

# Revisiting the piagetian test of conservation of quantities of liquid: argumentation within the adult-child interaction

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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. Contrarily to Piaget, we make the hypothesis that to a certain extent argumentation is 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 to be also the result of the interactions with the tester and in particular of his/her framing of what is at stake.

**Keywords:** conservation, argumentation, adult-child interaction, conversation, test.

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The neo-piagetian and neo-vygotskian approaches of collaborative interactions within goal-directed activities and the recent advances of argumentation theories call the researchers' attention to alternative modes of considering argumentation as a process within an interaction and not only as a result. In this paper we suggest a way to revisit the classical piagetian test<sup>1</sup> 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 judgements 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.

## 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 arguments has become an important element in his method of interview (Piaget, 1924, 1926; Piaget and Inhelder, 1966). Piaget suggested that confronting children with different points of view in various situations was more relevant than simply asking them to answer questions, in order to have access to their modes of reasoning. 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 their answers. This should allow the psychologist to assess the structure of the child's reasoning and not only the individual responses. 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 relation 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 it is crucial to consider the interpretation of the task in order to understand the situation and to assess whether people reason logically.

Our claim is that Piaget's exclusive attention to the logical structures of the child's thought, and to the child's statements as a sign of them, led Piaget into an underestimation of the social and conversational dynamics involved in his 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 has seldom studied empirically this point. The study of argumentation in its con-

text remains to be done. 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 to reconsider the argumentation in children's talk beyond Piaget's own reductionistic logicism on these matters.

### The relevance of argumentation

Argumentation has been the object of research during the last decades (e. g. Kuhn, 1991; Johnson and Johnson, 1994; Golder and Schneuwly, 1996; Schwarz, Neuman and Biezuner, 2000; Erduran, Osborne and Simon, 2004; Muller Mirza and Perret-Clermont, 2009; Rigotti and Greco Morasso, 2009). Their findings contribute to the understanding of the role of argumentation as a specific form of dialogical social interaction. Research is needed to better understand why the activity of argumentation 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 (van Eemeren and Grootendorst, 2004; Rigotti, 2006; Greco Morasso, 2008) propose different ways to understand argumentation as a pragmatic process. Arguments are constructed and considered not only in relation with other arguments and not as isolated elements of a discourse, but as nested in communication processes with their implicit, their goals, and their «manoeuvring».

In this perspective, we will not to look exclusively at the quality of arguments during an interaction between children or between children and adults, but consider argumentation as a collective construction of the discourse, constrained by the dimensions of the communicative context in which it is produced (Duranti and Goodwin, 1992; Perret-Clermont, 2006; Rigotti and Rocci, 2006).

A second motive to reconsider the investigation of argumentation in piagetian tests is that we make the hypothesis that, contrarily 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 and Newmann, 1987; Light and Perret-Clermont, 1989), and to the influence of social factors in symmetrical and asymmetrical power relations (Krstic and 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 scaffold can lead to different understandings (Schwarz, Perret-Clermont, Trognon and Marro, 2008), and how the competence that a person can demonstrate is affected by the relationship context (Schubauer-Leoni, 1986; Grossen, 1988; Nicolet, 1995). Marro Clement, Trognon and Perret-Clermont (1999) have also described the

interactions between children discussing around the notion of conservation of quantities of liquid when they don't share the same point of view. The results of these lines of study have demonstrated that even a supposedly similar context may turn out not to 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, Baucal, Perret-Clermont and Marro, 2003; Tartas, Perret-Clermont, 2008). Another relevant aspect concerns the repeated question effect in the conservation test, specifically studied by Baucal and Stepanovic (2006), following the idea that children expected «one would never ask the identical question twice if a significant change had not occurred» (Rose and 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. Within similar lines of research, another series of studies have showed, by the observation of the everyday activities in different contexts of socialization (such as classrooms and families), how competencies, reasoning and argumentation are imbedded in talk and, more generally, in social situations (Pontecorvo, 1987; 2004; Pontecorvo and Arcidiacono, 2007).

Therefore, as talk is far from being always argumentative, we think that it is important to investigate specifically how and under which circumstances the argumentation between the experimenter and the child is co-constructed within their interaction and when it is likely to be argumentative. In the following part of the paper, we will present the specific situation of the piagetian test of conservation of quantities of liquid, in order to introduce a revisiting study.

### 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 then 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 glass 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 to understand the structure of the child's thought. For Piaget, the answers of the child were the symptoms of his operational stage. We quote below an excerpt of a piagetian interview with a child (Piaget and Szeminska, 1941) in its «canonical» form.

**Excerpt 1**

Source: Piaget and Szeminska [23, p. 20]. Participants: experimenter (exp.), child (Clairette, female, age: 4,0 years-old).

