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# The Co-construction of Conversational Moves in the Context of Piagetian Interview: The Case of the Test of Conservation of Quantities of Liquid

by *Francesco Arcidiacono**, *Anne-Nelly Perret-Clermont**

The aim of this paper is to explain the interest of revisiting the classical piagetian test of conservation of quantities of liquid in order to reconsider Piaget's statements about argumentation in children. Contrary to Piaget, we hypothesize that to a certain extent the children's statements are co-constructed by the actors within the specific setting in which they interact, i.e. during the testing situation. We observe how children construct conversational moves in connection with the adult's interventions. Piaget considered children's statements as dependent on the cognitive level (i.e. logical): we expect the children's arguments also to be the result of the interactions with the tester and in particular to his/her framing of what is at stake.
Key words: *conservation, argumentation, adult-child interaction, conversation, test.*

The neo-piagetian and neo-vygotskian approaches to collaborative interactions within goal-directed activities and the recent advances of argumentation theories call researchers' attention to alternative modes of considering argumentation as a process within an interaction and not only as a result of the individual's thinking. In this paper[1] we suggest a way to revisit the classical piagetian test[2] of conservation of quantities of liquid in order to explore to what extent children's capacity to provide the arguments expected by Piaget is in fact co-constructed within the adult-child interaction. For Piaget, when children are able to back up their conservation judgments with logical arguments, it is a sign that they have reached the stage of concrete operations. Our hypothesis is that such logical arguments are also the fruit of a co-construction during a conversation in which both interlocutors are responsible for the outcome.

## 1
## Piaget and logic

Since the 1920s, when Piaget spent time in Paris with Binet trying to assess children's intelligence, the observation of children's argumentation has become an important element in his method of interviewing (Piaget, 1924; 1926; Piaget, In-

* University of Neuchâtel (Switzerland).

helder, 1966). To have access to children's modes of reasoning, Piaget suggested that confronting children with different points of view in various situations was more relevant than simply asking them to answer questions. Piaget described thereafter his method of "critical" or "clinical" interview as engaging in conversations with children, and granting special importance to "counter-suggestions" as invitations to defend and back up their answers. This should allow the psychologist to assess the structure behind the child's reasoning and not just the conformity of the isolated responses to the adult's normative expectations. Piaget described the growth of thinking as organized by logical structures that are gradually modified, during the course of the development, to become more and more powerful and integrative. This is supposed to happen through an auto-equilibration process that becomes active when the children encounter failures or contradictions and try to overcome them. Piaget has viewed formal logical reasoning as defining the structural end-point of cognitive development. We are particularly interested in Smedslund's (1970; 1977) questioning of the relationship between logic and reasoning during a task in which he pointed to the distinction between the experimental setting as viewed by adults and children, showing how crucial it is to consider the interpretation of the task in order to understand the situation and to assess whether people reason logically.

Our claim is that the exclusive attention to the logical structures of the child's thoughts, and to the child's statements as a sign of them, led Piaget into an underestimation of the social and conversational dynamics involved in the psychologist's elicitation of arguments from the child. Even if some of his theoretical writings can be understood as a call to study the cognitive dynamics resulting from cooperation between people with different points of views, Piaget seldom studied this point empirically. For this reason, we assume that there is a need to revisit his classical study, and in particular his prototypical test on conservation of quantities of liquid, with the possibility of reconsidering the conversational moves of adults and children beyond Piaget's own reductionistic logicism on these matters.

## 2
## The relevance of argumentation

Argumentation has been the object of research during the preceding decades with special attention paid to the communication or educational context and to developmental trends (e.g., Kuhn, 1991; Johnson, Johnson, 1994; Golder, Schneuwly, 1996; Schwarz, Neuman, Biezuner, 2000; Erduran, Osborne, Simon, 2004; Rigotti, Greco Morasso, 2009). These findings contribute to the understanding of the role of argumentation as a resource for education and as a potentially important domain to be taught in school (Muller Mirza, Perret-Clermont, 2009). It is a specific form of dialogical social interaction. Research is needed to better

understand why the activity of argumentation in schools is often limited and constrained to very poor forms and to study the process by which children and adults acquire argumentative skills. How can this learning be supported?

The advances in argumentation theories (Eemeren, Grootendorst, 2004; Rigotti, Greco Morasso, 2009) propose an understanding of argumentation as a pragmatic process. Arguments are constructed and considered not only in relation to other arguments or as isolated elements of a discourse, but as nested in communication processes with their implicits and their goals, as well as their strategic "manoeuvring". From this perspective, we will not look exclusively at the quality of arguments during an interaction between children or between children and adults, but will consider argumentation as a collective construction, constrained by the dimensions of the communicative context in which it is produced and its goals (Duranti, Goodwin, 1992; Perret-Clermont, 2006; Rigotti, Rocci, 2006).

