother and then raises her arm and fist to the sky. Her grandmother aligns with her and looks back at her. Her head tilt and the pause are not only aspects of the thinking process (McNeill, 1992), they also make it visible and audible (Goodwin, 2007, 2017). The palm-up gesture and Ellie's gaze aversion are also part of a fruitful search for the content of her message: after producing the palm-up, Ellie smiles, lifts her index as if she were signaling she is about to say something important, using the gesture as a focus marker. She then produces the last item of her multimodal turn "jam!" associated with the raised fist which ends the thinking process in a gleeful, self-congratulatory gesture (indexed by the pronoun "we" as well) as she has now presented a suitable solution to the lack of marmalade (in line with multimodal analyses of children's praise and self-praise in Aronsson & Morgenstern, 2021).

3.2. Madeleine's use of shrugs

Madeleine is a French-speaking girl who enters language through the vocal and spoken modality. Her gestural repertoire (apart from the use of pointing gestures which are quite numerous (Morgenstern, A., Blondel, M., Beaupoil-Hourdel, P., Benazzo, S., Boutet, D., Kochan, A., & Limousin, F., 2018) develops after 2;00 once her speech is sufficient enough for her to express herself verbally. There are 233 occurrences of shrugs in the data (much more than Ellie who had 98). Her use of shrugs begins later than Ellie's at the age of 1;10 with a variety of components in isolation - either the palm-up, or the shoulder lift, or the head tilt. Even though, like Ellie, she has all the components of the shrug in her repertoire, Madeleine makes a very extensive use of the head tilt as she grows older. The shoulder lift is in second position at the end of the data and she starts combining segments. Interestingly enough, her mother's shrugs are mostly performed with the head tilt just like Ellie's mother. As in Ellie's corpus, only one mouth shrug was coded in Madeleine's data (it is not included in the graph in table 3 as this category is underrepresented).

	Madeleine			Mother		
	Period 1 [1;10-2;05]	Period 2 [2;06-2;10]	Period 3 [2;11-4;02]	Period 1 [1;10-2;05]	Period 2 [2;06-2;10]	Period 3 [2;11-4;02]
Palm-up + shoulder lift + head tilt	0	0	2	0	0	0
Shoulder lift + head tilt	0	2	8	0	1	1
Palm-up + head tilt	0	0	2	0	0	0
Palm-up + shoulder lift	0	1	6	0	0	0
Head tilt	17	41	76	4	3	20
Shoulder lift	7	14	36	0	0	4
Palm-up	13	1	7	0	0	2
Mouth shrug	0	0	0	0	0	1

Mouth shrug + head tilt	0	0	1	0	0	0
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Table 3. Distribution of components of the shrug in Madeleine and her mother's data.

The multiple correspondence analysis (MCA) in R (Figure 11) indicates that during period 1 absence correlates with the use of palm-up. There are other clusters in the graph with affective stance combined with shoulder lift and epistemic stance with tilt, but they are only tendencies as the number of occurrences in the data is not high. Our analyses will allow us to capture how these two clusters evolve during periods 2 and 3.

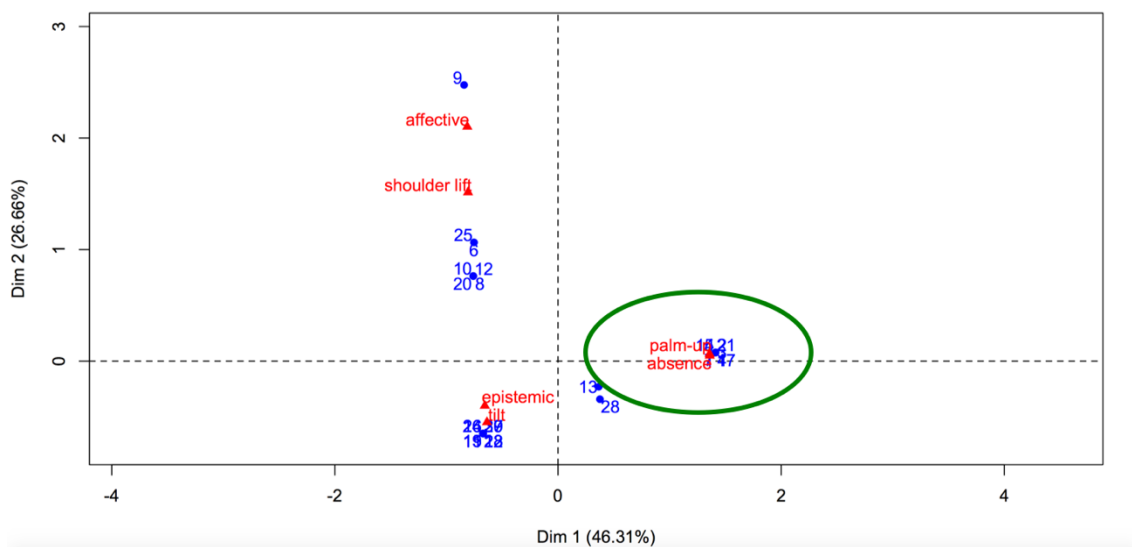


Figure 11. Multiple Correspondence Analysis (MCA) factor map showing the distribution of forms and functions in Madeleine's data. Period 1

Example 5 illustrates Madeleine's first use of a palm-up gesture mirroring her mother's multimodal production.

(5) Madeleine 1;10 – “plus aucun caneton” palm-up imitation (first palm-up in the data) (Beaupeil-Hourdel, 2015, p. 304, 306-307)

Mother and child are reading a book.

1- Mother: c'est la chenille qui s'est transformée en papillon je pense.

