Laughter in the cradle: A taxonomy of infant laughables

Yingqin Hu[1,2], Capucine Brillet[1], Bosko Rajkovic[4], Gauhar Rustamova[1], Chiara Mazzocconi[3], Catherine Pelachaud[2], Jonathan Ginzburg[1],

[1] CNRS, Université Paris-Cité, Laboratoire Linguistique Formelle (LLF)
[2] Sorbonne Université, Institut des Systèmes Intelligents et de Robotiques (ISIR)
[3] Aix-Marseille Université, Institute of Language, Communication and the Brain (ILCB)
[4] Independent Scholar

Abstract

This paper proposes a taxonomy for the laughables (events giving rise to laughter) of the child in their first year of life. We hypothesize that a child's laughables (within the first year) may relate to the following factors: sensory stimulation, cognitive challenges, and social interaction. We use Piaget's theory as a starting point for explicating the cognitive basis of the laughables, taking into account much subsequent literature. To test our hypothesis, we ran two longitudinal corpus studies using the Rollins Corpus and the SAYCam Corpus. On the basis of the results obtained, we developed a taxonomy of laughables. We believe this to be the most detailed empirical study of laughables hitherto conducted in research on child laughter.

1 Introduction

Understanding a baby's laughter is a complex yet crucial aspect of developmental psychology that has been historically overlooked (Addyman and Addyman, 2013; Addyman, 2020). Infant laughter serves as a form of communication and bonding between parent and child, reflecting cognitive and emotional development (Sauter et al., 2018). However, babies lack the ability to verbally express their thoughts, making it difficult to understand the context of their laughter. Without a clear context, interpreting the meaning behind their laughter becomes challenging. Additionally, infants are at a stage where their cognitive and emotional development is evolving radically. This developmental process can impact on the causes underlying their laughter, adding to the complexity of interpretation (Mireault and Reddy, 2016; Mazzocconi and Ginzburg, 2023). Therefore, further exploration of the factors contributing to infant laughter is necessary to gain a deeper understanding of its significance and implications.

The structure of the paper is as follows: in section 2 we review previous work, summarize potential factors that may elicit laughter, and discuss the feasibility of using Piaget's schema theory to explain laughables surrounding cognition. In section 3, we present our research questions and the objectives of this paper. In section 4, we explain how we classify laughables using data from two longitudinal corpus studies. Then, in section 5, we introduce a more comprehensive taxonomy based on the results of these studies (Section 5.1) and discuss inter-annotator agreement (IAA) (Section 5.2). Finally, in section 6, we summarize our findings.

2 Related Work

2.1 Sensorimotor stage

According to Piaget's cognitive development theory (Piaget et al., 1952), babies in their first year remain in the sensorimotor stage, a period characterized by the development of basic motor skills through perception and interaction with their environment via physical sensations and body coordination. At this stage, children progress from simple reflexes in response to sensory stimuli to actively exploring their environment and the objects within it. Through repeated actions, they start to understand the notion of *cause-and-effect*, e.g., realizing that crying loudly will draw a caregiver's attention or that pressing a button will make a toy produce sounds. The stage culminates in the understanding of *object permanence*—objects continue to exist even when they are out of sight.

2.2 Sensory stimulation

Sroufe and Wunsch (1973) observed that infants begin to laugh around four months of age. Initially, their laughter is primarily triggered by tactile or auditory stimuli, such as light touches on sensitive areas or high-pitched voices. These triggers become less potent over time, while more visual and social

Proceedings of the 28th Workshop on the Semantics and Pragmatics of Dialogue, September, 11–12, 2024, Trento, Italy.

stimuli become increasingly successful in eliciting laughter in the first year of life. From 5 to 8 weeks, babies are most responsive to dynamic visual stimulation, such as a nodding head. Other studies also indicate that babies exhibit strong responses to rhythmic, high-pitched voices, and moving objects across the first year (Slater et al., 1985; Singh et al., 2002; Kitamura and Burnham, 2003). Therefore, from the perspective of sensory stimulation lacking communicative significance, the sensory stimuli for laughter change over time, to include physical, visual, and auditory stimuli.