A second motive to reconsidering the investigation of argumentation in piagetian tests is that we hypothesize that, contrary to his intention, Piaget in fact did not really study children's argumentations, but the result of very specific types of conversations ("clinical interviews") between the experimenter and the child around a task. Over the past decades, different studies have already been devoted to children's understanding of piagetian questions when embedded in different narratives (Donaldson, 1978; Light, 1986; Light, Gorsuch, Newmann, 1987; Light, Perret-Clermont, 1989), and to the influence of social factors in symmetrical and asymmetrical power relations (Krstić, Baucal, 2003; Psaltis, Duveen, 2006). Other studies have demonstrated how the architecture of intersubjectivity structures the meanings deployed in the conversation (Rommetveit, 1976), how the partners' mutual scaffolding can lead to learning (Schwarz *et al.*, 2008), and how the competence that a person can demonstrate is affected by the established relationships (Schubauer-Leoni, 1986; Grossen, 1988; Nicolet, 1995; Perret-Clermont, Carugati, 2001). Marro-Clément, Trognon and Perret-Clermont (1999) have also described the interactions between children discussing the notion of conservation of quantities of liquid when they do not share the same point of view. Supposedly similar contexts may turn out to not be the same for each participant. This is made clear by the minute observation of what happens when children are asked to solve a task (Muller Mirza *et al.*, 2003; Tartas, Perret-Clermont, 2008; Arcidiacono, Perret-Clermont, 2009). Another relevant aspect concerns the repeated-question effect in the conservation test, specifically studied by Baucal and Stepanović (2006), following the idea that children expected «one would never ask the identical question twice if a significant change had not occurred» (Rose, Blank, 1974, p. 499). These studies have demonstrated that the issue of the repeated question and its role is still open: in particular, we need to consider in detail the relevance of the talk as *talk in context*. A series of studies dedicated to the observation of everyday activities in different contexts of socialization (such as classrooms and families) have shown how competencies, reasoning, and ar-

gumentation are embedded in daily talk (Pontecorvo, 1987; 2004; Pontecorvo, Arcidiacono, 2007; Arcidiacono, Pontecorvo, Greco Morasso, 2009).

Therefore, as talk is far from always being argumentative, we think that it is important to investigate specifically how and under which circumstances the conversation between the experimenter and the child is co-constructed within their interaction and when it is likely to be argumentative. According to previous studies on testing situations (Grossen, Florez, Lauvergeon, 2006), we intend to highlight the specific and situated character of the interaction among participants during the clinical interview. For this reason, in the following part of the paper, we will present a specific situation of the piagetian "épreuve" of conservation of quantities of liquid in order to introduce a revisiting study of the piagetian interview.

## 3
## The piagetian test of conversation of quantities of liquid

The conservation of quantities of liquid is one of the most famous piagetian tests for assessing concrete operations in children (typically 5 to 7 years old). From a psychological point of view, Piaget has considered the need for conservation as a kind of functional a priori of thought. Piaget and Szeminska (1941) have studied the construction of the notion of conservation via a series of experiments with continuous quantities: the test of conservation of quantities of liquid was part of this work. Typically, it concerned a situation in which a child was given two cylindrical glasses of equal dimensions (A and A') containing the same quantity of liquid. The content of A was then poured into two smaller containers of equal dimensions (B and B'), and the child was asked whether the quantity of liquid poured from A into (B + B') was still equal to that in A'. Then, the liquid in B could be poured again into two smaller, equal containers (C and C'), and the liquid in B' poured into two other containers C" and C"' identical with C and C'. Questions as to the equality between (C + C') and B', or between (C + C' + C" + C"') and A' were then asked. In this way, the quantities of liquid were subdivided in a variety of ways, and each time the problem of conservation was put in the form of a question as to equality or non-equality of the quantities with one of the original containers. Eventually, the experimenter would take another glass (D, taller and thinner), and pour the liquid into D from glasses B and B'. The child was asked to compare the quantities present in glasses B + B' and D: "Is there more liquid in one glass or another or is there the same amount in both glasses? Why?". Piaget invited the child to react to counter-suggestions in order to solicit argumentation, with the intention of understanding the structure of the child's thoughts. For Piaget, the child's answers were the symptoms of his operational stage. We quote below an excerpt form a piagetian interview with a child (Piaget, Szeminska, 1941) in its "canonical" form.

| | |
|---|---|
| 24 Clairette: de là dedans *((B))* | from in there *((B))* |
| 25 Exp: qu'est ce qu'il faut faire pour qu'Odette ait la même chose à boire? | what must we do so that Odette has the same to drink? |
| 26 Clairette: il faut prendre ce petit verre *((C''', dans lequel elle verse une partie du sirop de C))* | to take that little glass *((C''', into which she pours part of C))* |
| 27 Exp: mais c'est la même chose à boire, ou une a plus que l'autre? | but is it the same to drink, or has one more than the other one? |
| 28 Clairette: Odette a plus à boire | Odette has more to drink |
| 29 Exp: pourquoi? | why? |
| 30 Clairette: parce qu'elle a trois verres *((C presque vide, C' et C''', tandis que Clairette a C'' plein et B'))* | because she has three glasses *((C almost empty, C' and C''', while Clairette has C'' full and B'))* |