I think it's the caterpillar that has become a butterfly.

((turns the page))

2- Mother: mais plus aucun caneton ne rentre à la maison

But not a single duckling comes home anymore

palm-up gesture (Figure 12) [absence]

((looks at the book then at Madeleine))

3- Madeleine: *((looks at her mother's hands))*

palm-up gesture (Figure 13) [absence]

4- Mother: oh y a plus de canetons !

oh there are no more ducklings

palm-up gesture (Figure 14) [absence]

((looks at the book then at Madeleine))

5- Mother : où sont-ils donc ?

Where are they gone?

((looks at Madeleine))



Figure 12. Palm-up gesture synchronized with “plus aucun caneton”



Figure 13. Madeleine’s reproduction of her mother’s palm-up gesture



Figure 14. Palm-up gesture synchronized with “plus de canetons”

In example 5, the mother initiates a palm-up gesture in combination with her speech. The gesture is held for 4 seconds over three turns, which makes it visible. Madeleine’s gaze management is interesting as she looks more attentively and for longer periods at her mother’s open hands than at the pictures in the book. The two speakers maintain different points of attention during the whole sequence: the mother is looking for the ducklings in the picture book, but also shifts gaze to and from Madeleine to secure her attention and response, whereas Madeleine is observing her mother’s gesture. This sequence highlights how the child, who is usually much more verbal than gestural, adapts her behavior to her mother’s and thus takes up her gesture (and her gesture only) in the context in which the absence of the ducklings is emphatically expressed by her mother with both modalities, speech and gesture.

Period 2 seems to be a transitional stage in Madeleine’s data (Figure 15). The epistemic and affective functions are both very close to shoulder lifts and tilts. It is rather difficult to distinguish a preference for one particular form-function association at this stage.

We observe that absence and palm-up are far away and in separate areas on the map because there were not enough occurrences coded to determine any possible correlation.

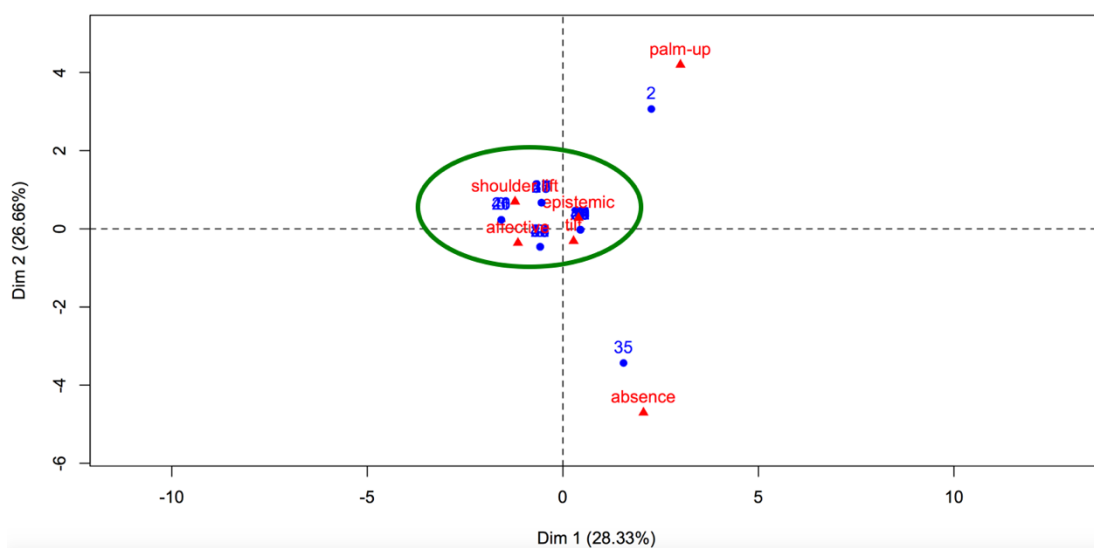


Figure 15. Multiple Correspondence Analysis (MCA) factor map showing the distribution of form and function in Madeleine’s data. Period 2

In example 6, Madeleine uses both head tilts and shoulder lifts to express epistemic stance.

(6) Madeleine 2;09 – shoulder lift + tilt

1- Madeleine: j(e) croyais c’était des aubergines ça.

I thought they were eggplants.

((She shows the observer a card with two plums.))

2- Mother: en fait c'est quoi ?

So what is it?

3- Madeleine: sais pas.

don't know

4- Mother: j(e) crois que ce sont des prunes.

I think they're plums

5- Observer: mh.

Mh

6- Madeleine: c'est des prunes.

they're plums

Palm-up (figure 16) [epistemic]

7- Madeleine: ((*activates the bell twice*))

8- Madeleine: faut pas faire beaucoup parce-que <la@fs pas> [///] sur cette carte

l@fs en a pas beaucoup l@fs en a que deux.

you must not do a lot because, here, there are not, on this card,

there are not a lot of, there are only two

(she is talking about activating the bell, which is part of the game)

head tilt (Figure 17) [affective]

9- Mother: bah oui.

well yes

((Madeleine makes a pitying sound with her mouth))

10- Madeleine: ((*mouth noise*)) elles sont toutes seules. Tous les deux.

they're all alone. The two of them.

head tilt (Figure 18) [affective]

11- Madeleine: i(l) ont pas d(e) mari !

they have no husband!

Shoulder lift (Figure 19) [affective]

12- Mother and OBS: ((*laugh*))

13- Madeleine: et pas d(e) femme.
and no wife

14- Mother: qui ça ?
who?

15- Madeleine: euh <les aube(rgines)> [/] <les aubergines> [>].
ehm, the eggplants

16- Mother: <les prunes> [<] ? ah.
the plums, oh?