2.3 Cognition

As rapid cognitive development ensues, the sources of laughter are not limited to sensory stimulation; they begin to include laughter based on cognitive understanding: in Shultz and Zigler (1970)'s study, a stationary clown emerges as a more effective stimulus than a dynamic clown (dynamic visual stimulation) for 3-month-old babies. Why do they laugh at a stationary clown? We relate this to a view of adult laughter developed by (Ginzburg et al., 2020). Two basic meanings are postulated for laughter, one involving the person laughing to express her enjoyment of the laughable l, the other expressing her perception of l as being *incongruent*. Building on work in humour theory (Raskin, 1985), incongruity can be explicated as a notion that relates a contextually salient entity l with a defeasible rule (a *topos* τ (Breitholtz, 2020)) which represents normal expectations in case there exists a contextually salient characterization of l that is incompatible with τ. In accordance with this theory, if we use incongruity to explain why three-month-old babies laugh when staring at a stationary clown, we assume that infants have certain expectations/cognition about human faces. The clown's face clashes with these expectations, causing the baby to laugh. Nonetheless, the question remains— why do babies derive pleasure from the incongruity?

2.3.1 Violation of a Schema

Piaget and other researchers posit that this pleasure is derived from a *cognitive challenge*, whereby a young child finds that they require effort to make sense of incongruent events using their existing knowledge, referred to as the *schema* in Piaget's theory (Piaget, 2013; Berlyne, 1960; Harter, 1974, 1978; Schultz, 1976; McGhee and Pistolesi, 1979). Piaget believed that individuals organize their knowledge into mental schemas, which help them to understand the world around them. These schemas include expectations about how objects, actions, and events should occur based on past experiences. Infants' expectations are formed by various schema types, including event schemas, self-schemas, object schemas, and role schemas. When they are born, they have innate schemas, such as grasping and sucking, to interpret and engage with their environment. As they grow, these schemas evolve and become more intricate. For instance, consider a child who encounters a dog for the first time. When shown a picture of a dog by their mother, the child forms a schema associating dogs with specific features like two ears, four legs, and a tail. Subsequently when a child sees a dog with only one ear instead of two, this conflicts with their schema of what a dog should look like.

Other researchers have argued that two necessary conditions must be met for children to appraise an event amusing when it violates their existing schemas. First, the child must be in an environment perceived as safe (Sroufe et al., 1974; Baillargeon et al., 1985; Mireault and Reddy, 2020). Second, the deviations/novelty should neither be too difficult nor too easy relative to the child's current knowledge. Instead, it should require an optimal amount of effort to understand, within their zone of proximal development (Vygotsky and Cole, 1978).

2.3.2 Exploration of New Schemas

Exploration itself can be a source of pleasure for babies. As early as the first year of life, children develop a strong sense of curiosity about their environment and themselves. Piaget argued that this "need" to explore novelty is an inherent part of a child's nervous system. For instance, when a baby encounters a new object and has not yet understood what it is or what it can do, they may engage in exploratory behaviors such as observing or patting the object (Piaget, 2013; Mc Reynolds, 1962; Hutt, 1966; Belsky et al., 1980; Bijou, 1980; Gibson, 1988; Rochat, 1989).

2.3.3 Conformity to a Schema

In addition, Piaget and other researchers have suggested that the pleasure babies derive is not limited to cognitive challenges or curiosity but also extends to a sense of recognition and mastery. McGhee and Pistolesi (1979) exemplify two situations in which babies experience a sense of recognition and mastery: social play and object play.

An example of social play is the game of peek-a-

boo, where a caregiver hides the baby's eyes and then reveals them while saying "peek-a-boo!". The first-time experience presents two novel events for the baby: the event schema (having vision blocked and then restored) and the concept of object permanence. After repeated play, the baby will eventually laugh when the caregiver removes their hands, as this action now conforms to the baby's existing event schema.

Object play often occurs when a baby visually examines and manipulates a novel object, such as a new toy. Unlike the pleasure derived from curiosity, this type of pleasure is elicited when the baby begins to understand the properties of the object and becomes less curious about it. For example, a baby may learn the function of an interactive toy or the concept of cause-and-effect by discovering that when they pat a toy pig, it responds with a pig sound. As with social play, the baby may laugh the moment the toy pig makes the sound, as it confirms their hypothesis.

2.3.4 Application of a Schema

At this stage, a baby is also actively involved in the emergence of pleasure (for themselves and others) by applying their schemas. Although schemas are not well-developed at birth, they gradually become refined and expanded through adaptation, which is a key process described in Piaget's schema theory. This adaptation can occur through either assimilation or accommodation. Assimilation occurs when the baby integrates new information into their existing schemas, while accommodation happens when new information alters or replaces their existing schemas. In this way, babies can incorporate novelty or incongruity into their current understanding. They might use their schemas to create joy in two different situations.