By interviewing children doing these pourings, Piaget demonstrated that quantities do not remain constant in children's minds. He describes three developmental phases: absence of conservation (perceptional aspects mislead the child), intermediate stage (the child starts operating mentally but still vacillates between perceptional centrations and co-ordinations), and necessary conservation (it has become obvious to the child that quantities are conserved according to their main arguments: identity of the juice, e.g., "nothing taken away, nothing added", compensations of the different dimensions of the glass, e.g., "thinner but wider", and reversibility, e.g., "if you pour it back you can see that nothing has changed"). Children are moving from a first step in which they only consider uncoordinated perceptions to a later stage in which a process of logical (operatory) coordination is established.

## 4
## Revisiting the piagetian test: methodological aspects

In the following part of the paper we present an exploratory study that revisits the piagetian test of conservation of quantities of liquid. Our main interest is to explore, in a qualitative way, how conversations between the adult and the child are co-constructed within this specific setting, and if the child is really given an opportunity to argue.

To some extent, we consider the test of the conservation of quantities of liquid as prototypical of piagetian situations in which a child is called to engage in conversation with a psychologist to answer questions and to provide explanations.

### 4.1. Aims

The goal of this study is to analyze specifically the conversational strategies of the interactants in order to explore to what extent the children's answers are co-con-

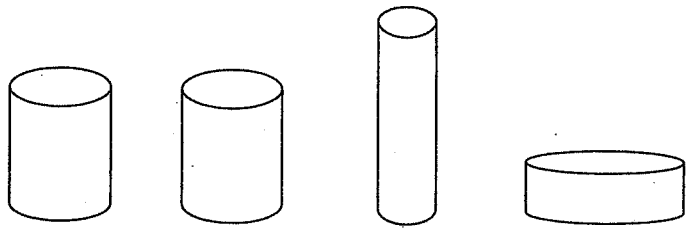
structed within the interaction with the adult and not only as a sign of the child's competencies. We suspect that the child's capacity to argue is not only a sign of concrete operations properly mastered to back up conservation judgments, but also a sign of the conversational competence of *both* the adult and the child.

### 4.2. Procedure and instruments

We have designed an experimental procedure to administer the test of conservation of quantities of liquid to children individually. The aim was to follow the traditional piagetian procedure: an adult tests a child's understanding of the notion of conservation of quantities via a conversation about the effects of pouring juice into glasses of different shapes (see FIG. 1).

The experimenter and the child were seated at the same table. At the beginning, two identical glasses (A and A') were filled to the same level, and the child was asked whether they each contained the same amount. Once the child had established that this was the case (sometimes after having added a few additional drops), the content of one (glass A') was poured into another (taller and thinner) glass (B). The child was then asked whether the two glasses (A and B) still contained the same quantity of liquid. Then, the content of B was poured back into A' and the child was asked the same question concerning A and A'. When the child had again established the equality of the initial quantities of A and A', the content of A was poured into another (smaller and larger) glass (C), and the child was asked again to discuss the relative quantities in A' and C.

FIGURE 1
Set of glasses




### 4.3. Participants and data collection

We have investigated 28 children aged from 5 to 7 years old; we trained two adults (students in psychology and education) in the experimental procedure. We videotaped all the interactions among students and children in the same room of

the children's school. All the children were living in the French-speaking part of Switzerland, in a small village in the Neuchâtel region.

## 5
## Qualitative analysis of the data

In this paper we do not present all aspects of our research. We want to consider some cases in which children's conversational moves appear closely linked to the adult's explicit or implicit suggestions and cannot be attributed to the child's own self-governed logical thinking. We intend to explore how the students we trained have managed their role, to what extent they diverged from the piagetian script[3] prescribed, and what the children produced as a result of their conversations with this specific adult. We will present and discuss three excerpts of videotaped conversations (for the simple form of transcription we used, see Appendix 1; for the original French transcription, see Appendix 2). A child and two adults were present (one directly interacting with the child, and another managing the video camera). For all participants, fictitious names replace real names in order to ensure anonymity in the presentation and in the analysis of the excerpts.

### 5.1. Adult's suggestions and children's statements

In this section we observe a situation in which the child is asked to answer the same question several times during the test. We consider the following excerpt as a sign of how children can show their competencies at a conversational level, even if it is not necessarily a sign of their cognitive level in a piagetian sense.