Figure 16. Palm-up gesture synchronized with “c’est des prunes”



Figure 17. head tilt synchronized with “pas faire beaucoup”



Figure 18. head tilt synchronized with “elles sont toutes seules. Tous les deux”



Figure 19. shoulder lift synchronized with “i(l) ont pas d(e) mari”

Madeleine expresses epistemic stance with various vocal and visual semiotic resources: she uses speech (turn 3) “sais pas” (*don't know*), mouth noises for ignorance, shoulder lift and head tilts. The supine hand position (turn 6) does not originate from a supination of the hand to convey epistemic stance. Indeed, after showing the card to her mother, Madeleine holds it with her palm in an upward position. She then takes the card with her left hand while her right hand remains in a palm-up position. The supine position originates from the manipulation of the object in interaction and does not seem to bear any intentional epistemic stance.

In this sequence, Madeleine’s movements are more articulated than in period 1: the movements of her head (turns 8 and 10) do not trigger a movement on the shoulders. The head and the shoulders no longer constitute a block and can be articulated separately to express specific epistemic stance.

During period 3 (Figure 20), we observe three different areas that we marked in the map with yellow curves: one with absence and palm-up, one with affective and shoulder lift and one with epistemic and tilt. Absence is far from the other functions and clearly associated with palm-up gestures, but the division between the use of shoulder lift for affective and epistemic functions is not well-defined, they constitute a form-meaning cluster without clear boundaries. As compared with period 2, the affective/epistemic/shoulder lift/tilt cluster is now more marked. Madeleine uses shoulder lifts for both affective and epistemic functions.

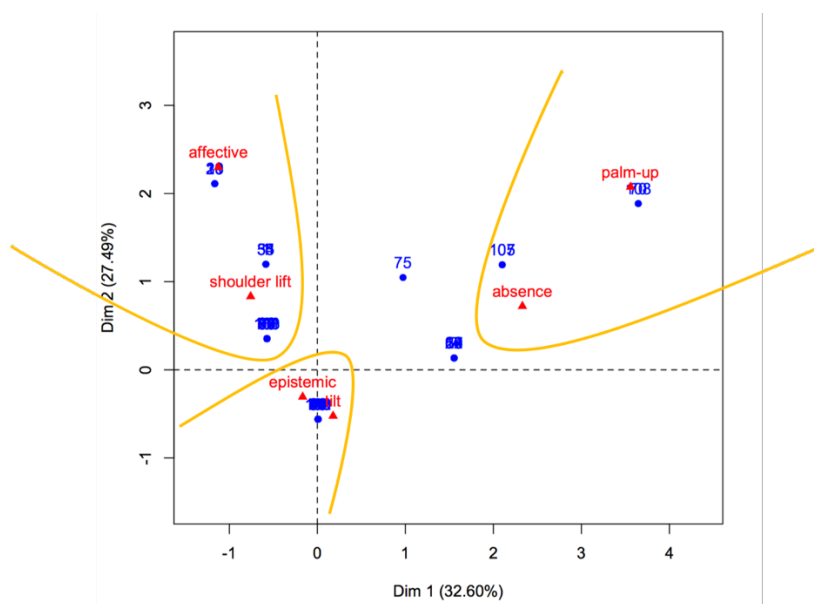


Figure 20. Multiple Correspondence Analysis (MCA) factor map showing the distribution of forms and functions in Madeleine’s data. Period 3

Example (7) illustrates Madeleine’s subtle use of the various segments composing shrugs.

(7) Madeleine, 3;00 (Morgenstern et al., 2016, p. 30-32)

1- Mother: là il nous faudrait un jaune et bleu.

we need to find a yellow and blue one

((points to a fish on the board game))

2- Mother: il est pas loin.

it's very close

((looks at the board game))

3- Madeleine: je le vois c'est celui+là *((whispers))*.

I can see it, it's this one

((points to a fish on the board game))

4- Mother: bah bah *((pause))* bah non *((smiles))*.

no

Shoulder lift, shoulder lift (Figure 21) [affective]

((smiles and looks at Madeleine))

5- Madeleine: *((points to another fish on the board game.))*

6- Mother: mais non !

No, not this one!

7- Madeleine: et lequel alors ?

So which one is it then?

Palm-up, shoulder lift (Figure 22)

[epistemic]

((looks at the board game.))

8- Mother: bah cherche !

Well, look for it

9- Madeleine: euh j(e) sais pas !

I don't know!

Palm-up, shoulder lift, head tilt (Figure 23) [epistemic-affective]



Figure 21. shoulder lifts synchronized with “bah” and “bah”



Figure 22. Palm-up and shoulder lift synchronized with “et lequel alors ?”

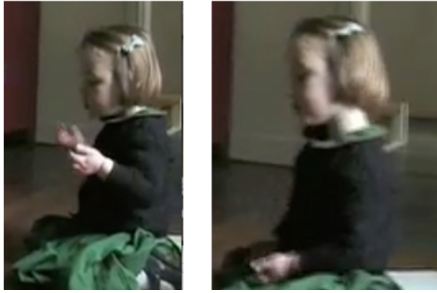


Figure 23. Palm-up and shoulder lift and then head tilt synchronized with “*euh j(e) sais pas*”

In (7) (Morgenstern et al., 2016), Madeleine and her mother are playing with a board game. The child is looking for a yellow and blue fish, but she cannot find it. She gets upset and asks “*et lequel alors?*” (“so which one is it then?”) and produces a shoulder lift and a palm-up simultaneously. The association of her rising prosodic contour and the gesture contribute to express her exasperation. As illustrated in the textgrid and spectrogram (figure 24), Madeleine starts her utterance with a pitch at 149 Hz on “*et*” (*and*) and her pitch reaches a maximum of 459Hz on the second syllable of “*lequel*” (*which one*). When Madeleine pronounces “*lequel*”, she starts gesturing and her palm-up is held during the production of “*alors*” (“*then*”). The combination of high pitch and a proximal gesture (shoulder lift) ending in a distal gesture (palm-up configuration), along with the child’s gaze set on the game and not on the mother, led us to code this utterance and the gesture as an expression of both exasperation and powerlessness rather than an actual question directed at her mother.