The first situation is social play. For example, after playing peek-a-boo multiple times with their mother, the baby becomes familiar with the event schema of peek-a-boo. As a result, when the mother covers the baby's eyes with her hands, the baby may start laughing in anticipation, having already predicted the mother's next action—removing her hands (an event that brings the baby true joy). Another possibility is that the baby uses the event schema of peek-a-boo to play a prank on the mother; for instance, by deliberately grabbing the mother's hands when she covers the baby's eyes (Trevarthen and Hubley, 1978; Reddy, 1991; Nomikou et al., 2017).

Another situation is object play. It has often been observed that a baby laughs when they see a toy they frequently play with, which excludes the possibility of curiosity about the toy, as it is already familiar to it. Piaget suggests that this laughter may be due to an affective response toward the object. He argues that there is as much construction in the affective domain as in the sensorimotor stage. This means that the construction of an object schema involves not only knowledge about the properties of the object but also emotional responses toward it. Thus, the toy evokes a sense of pleasure in the baby when they see it. Another hypothesis proposed by McGhee and Pistolesi (1979) is the function of make-believe play. For example, as described by Garvey (Garvey, 1990), instead of simply playing with a toy car, a baby might imagine the car in a race with themselves as the driver or pretend that the car is a spaceship. Humour would not be triggered by such play until attention shifts to the fact that the child is imagining the car doing something they know to be nonsensical, absurd, or impossible.

2.4 Social Interaction

Laughter can also occur in non-humorous forms, serving as a flexible social signal (McGhee and Pistolesi, 1979). In a similar fashion to how infants construct schemas for objects, Piaget argued that children also develop schemas of social interaction. The process of constructing this social schema can be considered a form of *social effort*, driven by an interest in others and *social reciprocity*, which involves spontaneous mutual engagement and the valuing of connections with others. Laughter may be a part of this social schema, helping to maintain attachment with caregivers. For instance, children may use laughter to elicite caregiver's positive caregiving gesture like patting or stroking (Ainsworth, 1967; Bowlby, 1982; Nelson, 2012). Laughter can also have a crucial role in learning how to direct others' attention and in establishing moments of shared attention in the child-caregiver dyad (Mazzocconi and Ginzburg, 2022; Parnell, 2023), which is a crucial building block in the neuropsychological development of a child, correlated with their later language and socio-communicative abilities (e.g. Lasch et al. (2023) Finally, laughter can be also a coping strategy to respond to a caregiver's laughter (El Haddad et al., 2019; Mazzocconi et al., 2023).

3 Research Questions

Based on our literature review, we hypothesize that a child's laughter may be triggered by three types of events: events involving sensory stimulation, cognitively demanding events (violation of a schema, exploration of new schemas, conformity to a schema, and application of a schema), and social interaction, where laughter serves as a flexible social signal.

This raises the following two questions: first, can these potential factors be used to exhaustively classify the laughable events in the first year of life? Second, can these factors be integrated in a precise way within Piaget's schema theory?

To address these questions, we conducted two longitudinal corpus studies analyzing the contexts of laughable events within the first year of life.

4 Method

4.1 The Corpus

To gather contextual data on baby laughter and to assess performance differences between laboratory and familiar environments, we conducted a longitudinal study using the Rollins Corpus (Rollins, 2003; Trautman and Rollins, 2006; Rollins and Trautman, 2011; Rollins and Greenwald, 2013) and the SAYCam Corpus (Sullivan et al., 2021).

4.1.1 Rollins Corpus

The Rollins corpus comprises a collection of longitudinal video recordings capturing the development of 61 infants from 3 months to 30 months of age and recorded in the laboratory.

Participating children were exclusively exposed to English as their primary language and minimal exposure to other languages (i.e., less than 7 hours per week).

The laboratory environment is child-friendly, equipped with two-way mirrors on both the front and back walls. During the recording sessions, parent-child pairs sat facing each other and engaged in spontaneous play using standardized age-appropriate toys (see Figure 1). Parents were encouraged to interact with their child naturally. Infants were initially seated in an infant seat with a tray for toy placement at 9 months, transitioning to seated floor play at 12 and 30 months. All sessions were recorded using split-screen video technology.