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|--|---|
| 1. Exp.: tu as une amie?   | Have you got a friend?  |
| 2. Clairette: Oui, Odette.   | Yes, Odette.  |
| 3. Exp.: Eh bien, tu vois on te donne à toi, Clairette, un verre de sirop rouge ((A rempli aux 3/4)) et à Odette un verre de sirop bleu ((A', même niveau)). Est-ce qu'une de vous a plus à boire que l'autre? | Well look, we're giving you, Clairette, a glass of red juice ((A, 3/4 full)), and we're giving Odette a glass of blue juice ((A', also 3/4 full)). Has one of you more to drink than the other? |
| 4. Clairette: La même chose.   | The same.   |
| 5. Exp.: Voilà ce que Clairette fait: elle verse son sirop dans deux autres verres ((B et B', ainsi rempli jusqu'à mi-hauteur)). Est-ce que Clairette a la même chose qu'Odette?                               | This is what Clairette does: she pours her juice into two other glasses ((B and B', which are thus half filled)). Has Clairette the same as Odette?   |
| 6. Clairette: Odette a plus.   | Odette has more.  |
| 7. Exp.: Pourquoi?   | Why?  |
| 8. Clairette: Parce qu'on a mis moins ((elle montre le niveau en B et B')).  | Because less has been put ((she points to the levels in B and B')).   |
| 9. ((on verse le sirop d'Odette en C et C')).  | ((Odette's juice is poured into C and C'))  |
| 10. Clairette: c'est la même chose ((exp transvase le sirop de B et B' en D, plus mince et étroit)).   | It's the same ((exp pours juice from B and B' into D, taller and thinner)).   |
| 11. Exp.: Et maintenant?   | And now?  |
| 12. Clairette: C'est moi qui a plus  | I've got more.  |
| 13. Exp.: Pourquoi?  | Why?  |
| 14. Clairette: On a versé dans ce verre ((D, montre le niveau)) et ici ((C et C')) pas.  | It is poured into that glass ((pointing to the level in D)), and here ((C and C')) not.   |
| 15. Exp.: Mais avant c'était la même chose?  | But before was it the same?   |
| 16. Clairette: Oui.  | Yes.  |
| 17. Exp.: Et maintenant?   | And now?  |
| 18. Clairette: C'est moi qui a plus ((ensuite on reverse le sirop de Clairette de D dans B et B')).  | I've got more ((Clairette's juice is then poured back from D into B and B')).   |
| 19. Exp.: Tu vois, Clairette verse aussi comme Odette. Alors tout le sirop bleu ense-  | Look, Clairette pours hers like Odette. Then, the blue juice all together ((C + C')) and  |

mble ((C et C')) et tout le rouge ensemble ((B et B')), est-ce que c'est la même chose?

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|--|--|
| 20. Clairette: C'est la même chose.  | It's the same.   |
| 21. Exp.: Alors voilà ce que Clairette fait ((on verse B dans C'' qui est ainsi rempli, tandis que B' demeure à moitié plein)). Vous avez la même chose à boire? | Then, see what Clairette does ((B is poured into C'' which is then full, while B' remains half full)). Do you both have the same to drink? |
| 22. Clairette: Moi j'ai plus.  | I've got more.   |
| 23. Exp.: Mais d'où vient ce qu'il y a en plus?  | But where does the extra come from?  |
| 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 (perceptual aspects mislead the child), intermediate stage (the child starts operating mentally but still oscillates between perceptual centration and co-ordinations), and necessary conservation (it has become obvious by 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.

**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.

### ***Aims and hypothesis***

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-constructed within the interaction with the adult and not only a sign of the child's competences. Our hypothesis is that the child's capacity to argue is not only a sign of concrete operations properly mastered to back up conservation judgements, but also a sign of the conversational competence of both the adult and the child.

### ***Procedure and instruments***

We have designed an experimental procedure to administer the test of conservation of quantities of liquid to children individually. The scope 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. 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 it 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 established again the equality of the initial quantities 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.

### ***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) on the experimental procedure. We videotaped all the interactions between 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 of the Neuchatel region.

## **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 own self-governed logical thinking. We intend to explore how the students we trained have managed their role, to what extent they were diverged from the piagetian script<sup>2</sup> prescribed, and what the children have produced as a result of the conversation 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.

### ***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 competences at a conversational level, even if it is not necessarily a sign of their cognitive level in a piagetian sense.

#### ***Excerpt 2***

Code of video-recording: Clpr1. Pre-test 1<sup>st</sup> grade. 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 to the glass B))* then, if now I drink from my glass and you drink from your glass, will we have as much *((in the two glasses A' and B))* or will someone have more juice, will someone have less juice?

8. **Manon: As much.**

9. Exp.: As much. can you tell me why we are having as much?

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 one 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 to the glass C))* and now, if I drink from my glass and you drink from your glass, we will have as much or will someone have more juice, will someone have less juice?

22. **Manon: As much.**

23. **Exp.: Always as much, now you continue to explain to me why there we will have as much?**

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). She explains to the experimenter why there is the same quantity of juice, by referring to the shapes of the glasses (turn 10 «*this is thinner*», and

turn 12 «*this one is larger*»), even if she does not make explicit 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 so, we will have the same*»). The piagetian script would have instead required from 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 to understand how she reasons.