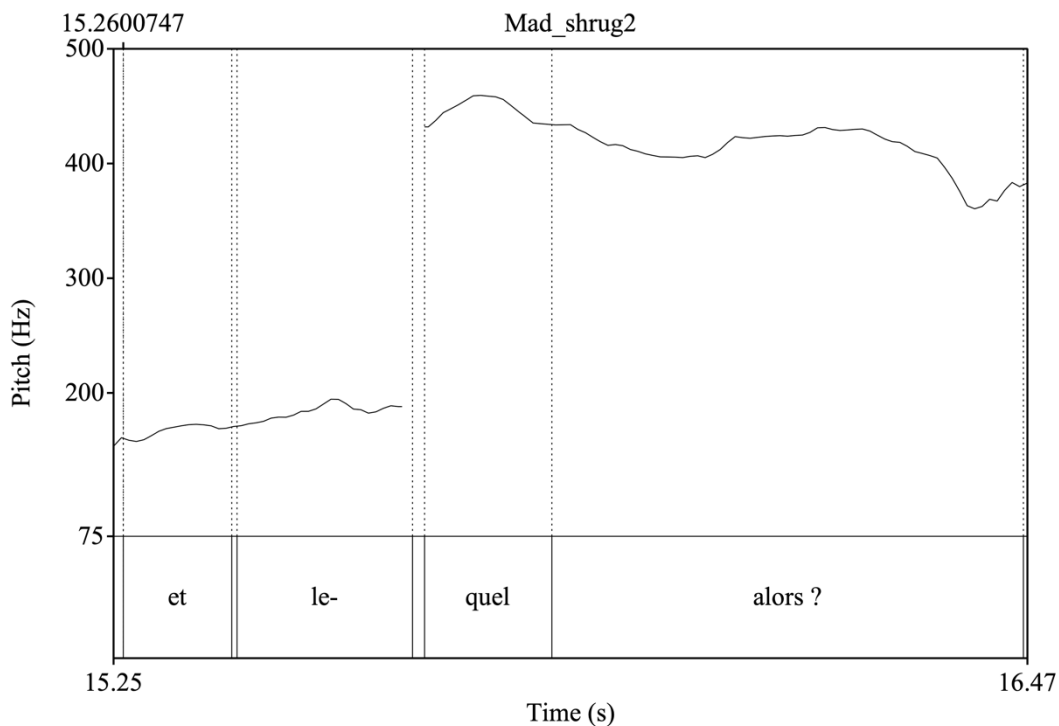


Figure 24. Text grid and spectrogram for “Et le quel alors?” (‘so which one is it then?’) extract from PRAAT.

The second instance of Madeleine’s gesture is combined with the spoken utterance “euh je sais pas !” (*I don’t know*) and is composed of three distinct forms: a palm-up on both hands, a shoulder lift and a head tilt. This composite gesture, because it is coupled with the spoken utterance ‘I don’t know’, has an epistemic meaning but unlike the previous one, it adds affective stance - powerlessness and exasperation - to the meaning of the spoken utterance. The prosody of her utterance is synchronized with the gesture phase since “moi je sais” follows a rising prosodic contour and is produced timely with the scope of the shoulder lift and “pas” follows a falling contour with the lengthening of the vowel when Madeleine’s body collapses. Interestingly, we note that the second

instance of the gesture is more emphatic than the first one and is composed of three elements. Madeleine needs to know where the fish is for the game to continue. By keeping the answer for herself, the mother is reframing her role from helper to observer and this shift in her posture has an impact on the interactional framework and the ongoing action: the game activity stops because Madeleine cannot find the right fish. The mother's posture indicates that she has a different project from Madeleine's. Her daughter's gesture forms become more visible each time she fails to find the right fish and each time the mother refuses to help her. Her speech and gestures show her exasperation and her willingness to continue playing. The shoulder lifts both convey epistemic and affective stance.

3.3. Comparison between Ellie and Madeleine

Our analyses of two longitudinal case studies of one British and one French little girl interacting with their mothers do not allow us to draw conclusions as to variations in the use of shrugs across languages, as the differences we captured between the French and British dyads could be attributed to individual differences. However, despite the use of two different languages and the differences in frequency, form and functions in the two children, there are interesting similarities when we compare our developmental results.

- During the first period, both children start by producing the palm-up when they express absence (object or action).
- During the second period, shoulder lifts are mostly used when the children express epistemic functions (which are sometimes accompanied with spoken expressions of uncertainty "I don't know").

- During the third period, head tilts are used in contexts when the children are cognitively and linguistically able to express interpersonal positioning. The two children's repertoire of forms and functions is enlarged.