4.1.2 SAYCam Corpus

The SAYCam corpus comprises a collection of longitudinal video recordings of 3 infants aged from 6 months to 32 months, captured in various settings including their homes, cars, neighborhoods, and workplaces where the child spent time. The recording method involves the babies wearing a head-mounted camera (see Figure 2), allowing access to information from the child's perspective.

Figure 1: Observing the child from two perspectives in Rollins Corpus

All three families spoke English exclusively (see Table1). Alice and Asa are from a family that lived in the United States and Sam lived in Australia. Alice wore a headcam from 8 months to 31 months of age. Sam wore the headcam from 6 months to 30 months of age. He was diagnosed with autism spectrum disorder at age 3; as of this writing (at age 7), Sam is fully integrated into mainstream activities, has friends, and does not require any special support. Asa started wearing the headcam at 7 months. Due to the onset of the COVID-19 pandemic and the birth of a younger sibling, data collection for Asa ended at 24 months.

Table 1: Participant Information in SAYCam Corpus

Participant	Location	First recording (months)	Last recording (months)
Alice	USA	8	31
Asa	USA	7	24
Sam	Australia	6	30

Each family recorded approximately 2 hours per week, once at a fixed time and once at a randomly chosen time. All caregiver-infant activities were spontaneous and not designed.

4.2 Our Data

From the cohort listed in Table 2, in the Rollins corpus, we selected 15 children aged from 3 to 12 months. In the SAYCam corpus, we have 3 children aged from 8 to 12 months. Ultimately, we annotated 294 instances of baby laughter and 631 instances of caregiver laughter in the Rollins corpus, as well as 458 instances of baby laughter and

Figure 2: Participant (7 months old) wearing Veho camera with fish eye lens in SAYCam Corpus (Sullivan et al., 2021)

396 instances of caregiver laughter in the SAYCam corpus.

Table 2: Information about the Two Corpora

	Month	Caregiver	Child	Duration
Rollins	3	12	11	0:21:41
	6	99	44	2:50:49
	9	279	110	5:56:15
	12	241	129	5:20:06
	Total	631	294	14:28:51
SAYCam	8	67	96	5:24:49
	9	118	81	5:42:56
	10	72	106	5:35:14
	11	71	75	5:27:11
	12	68	100	6:16:22
	Total	396	458	28:26:32

4.3 Our Annotation

All our annotations were conducted using the software ELAN (Brugman and Russel, 2004). The coding was carried out by the first author and three other coders. The coders annotated both the laughter and the position of laughables within two corpora, providing natural language descriptions of the laughables. Laughter is defined as a segment starting when laughter-related auditory, facial, or bodily cues are observed, and ending with a perceived breath intake or, if absent when the facial or body movement ceases. If a breath intake occurs after a delay and the participant is still perceived as laughing, it is considered part of the laughter; otherwise, the segment concludes with the end of sound or movement. The laughable descriptions are then clustered using keywords they have in common (including their synonyms). These have been found in the videos being annotated and, hence, for now, the class of keywords used in the clustering is dependent on the data used.

4.4 Inter-annotator agreement

For the SAYCam corpus, we extracted 16% (74 instances) of laughs, and for the Rollins corpus, we extracted 23% (69 instances) of laughs. These laughs cross baby and age and the cross-annotation was performed by two other authors. The Inter-Annotator Agreement (IAA) is calculated under the same exact conditions, except that concerning laughter position.

5 Results

5.1 Laughable Taxonomy

Based on the studies mentioned in related work and Piaget's theory, we attempt to classify laughables in our dataset. We categorized laughable types into: *sensory stimulation, conformity to a schema, violation of a schema, application of a schema, exploration of new schema, and social interaction.*

Data presented in Table 3 show that most laughable events can be categorized within our schema-based taxonomy of laughables, with only 5 cases (3 in Rollins and 2 in SAYCam) not successfully explained. Secondly, half of the babies' laughter in both corpora is elicited by sensory stimulation or by encountering novel or incongruous events, which aligns well with the characteristics of the sensorimotor stage. Furthermore, there appears to be an influence from different environmental contexts. In laboratory settings, children respond more to sensory stimulation and schema violations, where caregivers play a prominent role, but less to self-directed laughable types, such as the application of a schema and social interaction. Babies in a naturalistic environment, however, exhibit a greater diversity and a more balanced distribution of laughable types.