Excerpt 2

[Participants: experimenter (Joseph), child (Manon, female; age: 7,3 years old) *((the child has established the equality of the quantities of liquid in glasses A and A'. Then, the adult changes the set of glasses, using A' and B))*]


7 Exp: so there. now, let's take another glass, pour all your juice in this glass *((exp pours the juice from the glass A into the glass B))* then, if now I drink from my glass and you drink from your glass, will we both have the same thing *((in the two glasses A' and B))*, will someone have more juice, will someone have less juice?

**8 Manon: the same**

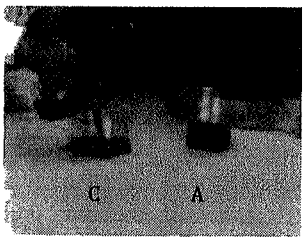
9 Exp: the same. can you tell me why we will have the same?

**10 Manon: because that one is thinner** *((glass B))*

11 Exp: thinner

**12 Manon: this one is larger** *((glass A'))*
**13 Exp: and then, we will hence have the same thing**
14 Manon: ya ya
15 Exp: even if there is one that is thinner?
16 Manon: yeah

[*((the child has established the equality of the quantities of liquid in glasses A and A'. Then, the adult changes the set of glasses, using A and C))*]




21 Exp: I pour all the juice in this glass now *((from the glass A into the glass C))* and now, if I drink from my glass and you drink from your glass, we will have the same thing to drink or will someone have more to drink, will someone have less to drink?
**22 Manon: the same**
**23 Exp: always the same, now you continue to explain to me why there we will have the same?**
**24 Manon: because that one is thinner** *((glass A))* yeah and *((the juice))* then it goes further up because it is thinner, **that one** *((glass C))* **is more widened,** *((the juice))* it does that it gives less. it is larger. yeah
**25 Exp: ok, perfect!** not more than that, we have finished, I thank you very much

In this excerpt, the child answers the first question (turn 7) about the quantities of juice in two different glasses, declaring that the amounts are the same in the containers (turn 8 "the same"). She explains to the experimenter why there is the same quantity of juice by referring to the shapes of the glasses (turn 10 "that one is thinner", and turn 12 "this one is larger"), even if she does not explicitly say that one compensates for the other. In turn 13, it is the experimenter who draws the conclusion assuming (rightly or wrongly) that it was implicit in the child's answer ("and then, we will hence have the same thing"). The piagetian script would have instead required him to test the child's answer by asking her to justify it fully or by making a counter-suggestion: the answer alone has no value. It is the argumentation given by the child that allows us to understand how she reasons.

When the experimenter, later in the sequence and using another set of glasses (A and C), is again asking the child a question, we observe that Manon provides the answers she had provided the first time, as if she were following the previous script. In fact, turns 22 and 24 are similar to turns 8, 10 and 12: the child repeats that there is the same quantity of juice because of the shapes of the glasses. Even the experimenter is following the same conversational strategy used in the first part of the sequence: in turn 23 he asks the child to justify again why there is the same quantity in the two glasses (instead of opening a discussion about it). The invitation to "continue" can be understood by the child as a suggestion to follow with the same answers as those that seemed to have been successful during the

first part of the interaction. However, the script of the piagetian interview with a child does not require this suggestion at all; on the contrary, it is supposed to open possibilities for the child to decentrate from her first perspective. Here, Manon is referring to each glass as thinner and larger (turn 24), and the experimenter ends the sequence (turn 25) even validating (although in sign of thanks) as "perfect" the child's answer.

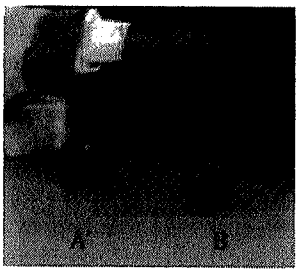
As a result, in this excerpt the child who is interacting with the adult maintains the same responses throughout the sequence. This behavior seems to have been induced by the adult who is unwittingly making suggestions. When the adult is asking the child to answer the same question several times, the script is followed too blindly. In this sense, the interview does not fulfil its goal, because it is not possible for the child to explain her point of view. As a consequence it seems that the interventions of the child are not (or not exclusively) signs of her reasoning, but rather signs of her capacity to adapt to the conversational demands of the adult.

### 5.2. The adult's diversions from the script and the influence on the child

In the next excerpt we present a situation in which there is a relevant diversion from the script: the adult plays his role differently than expected by his trainer; this is crucial to interpreting and understanding the conversational moves of the child. The adult's interventions influence the child's attitude and understanding of the situation.