The use of the various segments of the shrug seems to follow a developmental trend in terms of form and function. The two children first produce mostly distal gestures engaging their hands (palm-up) in association with the expression of observable, objective absence. Their gestures progressively propagate to more proximal segments (shoulder and head) in contexts in which they express their subjectivity and interactive positioning. Gestures also seem to be more finely controlled and timed with the use of other semiotic resources as the children's motor, cognitive and linguistic skills develop. The two children become competent communicators who initiate the performance of their gestures: they finely combine them with speech and attune with their interlocutors by adding gaze. We have analyzed how Ellie over-extends her arms at the beginning of the data and performs her ample palm-up holistically, all the way to the back (example 1) whereas she finely monitors both speech and gesture in example 3. At the end of the data, she can produce self-directed gestures in a smaller gesturing space, during her thinking process or fill the interactive space with large *glee gestures* (Aronsson & Morgenstern, 2021) directed at her interlocutor. Madeleine's first palm-up in the data is taken up from a gesture her mother produces, whereas at the end of the data, she creatively and dynamically uses the full range of semiotic resources at her disposal to combine speech (lowering its intensity when needed, or increasing when exasperated) and gesture (using each segment of shrugging expertly synchronized with speech) to express powerlessness. Those apparent trends need to be analyzed with more examples and to be confirmed with a larger number of children. Comparisons with adult cross-linguistic uses of the shrug

would also be useful as we did not capture enough occurrences of the mothers' shrugs in our video-recorded data to use statistical analyses of their form-function correlations.

Conclusion

Our general objective is to retrace children's pathways into multimodal language acquisition in a scaffolding interactional environment. We study how children's first syncretic, holistic, multimodal buds blossom into more complex constructions, and how they bloom into full multimodal intricate productions containing positioning, displacement and argumentation. Those productions include an increasingly larger range of recurrent gestures (Beupoil-Hourdel, 2015) as children grow older and have the motor, cognitive, intersubjective and linguistic skills to use the gestural repertoire of the linguistic community that surrounds them.

The composite nature of the shrug is an excellent basis for a developmental study of forms and functions (Beupoil-Hourdel & Debras, 2017). We have shown that there is a clear specialization of certain articulators with certain functions across both datasets over the three stages we have delimited.

A family of meanings is thus dynamically paired with a family of forms. Thanks to our MCA analyses, we found certain correlations between a segment, for example the palm-up, and a meaning, for example absence and another form, the shoulder lift, with lack of knowledge. As children's motor abilities develop, they gain dexterity over the use of each segment and they will be able to exploit the full potential of their bodies to express their affects, thoughts or knowledge. With a combination of quantitative and qualitative analyses grounded in Boutet's kinesiological approach (2010), we have shown how

Madeleine and Ellie both use distal gestures with palm-ups before they become more expert at using shoulder lifts and head tilts with more intersubjective functions. We still need to enrich our method and annotations in order to capture all the complexity of how children's bodies structure semiotic expressions as they grow older, but we have illustrated how developmental trends can be tracked in child-adult interactions. The quantitative results were combined to more extensive qualitative analyses that indicate how children finely and dynamically adjust the semiotic resources they employ to the affordances of the situation. Our qualitative observations need to be operationalized into finer annotations of the data and to be confirmed on a larger number of children as well as in a variety of cultures and languages.

We are constantly amazed by infants' interactive skills and the speed with which children become multimodal speakers attuned to others. Analyzing their first steps into language can only increase our appreciation of how crucial interactions with adults and older siblings are in the development of their multimodal cooperative language skills. Through constant exposure to adult input in interaction, children's language gradually develops into rich linguistic constructions containing multiple cross-modal elements subtly used together for communicative functions.

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Figures:

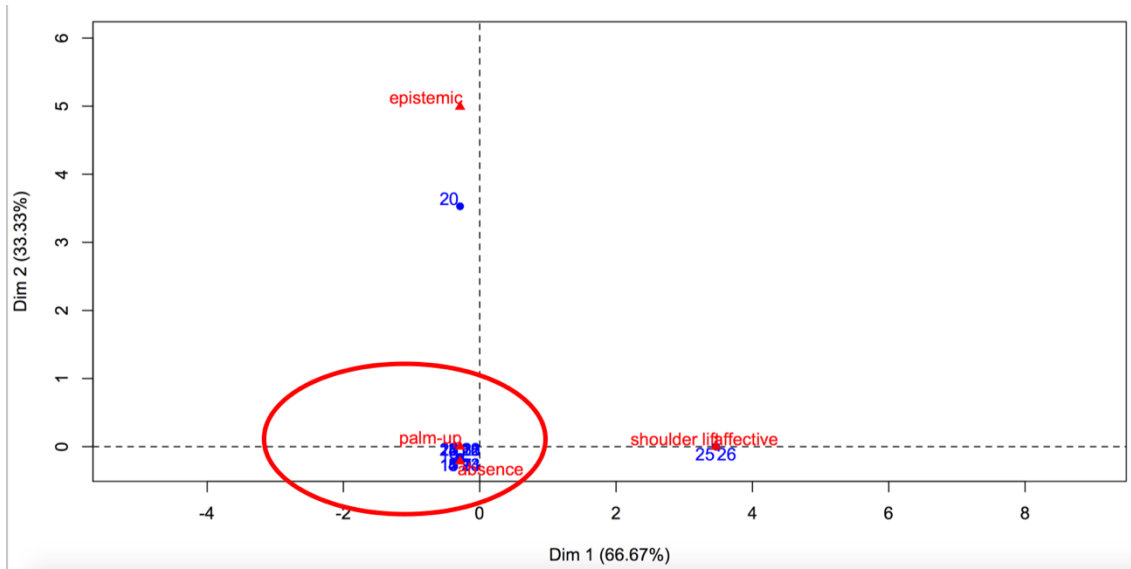


Figure 1. Multiple Correspondence Analysis (MCA) factor map showing the distribution of form and function in Ellie's data. Period 1



Figure 2. Ellie's gesture complementing the spoken utterance "Elmer gone"