Table 3: Distribution of Laughable Types in the Two Corpora

	Rollins		SAYCam	
Sensory Stimulation	95	32.31%	103	22.49%
Violation of a Schema	93	31.63%	64	13.97%
Conformity to a Schema	15	5.10%	28	6.11%
Exploration of New Schemas	47	15.99%	119	25.98%
Application of a Schema	14	4.76%	69	15.07%
Social Interaction	27	9.18%	73	15.94%
Other	3	1.02%	2	0.44%
Total	294	100.00%	458	100.00%

5.1.1 Sensory Stimulation

We categorized sensory stimulation into three main classes: *Physical, Auditory, and Visual.* In both

corpora, most sensory stimulation occurs in a combined form, like visuo-auditory. For example, a caregiver slowly approaches the baby while making a plosive sound ("booh!"). We only list the frequency of each type stimulus in Table 4.

The result suggests that physical stimuli, particularly tickling, are the most consistent triggers of laughter across both corpora. Auditory stimuli such as rhythmic and high-pitch sounds also play a significant role. Approaching (a person/object) is the most frequent visual stimulus in the SAYCam corpus but exhibits a lower frequency in the Rollins corpus.

Table 4: Distribution of Sensory Stimulation in the Two Corpora

		Rollins		SAYCam	
Physical	be held	0	0.00%	8	17.02%
	be kissed	1	1.85%	4	8.51%
	be lifted up	0	0.00%	6	12.77%
	be tickled	44	81.48%	13	27.66%
	be touched	8	14.81%	4	8.51%
	cannot keep balance	0	0.00%	10	21.28%
	good taste	0	0.00%	2	4.26%
	jump	1	1.85%	0	0.00%
	Total	54	100.00%	47	100.00%
Auditory	animal sound	2	5.26%	0	0.00%
	bumblebee sound	1	2.63%	0	0.00%
	clapping hands	3	7.89%	0	0.00%
	high pitch sound	4	10.53%	18	40.91%
	plosive sound	0	0.00%	2	4.55%
	rhythmic sound	20	52.63%	24	54.55%
	tickling sound	6	15.79%	0	0.00%
	whistling sound	2	5.26%	0	0.00%
	Total	38	100.00%	44	100.00%
Visual	approach	12	54.55%	15	41.67%
	be hided	1	4.55%	0	0.00%
	bumblebee sound	1	4.55%	0	0.00%
	clapping hands	4	18.18%	5	13.89%
	shaking hand	1	4.55%	1	2.78%
	shaking toy	3	13.64%	2	5.56%
	shining toy	0	0.00%	13	36.11%
	Total	22	100.00%	36	100.00%

5.1.2 Conformity to a Schema

We found 2 subcategories of conformity to a schema: *conformity to object schema* and *conformity to event schema*. Their distribution is shown in Table 5.

The primary difference between these categories is that conformity to an object schema occurs when a baby receives the expected reaction from an object after observation or repeated examination. For example, a baby pats a toy, and the toy starts singing. In contrast, the majority of cases for conformity to the event schema stem from the peek-a-boo game, wherein the caregiver obscures the child's vision with an object or their hands and then removes it while saying "peek-a-boo!". Consequently, through repeated exposure to this game, children are likely to develop an event schema for peek-a-boo, where the sequence involves having their vision obscured followed by its restoration. For example, if we consider the process of $vision\_obstructed \rightarrow vision\_restored$ as the laughable, then the start time of the laughable is the moment when the vision is obstructed, and the end time is the moment when the vision is restored. Therefore, the reaction time to this laughable is calculated as $laughter\_start\_time - laughable\_end\_time$. From the reaction time column in the Table 6, it can be observed that the baby's laughter and the caregiver's removal of hands are almost synchronous.

Table 5: Distribution of Conformity to a Schema in the Two Corpora

	Rollins		SAYCam	
Conformity to event schema	10	66.67%	20	71.43%
Conformity to object schemas	5	33.33%	8	28.57%
Total	15	100.00%	28	100.00%

Table 6: Reaction Time for Five Cases in Conformity to the Schema

Laughter		Laughable		Reaction Time (s)
Start Time	**End Time**	**Start Time**	**End Time**	
217.01	217.79	216.12	217.20	-0.19
1048.67	1049.39	1047.82	1048.67	0.00
1050.42	1050.90	1049.78	1050.42	0.00
1105.71	1106.19	1104.06	1105.71	0.00
633.48	634.46	632.02	633.47	0.00

5.1.3 Violation of a Schema

We observed 5 categories of violation of a schema. Their descriptions and examples are as follows and their distribution is shown in Table 7:

1. **Violation of facial schemas:**
   Description: Situations where the baby observes a caregiver's facial expressions deviate from the normal.
   Example: A surprised face, sticking out a tongue, opening the mouth wide open, a fierce face, a face showing discomfort, and a yawning face.