Excerpt 3

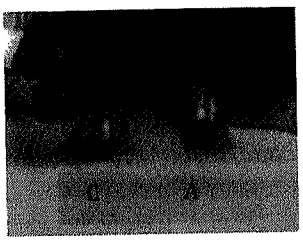
[Participants: experimenter (Joseph), child (Edy, male; age: 6,11 years old) *((the child has established the equality of the quantities of liquids in glasses A and A'. Then, the adult changes the set of glasses, using A' and B))*]




21 Exp: your juice will be poured into this new glass *((he pours the juice from glass A' into glass B))* now, what I would like to know is when I drink from my glass and you drink from your glass, do you think that we will have as much or will someone have more juice, will someone have less juice?
**22 Edy: I don't know**
23 Exp: you don't know
24 Edy: no no
**25 Exp:** then I will do what I have done in other classes, **he was looking at the shape of the glass, the height of the juice,** in order to know if there was as much or someone has more juice, someone has less juice
26 Edy: uhm
**27 Exp: maybe we can put the glasses side by side, look at their shapes,**
**28 Edy: well, not the same height**

29 Exp: not the same height
30 Edy: no no
**31 Exp: do you think that we will have as much or will someone have more juice, will someone have less juice?**
**32 Edy: I don't know**
**33 Exp:** you don't know, you have no idea, **maybe you have an idea?**
**34 Edy: no**
**35 Exp: you know that in your glass the juice is higher**
36 Edy: ya ya

[*((the child has established the equality of quantities of liquid in glasses A and A'. Then, the adult changes the set of glasses, using A and C))*]




39 Exp: I take again another glass, this time I take my juice and I pour it in *((he pours the juice into the glass C))* and now if I drink in this glass and you drink in the other glass, we will have as much or will someone have more juice, will someone have less juice?
**40 Edy: well, I don't know**
41 Exp: you don't know
42 Edy: no no
43 Exp: not a small idea?
44 Edy: no
**45 Exp: if you compare the two glasses side by side**
46 Edy: well this one *((glass C))* is more, more round so *((the juice))* then it is, it goes lower down, and then the other one *((glass A))* is smaller on top so it is higher
**47 Exp: ok, as a result of this, it gives you an idea of the quantities of juice, Edy?**
**48 Edy: no, euh not especially**
**49 Exp:** not especially, **ok, very well,** we have finished, thank you very much.

Excerpt 3 concerns a sequence in which the child answers the experimenter's question about the amount of juice in the glasses by stating that he is unable to judge the relative quantities (turn 22 "I don't know"). In accordance with the piagetian script, the adult then suggests some alternatives, referring to other (hypothetical) situations in which other children were looking at some particular aspects of the material (turn 25 "the shape of the glass, the height of the juice") to judge the amount, in order to invite the child to make his thoughts more explicit. However, the intervention of the adult in turn 27 is a diversion from the piagetian script: the adult is explicitly suggesting to the child to compare the two glasses, and especially their shapes. In the eyes of Edy, it is then evident that there is not the same height of juice (turn 28 "well, isn't the same height"), and maybe it is not clear to him why the adult suggested looking at the height of the juice. Within this sequence, the next intervention of the adult in turn 31 (when he is asking again the same question) is an effort to re-establish the main question, but the re-

action (turn 32 "I don't know") demonstrates that the child is far from providing the answer expected by the adult. After another attempt of the experimenter (turn 33 "maybe you have an idea"), and the child's answer (turn 34 "no"), this kind of "escalation" is completed by an inference from the adult: he attributes to the child the recognition of having a higher level of juice (turn 35 "you know that in your glass the juice is higher"), without asking for an explanation, as required by the piagetian script.

In the second part of the excerpt, the same manner of conducting the interview is repeated: when the child in turn 40 (even if he is confronted with a different set of glasses) states that he does not know how to answer the question, the experimenter tries to suggest the comparison of the glasses as a way toward a solution. Edy then describes the shapes of the glasses and the level of the juice in each glass (turn 46, the juice "it goes lower down"). Then the adult asks if this comparison brings a solution about the quantities of juice: in his diversion from the script, the experimenter is now introducing another possible answer, i.e., that the quantities of juice could be related to the shapes of the glasses. Finally, the child confirms that he cannot answer the question, and the experimenter (although in a sign of thanks) offers what seems to be a positive feedback to the child (turn 49 "ok, fine"). This, of course, is not prescribed by the script and might confirm the child in his error.

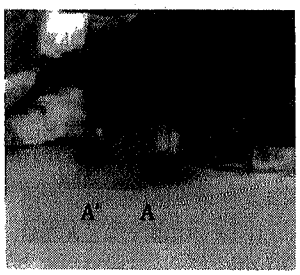
The sequence above shows how the adult's interventions can strongly influence the statements made by the child during the interview and fail to offer opportunities to assess the child's individual thoughts. Although trained to interview and to follow the piagetian script in testing the conservation of quantities of liquid, the adult repeatedly diverged from the intentions of the piagetian script and consequently induced answers from the child. The adult's diversions might be an inevitable condition of the situation: within the "frame" (Grossen, Perret-Clermont, 1992) of the interaction, the adult might also be induced to transgress the script because of the child's reactions. In the following part of the paper we will show how the children's answers can be considered the result of their conversational sensitivity to adapt themselves to the situation.