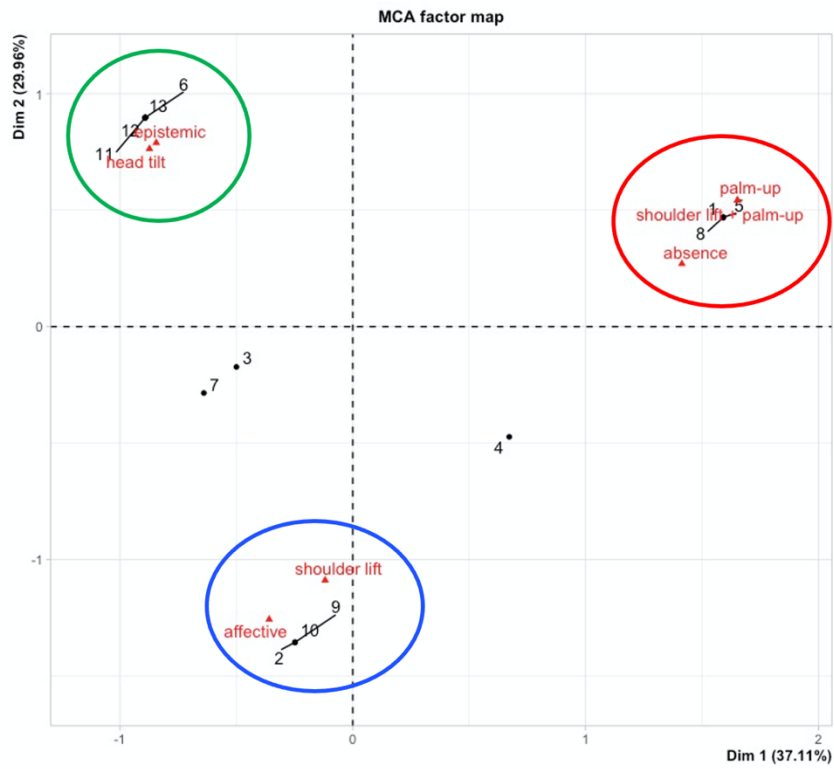


Figure 3. Multiple Correspondence Analysis (MCA) factor map showing the distribution of forms and functions in Ellie's data. Period 2



Figure 4. shoulder lift synchronized with a long “no” performed with a creaky voice.

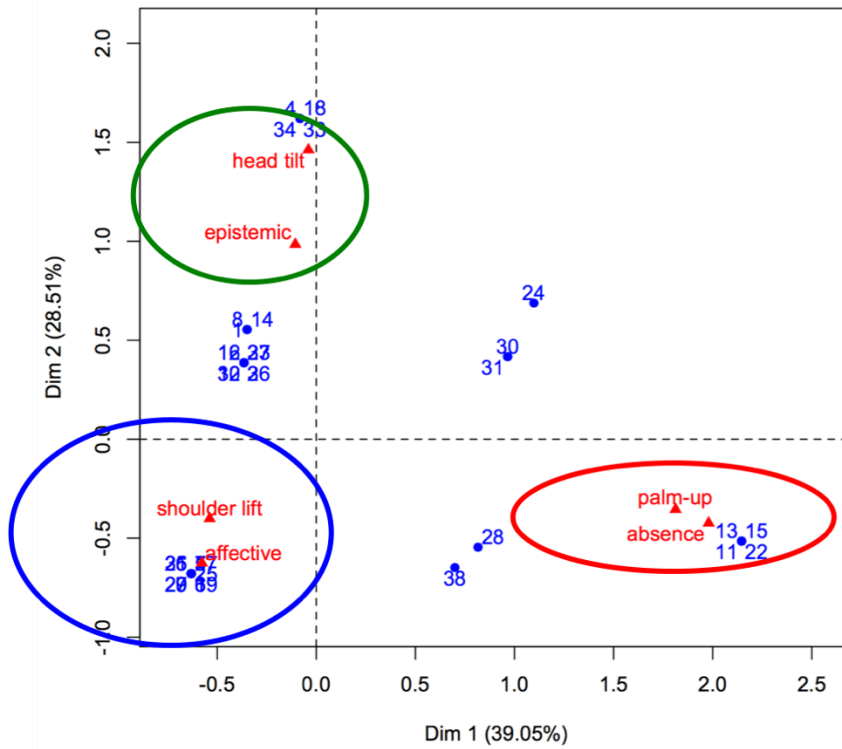


Figure 5. Multiple Correspondence Analysis (MCA) factor map showing the distribution of form and function in Ellie's data. Period 3



Figure 6. Shoulder lift and tilt synchronized with “light blue”



Figure 7. shoulder lift synchronized with “dark blue”



Figure 8. head tilt synchronized with “pink”



Figure 9. head tilt synchronized with “got”

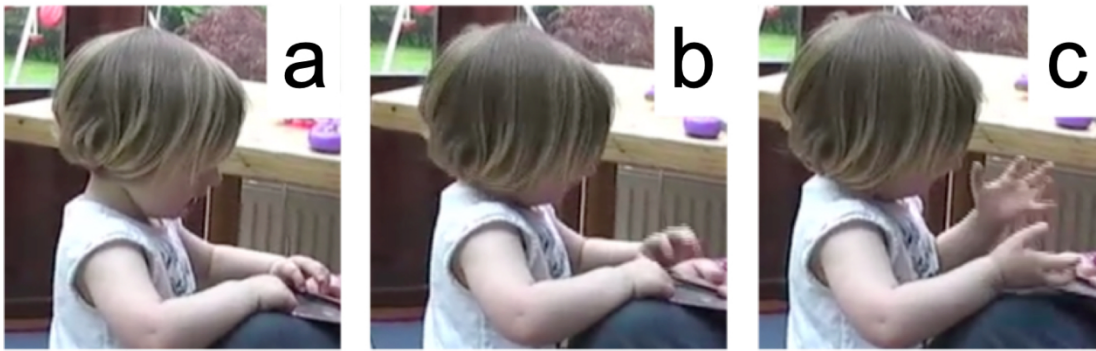


Figure 10. Ellie’s gesture sequence combined with “we’ve got jam”