2. **Violation of object schemas:**
   Description: Situations where the intended use or characteristics of objects conflict with the established cognitive understanding.
   Example: A toy duck, typically stationary, is manipulated by the caregiver to speak with or kiss the baby.

3. **Violation of social role schemas:**
   Description: Situations where a caregiver engages in actions that do not align with their

typical role or identity.
Example: Mimicking the baby's actions or speech. When the baby screams, the caregiver also screams; when the baby opens their mouth wide, the caregiver does the same; when the baby says "bababa", the caregiver echoes "bababa".

4. **Violation of event schemas:**
Description: Occurs when the expected sequence of actions is disrupted, deviating from the established order. When the natural action sequence is known to be $Action\ A \rightarrow Action\ B$, but instead, it becomes $Action\ A \rightarrow Action\ C$.
Example: An example involves a caregiver playing a prank on the baby, such as when the baby reaches out to grab a ball, but the mother quickly picks it up and throws it away.

5. **Violation of behavior schemas:**
Description: Situations where the caregiver behaves in a manner inconsistent with the established schema of caregiver-baby interaction.
Example: A caregiver pretends not to see the baby and looks for the baby but the baby is just sitting in front of the caregiver.

Table 7: Distribution of Violation of a Schema in the Two Corpora

	Rollins		SAYCam	
Violation of behavior schemas	11	11.83%	0	0.00%
Violation of event schemas	0	0.00%	11	17.19%
Violation of facial schemas	11	11.83%	19	29.69%
Violation of object schemas	65	69.89%	22	34.38%
Violation of social role schemas	6	6.45%	12	18.75%
Total	93	100.00%	64	100.00%

5.1.4 Application of a Schema

We observed two categories of the application of a schema. Their descriptions are as follows and their distribution is shown in Table 8:

1. **Application of object schema:**
Description: Typically occurs when a child sees or receives their favorite toy.

2. **Application of event schema - Prediction:**
Description: Typically occurs when a child and caregiver have repeatedly engaged in a game with same sequence of actions $Action\ A \rightarrow Action\ B \rightarrow Action\ C \rightarrow Action\ D$, with $Action\ D$ being the truly laughable event. Once the child becomes familiar with this sequence, they tend to laugh even before $Action\ D$ occurs.

Table 8: Distribution of Application of a Schema in the Two Corpora

	Rollins		SAYCam	
Application of object schema	10	71.43%	13	18.84%
Application of event schema - Pranks	1	7.14%	26	37.68%
Application of event schema - Prediction	3	21.43%	30	43.48%
Total	14	100.00%	69	100.00%

Table 9: Distribution of Exploration of New Schema in the Two Corpora

	Rollins		SAYCam	
Explore Self Schema	1	2.13%	4	3.36%
Explore the environment	46	97.87%	115	96.64%
Total	47	100.00%	119	100.00%

3. **Application of event schema - Pranks:**
Description: Typically occurs when a child becomes familiar with the sequence of actions in a game. Assuming the sequence is $Action\ A \rightarrow Action\ B \rightarrow Action\ C \rightarrow Action\ D$, and the caregiver is the one performing these actions, the child will attempt to prevent the caregiver from performing $Action\ B$ once $Action\ A$ has been completed and $Action\ B$ is imminent.

5.1.5 Exploration of New Schemas

In Table 9, we categorized the exploration of new schemas into two types: exploring the environment and exploring self-schemas. In both datasets, infants are more engaged in exploring the environment by observing what happens after a novel event or action, such as patting or shaking objects to test the properties of unfamiliar objects. Exploration of self-schemas occurs when infants observe themselves in a mirror.