### 5.3. A good answer in the eyes of the adult

Another aspect found in our data concerns the children's capacity to adapt their answers to the adult's questions. In the following excerpt, we observe how the child can propose and develop what she considers a "sufficient" response in order to produce the "right answer" in the eyes of the adult, not understanding that she is being asked to reason aloud. The sequence highlights how some conversational moves of the child are adapted to what she believes are the expectations of the interlocutor.

Excerpt 4

[Participants: experimenter (Mary), child (Daria, female; age: 7,2 years old) *((the child has established the equality of quantities of liquid in glasses A and A'. Then, the adult changes the set of glasses, using A' and B))*]




21 Exp: I take your juice *((glass A'))* and I'm going to pour it in this glass. *((glass B))* here we are. and now what do you think, if you drink from your glass and I drink from my glass, will we both have the same thing to drink, or will someone have more, or will someone have less?
22 Daria: someone will have less
23 Exp: someone will have less, who is it?
24 Daria: you
**25 Exp:** it's me, and **how do you know that, that I have less than you?**
**26 Daria: because it's a bigger glass**
27 Exp: then look carefully now, I take again your glass *((glass B))*, pour it in that glass *((glass A'))*, then now what do you think, you drink from your glass *((glass A'))* and I drink from my glass *((glass A))*. will we both have the same to drink or will someone have more, or will someone have less?
28 Daria: I don't know
**29 Exp: more or less. what do you think?**
**30 Daria: yeah**
**31 Exp: we will have the same to drink both of us?**
**32 Daria: yeah, I believe**
33 Exp: ok

In this excerpt, we consider that the statements are based on what the child estimates a sufficient answer to reply to the experimenter's expectations. Daria says that the experimenter has less because her glass is bigger (turn 26). The adult Mary seems to accept this statement (instead of inviting Daria to back up her statement), and does not provide requests for more specific explanations. Mary does not question the child about the relation between the lesser quantity of juice and the bigger size of the glass. In this case, the experimenter is deviating from the script and, by doing so, she is probably offering positive feedback to the child. In turn 21, the adult tries to ask an open question: Daria behaves as if she had "tested" her answer on the adult during turn 22, and became convinced that it was the proper answer. But immediately later (turn 23), the experimenter suggests an answer unwittingly ("someone will have less, who is it?") and in response the child keeps to a minimally compatible answer (turn 24 "you"), a sort of economic move.

In the second part of the excerpt, the adult pours back B into A' and asks the child to compare the quantities in A and A' (turn 27). When Daria

says that she does not know if there is the same amount in these two similar glasses, the experimenter asks a very general question (turn 29 "more or less. what do you think"), and no specific questions. As a consequence, the child limits herself by saying "yeah" (turn 30), and "yeah, I think" (turn 32), but without giving any extra explanations. The child's effort is to produce what she is induced to think are the expected answers in the eyes of the adult, without debating. It seems that, within this interaction, the adult is not able to manage the situation, and the child limits her statements to the estimated sufficient answer requested by the test. This "acknowledgement" of a minimal answer by the adult is quite difficult to interpret: probably, the experimenter understands that the quantities of liquid were not equal, because the child was declaring the inequality before, and this influences the conversation and the adult's capacity to properly manage the interview. The adult does not seems to manage the piagetian goal of eliciting reasoning from the child and instead keeps asking for answers.

## 6
## Discussion and concluding perspectives

Our main intention was to look at the reasoning of the children not only as a sign of concrete operations, but also as the fruit of a co-ordination with the adult.

The excerpts presented are just three examples of how adults and children construct, turn by turn, their interventions and how Piaget's intentions can be misunderstood. We have found that sometimes participants follow some implicit and/or explicit suggestions of the partner, and implicit assumptions; sometimes they try to understand which kind of object of discourse is at stake; and sometimes they produce just the estimated sufficient conversational move to provide the right answer in the eyes of the partner. We have observed diversions from the script, adults' inferences and attributions to the child, and the participants' tendency to repeat an interactive pattern (or repeat an answer that he or she thought successful). It is useful to pay attention to the existing discrepancies between the intentions of the script and what really happens. Piaget suggests confronting children with different points of view; not only to simply ask them to answer questions, but to have access to their modes of reasoning. The data we have analyzed confirm that the conversation has been "squeezed" into "a matter of answers" and has not been a shared reasoning or an argumentation.

In the line of revisiting the test of conservation of quantities of liquid, we think that more specific attention is crucial to understanding the specific forms taken by the conversations if we want to access argumentation. As suggested by Ginsburg (2009), Piaget's clinical interview is supposed to challenge the child's

response to assess its stability and the child's confidence in it. If the child enters into argumentative moves, his/her reasoning becomes observable, and the premises of his/her reasoning can be known. However, in our data, the goals of the clinical interview have been interpreted differently by the experimenter and the child: the adult intended to explore the child's argumentation, but in fact he/she often immediately took the child's first answer at "face value"; the child was trying to give the expected answer but did in fact guess what the adult was looking for.