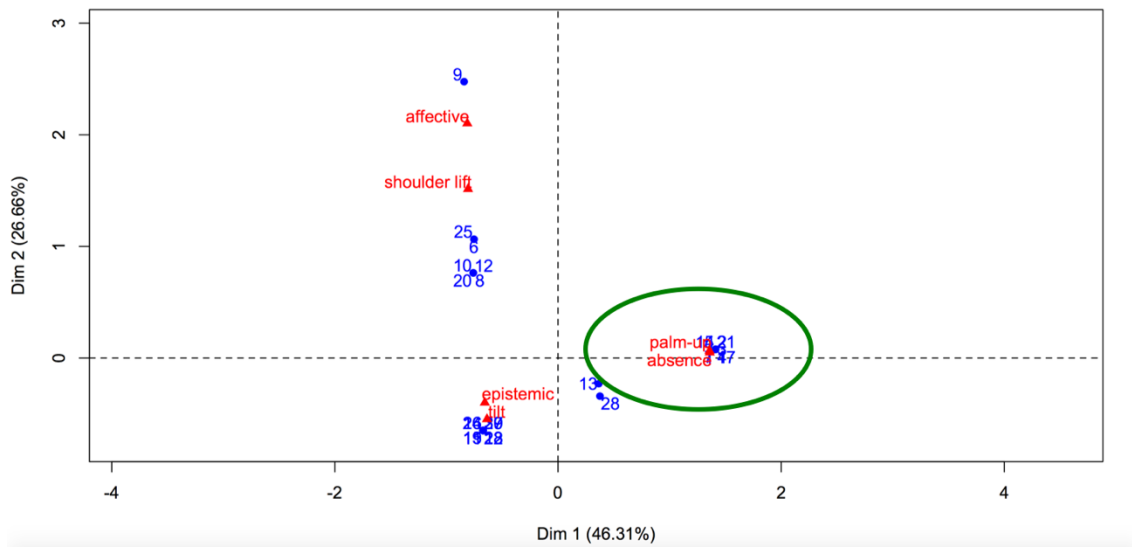


Figure 11. Multiple Correspondence Analysis (MCA) factor map showing the distribution of forms and functions in Madeleine's data. Period 1



Figure 12. Palm-up gesture synchronized with "plus aucun caneton"



Figure 13. Madeleine's reproduction of her mother's palm-up gesture



Figure 14. Palm-up gestures synchronized with “plus de canetons”

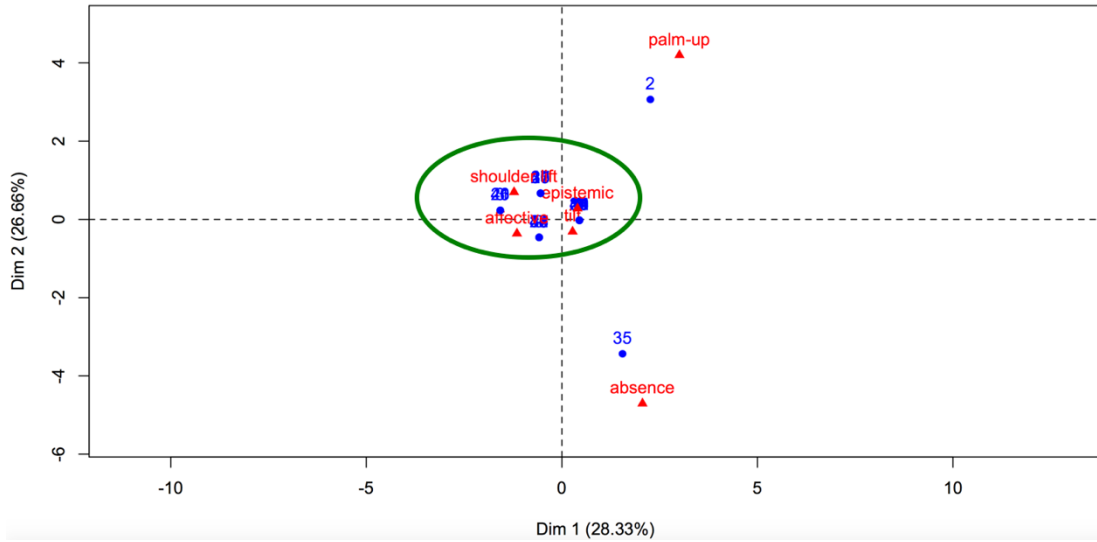


Figure 15. Multiple Correspondence Analysis (MCA) factor map showing the distribution of form and function in Madeleine's data. Period 2



Figure 16. Palm-up gesture synchronized with “c'est des prunes”

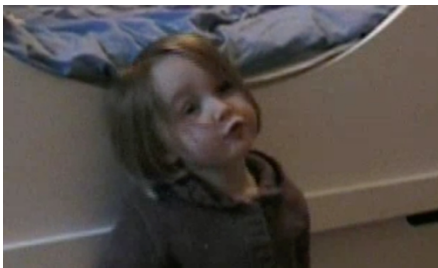


Figure 17. head tilt synchronized with “pas faire beaucoup”