5.1.6 Social Interaction

We observed 6 categories of social interaction. Their descriptions are as follows and their distribution is shown in Table 10:

1. **Sharing:**
Description: When a baby obtains or discovers an object (denoted as A) and subsequently redirects their gaze from the object A to the caregiver, often accompanied by a gesture in-

Table 10: Distribution of Social Interaction in the Two Corpora

	Rollins		SAYCam	
Attempting to Capture Caregiver's Attention	0	0.00%	6	8.22%
Initiation of Engagement by the Caregiver	7	25.93%	19	26.03%
Invitation to Play with the Caregiver	0	0.00%	4	5.48%
Receiving Encouragement from the Caregiver	3	11.11%	5	6.85%
Receiving Friendliness from the Caregiver	14	51.85%	29	39.73%
Sharing	3	11.11%	10	13.70%
Total	27	100.00%	73	100.00%

dicating sharing, such as showing or offering the object A.

2. **Attempting to Capture Caregiver's Attention:**
   Description: When a baby notices that the caregiver's gaze is not directed towards them, they attempt to use laughter as a means to attract the caregiver's attention.

3. **Receiving Encouragement from the Caregiver:**
   Description: The caregiver typically provides encouragement through verbal utterances such as "yeah! <Baby's name>", "you did it!" accompanied by encouraging action like clapping hands.

4. **Receiving Friendliness from the Caregiver:**
   Description: The caregiver demonstrates friendliness by laughing or smiling at the baby, or by using greeting utterances such as "Hi, <Baby's name>."

5. **Invitation to Play with the Caregiver:**
   Description: Following a game with the caregiver, the baby give the game object to the caregiver, inviting them to engage in play once more.

6. **Initiation of Engagement by the Caregiver:**
   Description: While the baby is playing independently, the caregiver takes the initiative to ask or engage in the game with the baby.

5.2 Confusion on Laughable Annotation

The confusion matrix (Figure 3) shows that "sensory stimulation" and "violation of a schema" are the most divergent categories between the two annotators. For example, when a caregiver pronounces a plosive sound like "booh", it is usually accompanied by the mouth forming an exaggerated O-shape. Additionally, the category "exploration" is often confused with "conformity to a schema" or

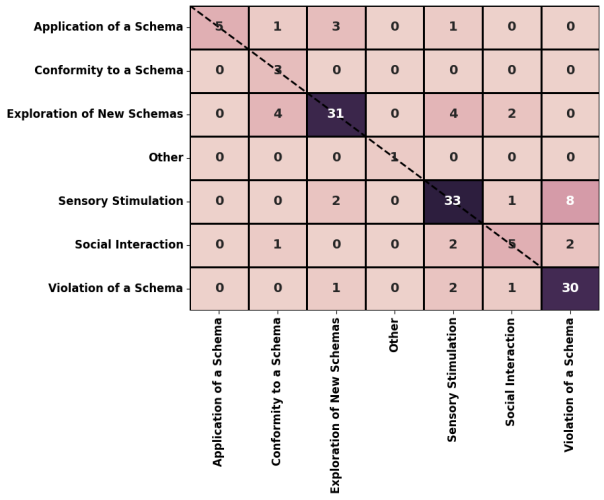

Figure 3: Confusion matrix for inter-annotator agreement (IAA) results across the two corpora, with a kappa IPF of 0.6783, a kappa max of 0.8897, and a raw agreement of 0.7552. The required minimum overlap percentage is 100%.

"sensory stimulation". For instance, when a child looks at a shiny toy, it can be interpreted in several ways: the child could be merely observing the shiny toy, understanding its function (e.g., patting the toy to make it shine), or laughing at the visual stimulation. Therefore, we argue that this divergence is unavoidable as it depends on plausible inter-subject differences in event classification.

6 Conclusions

This paper proposes a taxonomy of laughables for baby laughter, building on previous literature and evaluated on two corpora. The results demonstrate that a baby's laughables (events triggering laughter) in the first year align with our initial hypothesis, encompassing three main classes, namely *sensory stimulation, cognitive challenges, and social interaction.* Within the class of cognitive challenges we have a further, fine-grained partition into five sub-classes (*conformity to the schema, violation of a schema, application of a schema, exploration of new schema.*) inspired in part by the Piagetian notion of *schemas*. This ties in closely with a view of adult laughter meaning (Ginzburg et al., 2020) as expressing for the most part a laughable l's being incongruent.

Acknowledgments

This work was supported by the French National Centre for Scientific Research (CNRS) under the reference 80PRIME2023—TELIN and by the French *Investissements d'Avenir-Labex EFL* program (ANR-10-LABX-00). We would like to thank the three TrentoLogue reviewers for their valuable comments on the first draft of this paper.

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