Our interpretation is that conversations are usually not understood by children as meant to "display the mind and its reasoning": participants can co-construct a common discourse with little intersubjectivity, but it is often undecidable whether the children are really discussing conservation or have (or have not) reached the concept of conservation of quantities within this conversation.

In this sense, further specific analytical efforts will be useful in considering argumentation not just as a symptom of the logical structure of the child's thought, but also as a product of the interactants' conversations. Referring to previous studies on the relevance of the context within the adult-child interactions, we consider it very crucial to turn back to the role of the adult: we think that some evidence coming from our study might be considered in order to pay more attention to the delicate and difficult role of the experimenter. The adult has to offer a real place for debating, so as to give epistemic agency to the child. In other words, we need to open a space of investigation in which the adult can be considered not just as a tester, but as a player during the conversation; for this reason, we have to look at both interlocutors as responsible for the outcome of the interaction and the communication process within this asymmetrical relationship.

In the long term, we consider that multiple extensions of this study can provide a better understanding of how to design settings of interaction between adults and children in order to really have the opportunity to improve argumentation skills and to facilitate argumentation as a collaborative thinking.

## Appendix 1
## Transcription symbols

| | |
|---|---|
| . | falling intonation |
| ? | rising intonation |
| , | continuing intonation |
| ! | exclaiming intonation |
| (( )) | segments added by the transcribers in order to clarify some elements of the discourse |
| Bold | segments of special analytical interest |

## Appendix 2
## Original transcription of the data

Excerpt 2
[*((l'enfant a établi l'égalité des quantités de liquide en A et A'. Après, l'adulte change le set des verres, en utilisant A' et B))*]

7 Exp: voilà. maintenant, on prend un autre verre, on va verser tout ton sirop dans ce verre *((exp verse le sirop du verre A au verre B))* alors, si maintenant moi je bois dans mon verre et toi tu bois dans ton verre on aura la même chose de sirop. quelqu'un aura plus de sirop, quelqu'un aura moins de sirop?
8 Manon: la même chose
9 Exp: la même chose. tu peux me dire pourquoi on aura la même chose?
10 Manon: parce que celui là il est plus mince *((verre B))*
11 Exp: plus mince
12 Manon: celui là il est plus gros *((verre A'))*
13 Exp: et puis, on aura donc la même chose
14 Manon: hin hin
15 Exp: même si y en a un qu'est plus mince?
16 Manon: ouais

*((l'enfant a établi l'égalité des quantités de liquide en A et A'. Après, l'adulte change le set des verres, en utilisant A et C))*

21 Exp: je mets tout dans ce verre-là *((du verre A au verre C))* puis maintenant si moi je bois dans mon verre, toi tu bois dans ton verre on aura la même chose à boire? quelqu'un aura plus à boire, quelqu'un aura moins à boire?
22 Manon: la même chose
23 Exp: toujours la même chose, maintenant tu continues à m'expliquer pourquoi on aura la même chose?
24 Manon: parce que celui-là il est plus mince *((verre A))* ouais et *((le sirop))* puis ça va plus loin parce que c'est plus mince, celui-là *((verre C))* c'est plus élargi, *((le sirop))* ça fait ça donne moins. il est plus large. ouais
25 Exp: ok, parfait! pas plus que ça on a fini, je te remercie beaucoup

Excerpt 3
[*((l'enfant a établi l'égalité des quantités de liquide en A et A'. Après, l'adulte change le set des verres, en utilisant A et C))*]

21 Exp: on va verser ton sirop dans ce nouveau verre *((il verse le sirop du verre A' au verre B))* maintenant ce que j'aimerais savoir c'est si moi je bois dans mon verre, et toi tu bois dans ton verre, tu penses qu'on va avoir la même chose de sirop, quelqu'un va avoir plus de sirop, quelqu'un va avoir moins de sirop
22 Edy: je sais pas
23 Exp: tu sais pas
24 Edy: hin hin
25 Exp: alors je vais faire ce que j'ai fait dans d'autres classes, il regardait la forme du ver-

re, la hauteur du sirop, pour pouvoir savoir s'il y avait la même chose, si quelqu'un avait plus, quelqu'un avait moins
26 Edy: uhm
27 Exp: on peut p'têtre mettre les deux verres à côtés, regarder leurs formes,
28 Edy: bin, c'est pas la même hauteur
29 Exp: pas la même hauteur
30 Edy: hinhin
31 Exp: est-ce que tu penses qu'on va avoir la même chose, ou quelqu'un va avoir plus ou quelqu'un va avoir moins de sirop?
32 Edy je sais pas
33 Exp: tu sais pas, t'as aucune idée, t'as peut être une idée
34 Edy non
35 Exp: tu sais que dans ton verre y a le plus haut sirop
36 Edy: hin hin