Figure 18. head tilt synchronized with “elles sont toutes seules. Tous les deux”



Figure 19. shoulder lift synchronized with “i(l) ont pas d(e) mari”

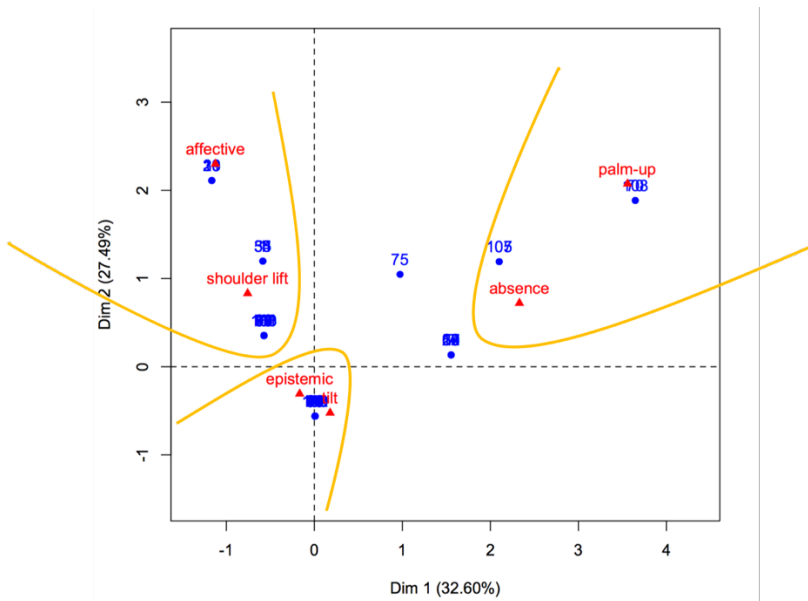


Figure 20. Multiple Correspondence Analysis (MCA) factor map showing the distribution of forms and functions in Madeleine's data. Period 3



Figure 21. shoulder lifts synchronized with “bah” and “bah”

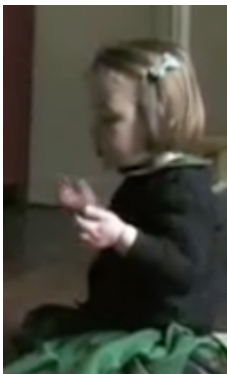


Figure 22. Palm-up and shoulder lift synchronized with “et lequel alors ?”

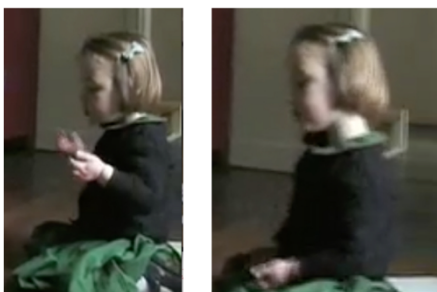


Figure 23. Palm-up and shoulder lift and then head tilt synchronized with “euh j(e) sais pas”

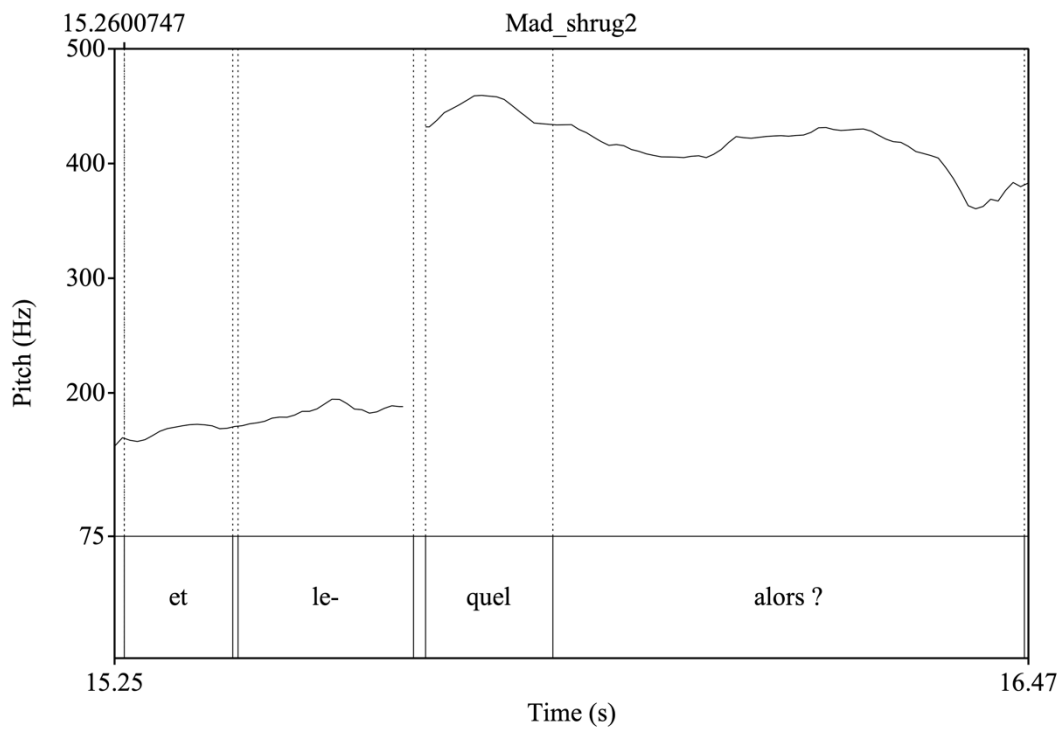


Figure 24. Text grid and spectrogram for “Et le quel alors?” (“so which one is it then?”)