When the experimenter, later in the sequence and using another set of glasses (A and C), is asking again a question to the child, we observe that Manon provides the answers she had provided the first time, as if she was following the previous script. In fact, turns 22 and 24 are similar to the turns 8, 10 and 12: the child repeats that there is the same quantity of juice because of the shapes of 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 be successful during the first part of the interaction. However, the script of the piagetian interview with a child does not require at all this suggestion; 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 answer of the child.

As a result, in this excerpt the child who is interacting with the adult maintains the same responses along the sequence. This behaviour seems to have been induced by the adult. 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.

### ***The adult's diversions from the script and the influence to the child***

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

#### ***Excerpt 3***

Code of video-recording: Clpr3. Pre-test 1<sup>st</sup> grade. 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' to glass B*)) now, what I would like to know is when I drink in my glass and you drink in 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 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 have more juice, someone have 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 there 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 in the glass C*)) and now if I drink in this glass and you drink in the other glass, there 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 little 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 that he is unable to judge the relative quantities to the experimenter's question about the amount of juice in the glasses (turn 22 «*I don't know*»). In accordance with the piagetian script, the adult suggests then 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 thought 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 for him why the adult suggested to look at the height of the juice as a possible element to be considered. 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 reaction (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 answer of the child (turn 34 «*no*»), this kind of «escalation» is completed by an inference of 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 states that he doesn't know how to answer the question (even if he is confronted to a different set of glasses), the experimenter tries to propose the comparison of the glasses as a possible solution. Following this suggestion, Edy describes the shapes of the glasses and the level of the juice into 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 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 give opportunities to assess the child's individual thought. The adult has repeatedly diverged from the intentions of the piagetian script and consequently induced answers in the child. However, even if trained to interview and to follow the piagetian script in testing the conservation of quantities of liquid, the adult's diversions might be an inevitable condition of the situation: within the frame of the interaction, the adult might be induced to transgress the script also because of the child's reactions. In the following part of the paper we show how the answers of the children can be considered the result of their conversational capacity to adapt themselves to the situation.

### ***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 «good answer» in the eyes of the adult, not understanding that she is 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***

Code of video-recording's code: Clpr 5. Pre-test 1<sup>st</sup> grade. 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 pouring 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 there will have as much or will someone have more juice, will someone have less juice?

22. Daria: Someone will have less.

23. Exp.: Someone will have less, who?

24. Daria: You.

25. Exp.: It's me, and **how do you know that I have less than you?**

26. Daria: **Because it's a bigger glass.**

27. Exp.: So could you have a look, I take your glass, ((*glass B*)) I pour in that glass, ((*glass A'*)) and now what do you think, you drink in your glass ((*glass A'*)) and I drink in my glass, ((*glass A*)) there will have as much or will someone have more juice, will someone have less juice?

28. Daria: I don't know.

29. Exp.: **More or less. what do you think?**

30. Daria: **Yeah.**

31. Exp.: **We will have as much to drink both of us?**

32. Daria: **Yeah, I believe.**

33. Exp.: Ok.

In this excerpt, we consider that the statements are based on the estimated (by the child) sufficient answer expected by the experimenter. In answering to the adult question about the quantities of liquid in the glasses, 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 her to argue), and doesn't provide requests for more specific explanations. She doesn't question the child about the relation between the less quantity of juice and the bigger size of the glass. In this case, the experimenter is deviating from the script and, at the same time, she is probably offering a positive feedback to the child.

In the second part of the excerpt, the adult pours back B in 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*»), without soliciting the child with more 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. It seems that, within this interaction, the adult is not able to manage the situation, and the child limits her statements on the estimated sufficient answer requested by the test. This «acknowledgement» of a minimal answer 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 seems not to have understood the piagetian goal of eliciting reasoning from the child and keeps asking for answers.

### **Discussion and concluding perspectives**

Our main idea has been to look at the reasoning of the children not only as a sign of concrete operations to

back up conservation judgements, 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, in order to provide the right answer in the eyes of the partner. We have observed diversions from the script, adult's 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 to confront children with different points of view, and not only to simply ask them to answer questions, in order 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 not a shared reasoning or an argumentation.

In the line of revisiting the test of conservation of quantities of liquid, we think that a more specific attention is crucial to understand the specific forms taken by the conversations if we want to access argumentation. In this sense, further specific analytical efforts will be useful, in order to consider 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 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. In order 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, we have to look at both interlocutors as responsible for the outcome of the interaction.

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 analyze the argumentation processes.

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#### 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-la il est plus mince *((verre A))* ouais et *((le sirop))* puis ca va plus loin parce que c'est plus mince, celui-la *((verre C))* c'est plus élargi, *((le sirop))* ca fait ca donne moins. il est plus large, ouais.

25. Exp.: Ok, parfait! Pas plus que ca 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 verre, 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 peut-être 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 il 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 la (*verre C*) il est plus il est plus arrondi alors c'est, ca va c'est plus bas, puis cuila (*verre A*) il est plus petit en haut alors c'est plus haut.  
 47. Exp.: Ok, en fonction de ca ca 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'arrête 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*) voila. 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 ca 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 meme chose a boire toutes les deux, ou bien quelqu'un en aura plus ou quelqu'un en aura moins?  
 28. Daria: J'sais pas.  
 29. Exp.: A peu pres. 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.