[*((l'enfant a établi l'égalité des quantités de liquide en A et A'. Après, l'adulte change le set des verres, en utilisant A et C))*]

39 Exp: je prends encore un autre verre, cette fois je prends mon sirop et je le mets dedans *((il verse le sirop dans le verre C))* puis maintenant si moi je bois dans ce verre si puis toi tu bois dans l'autre verre, on aura la même chose de sirop, quelqu'un aura plus, quelqu'un aura moins?
40 Edy: ben j'sais rien
41 Exp: t'en sais rien
42 Edy: hin hin
43 Exp: pas une petite idée
44 Edy: non
45 Exp: si tu compares les deux verres tu mets l'un à côté de l'autre
46 Edy: ben c'est que celui là *((verre C))* il est plus il est plus arrondi alors c'est, ça va c'est plus bas, puis cuilà *((verre A))* il est plus petit en haut alors c'est plus haut
47 Exp: ok, en fonction de ça ça te donne une idée sur les quantités de sirop, Edy?
48 Edy: non, euh non pas spécialement
49 Exp: pas spécialement, ok, très bien, on s'arrêt là, merci bien.

Excerpt 4
[*((l'enfant a établi l'égalité des quantités de liquide en A et A'. Après, l'adulte change le set des verres, en utilisant A' et B))*]

21 Exp: je prends ton sirop *((verre A'))* et je vais le verser dans ce verre. *((verre B))* voilà. pis maintenant qu'est-ce que tu penses, si toi tu bois dans ton verre et moi je bois dans mon verre, est ce que toutes les deux on aura la même chose à boire, ou est-ce que quelqu'un en aura plus ou quelqu'un en aura moins?
22 Daria: quelqu'un en aura moins
23 Exp: quelqu'un en aura moins, c'est qui?
24 Daria toi
25 Exp: c'est moi, pis comment tu sais ça moi j'en ai moins que toi?

26 Daria: parce que c'est un plus grand verre
27 Exp: alors regarde bien maintenant, je reprends ton verre, *((verre B))* je le verse dans ce verre, *((verre A'))* pis maintenant qu'est ce que tu penses, tu bois dans ton verre *((verre A'))* et moi je bois dans mon verre, *((verre A))* est-ce qu'on aura la même chose à boire toutes les deux, ou bien quelqu'un en aura plus ou quelqu'un en aura moins?
28 Daria: j'sais pas
29 Exp: à peu près. qu'est-ce que tu en penses?
30 Daria: ouais
31 Exp: on aura la même chose à boire toutes les deux?
32 Daria: ouais, moi je crois
33 Exp: d'accord

## Notes

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[2] In his work, Piaget used the term "*épreuve*" in order to describe his interviews with children. Whereas in French there is a distinction between the terms "test" and "épreuve", as well as in Italian between the terms "test" or "prova" in English there is only the term "test" to refer to the piagetian épreuve. For this reason, in this paper we use the term "test" to refer to Piaget's idea of challenging the child's capacity to reason. In a conversation with B. Inhelder, Anne-Nelly Perret-Clermont learnt about the distinction between "épreuves" that solicit the child's judgement about a phenomenon and "épreuves" that solicit the realization of a task. In our case, the piagetian "épreuve" of conservation of quantities of liquid is intended to solicit judgement and for this reason we prefer to avoid the term "task" .

[3] Even though Piaget does not use the term "script", we will refer to the script that is supposed to structure the "usual" piagetian conversation in this test. We are referring especially to the intentions of the script that we can observe in our data.

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## Riassunto

Lo scopo di questo lavoro è quello di esporre l'interesse nel rivisitare il classico test piagetiano di conservazione dei liquidi per riconsiderare il pensiero di Piaget riguardo all'argomentazione nei bambini. In contrasto con Piaget, ipotizziamo che in una certa misura gli interventi dei bambini sono co-costruiti con gli altri attori nello specifico setting di interazione, per esempio durante situazioni di test. È possibile osservare come i bambini costruiscano mosse conversazionali in connessione con gli interventi dell'adulto. Sebbene Piaget considerasse gli interventi dei bambini in relazione al loro livello cognitivo (per esempio logico), ci attendiamo che i loro argomenti siano anche il risultato dell'interazione con lo sperimentatore e che dipendano dal quadro specifico della situazione in cui vengono prodotti.


Parole chiave: *conservazione*, *argomentazione*, *interazione adulto-bambino*, *conversazione*, *prova*.

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Le richieste di estratti vanno indirizzate a Francesco Arcidiacono, University of Neuchâtel, Institute of Psychology and Education, Espace L. Agassiz 1, 2000 Neuchâtel (Switzerland); phone: +41 0327181743, fax: +41 032718185l, email: francesco.arcidiacono@unine.ch