

Chapter

DEPICTION IN SOLVING EXPERIMENTAL TASKS AT PRIMARY SCHOOL: AN EXPLORATORY STUDY

Francesco Arcidiacono¹ and Eva Neuenschwander²

¹University of Teacher Education (HEP-BEJUNE), Biel/Bienne, Switzerland

²University of Neuchâtel, Switzerland

ABSTRACT

The study explores how different acts of depiction play a role in orienting children's thinking and reasoning during experimental tasks at school. In particular, the focus is on a revised version of the Piagetian liquid conservation experiment. The data corpus is composed of 9 video-recorded experiments taken in a Swiss primary school, involving 2-3 children (aged 6-7) per session with an adult leading the task. The experiments were an adapted version of the Piagetian original task, with the following modifications: i) the adult used three characters (soft toys) in interacting with children; ii) by animating the three characters, the experimenter was systematically introducing a counter-opinion with respect to the children's statements about the amount of liquid in the glasses. The analytical approach adopted to identify the role of depiction's acts during the experiment relies on a qualitative methodology based on the analysis of discursive interactions among participants. The findings of the study show a variety of children's reactions (verbal and non-verbal) toward different types of acts of depiction made by the adult. The results are discussed in terms of elements that can improve the argumentative capacities of children during tasks requiring a certain degree of reasoning at school. The role of the adult (as teacher) constitutes the main element in ensuring a variety of forms of teaching that can enable children's reasoning and argumentation.

INTRODUCTION

How children think has been the object of a plethora of research projects in education, globally questioning the way in which individuals function from a psychological point of view. As highlighted by Siegler (2001), thinking is dynamic and constantly changes as a result of evolutionary developmental processes. This seems to be an acute observation, yet one which

also is sometimes illogical and irrational in the eyes of an adult: “*why, for example, would a child of 5 years old who is in other respects reasonable, say that to pour a glass of water into a container of a different form would change the quantity of water, even after having been informed by an adult that the quantity was the same as before?*” (Siegler, 2001, p. 7). This question hints at recognizing the fact that underlying children’s ways of thinking are complex processes which make up the curricula competences at school, such as classification, problem-solving and reasoning. Piaget (1964, 1970) was already interested in studying intelligence and more specifically the way in which individuals reason and, in developing his theory, he highlighted the social nature of intelligence: “*the recognition resulting from the construction through exchanges between the individual and the environment (...), the interaction between the subject and his environment, alone or collectively, is the only producer of knowledge*” (Perraudau, 2002, p. 145, our translation). This highlights the direct link between the construction of thought, of reasoning and the external environment, taking into consideration pre-existing mental structures which the child uses in order to integrate the contributions of the social experience (Perret-Clermont, 1979; Liengme Bessire, 1995), and further suggests the importance of considering the conditions in which the child reasons.

In this study, we are interested in examining the links between children’s reasoning and their social interactions in the context of learning. More specifically, we suggest an observation of the reasoning of the child whilst interacting with an adult in the specific context of a liquid quantity conservation task. Our decision to revisit Piagetian theory with a specific focus on the reasoning of the child in context has lead us to include an added linguistic dimension to the adult-child interaction during the aforementioned Piagetian task. In fact, in the study presented here, the child will not be alone with an adult during the execution of the task, but will be faced with many ‘characters’ (sometimes soft toys animated by the experimenter). The adult will thus engage in acts depiction, whilst animating the characters and speaking through them. In this article, we therefore wish to observe the role of the actors in depicting the characters and in which moments they are used by the child in completing a task at school. The analysis of these various aspects could give rise to reflections on education in the context of interaction and the different stimuli which the adult (either the experimenter or indeed the teacher) could use to enable the child’s reasoning capacity.

THE NOTION OF DEPICTION AND ITS COMPONENTS

In order to briefly present the concept of depiction, we will draw upon pre-defined processes of signalling and demonstrating in particular. We refer to Davidson and Noble (1989) who define depiction, the key term of our study, as “*the deliberate marking of marks on surfaces or other modification of objects such that an image or pattern results which is recognizable as an image of something*” (p. 125). The actions by which a person signifies something to another, in other words signals, are composed of signs deliberately created within interactions for communication (Clark, 1996): an element is only a sign if it is addressed to someone, thereby creating the conditions for an interpretation of the sign (for example, words, gestures, noises). Furthermore, signs are part of a relationship between an object and an interpretation: if we take the example of a portrait, the object is the person themselves, the sign is the portrait of the person painted by the artist, and the interpretation is the idea itself of the person.

Specifically, it is possible to recognize 3 types of signs: the icon, the index and the symbol. The icon is a resemblance on a perceptive level, the object is that which it represents (for example, the portrait of a person is an icon because it resembles, on a perceptive level, the person). The index is a sign designating its object. It is, in some way, in dynamic and spatial connection to the object and in another way connected to memories, general knowledge of the world and/or the meaning of the person who is interpreting the sign (let's take the case of a weather vane: it is first and foremost an index of the direction of the wind because it is moved by wind direction and because it is in dynamic and spatial connection to it. Furthermore, when we see a weather vane pointed in a certain direction, it draws our attention to this direction and, in connection to our meaning making and knowledge, we know that the direction in which it is facing is as a result of the wind – because of our general knowledge of the world). The symbol is a sign which the individual could attribute a signification as a result of its representative characteristics (it is therefore a sign which refers to the object which it is denoting). All conventional signs, for example a 'stop' sign, are symbols. Letters, words, phrases and discourses are also symbols as we attribute a certain significance to them (Peirce, 1993). In everyday conversation, as well as in school, various types of signaling are used with different types of signs – in other words, icons, indexes and symbols. These different types of signaling include describing, therefore using conventional forms of language, indicating by using pointing and demonstrating – that is to say iconic gestures (Clark, 1996). Describing consists of using symbols in a verbal, non-verbal or acoustic way. In verbal language, individuals use a linguistic system such as French or English in their speech with certain words having a certain signification. In non-verbal language, individuals interacting use gestures, for example moving the head up and down to signify 'yes.' In terms of acoustics, we make use of little sounds made by the body to signify certain things (for example, clicking the tongue could signify discontent). Indicating is a method of signaling by which interactions create indices for objects to which they are referring. When interlocutors want to indicate a state, an event or an object, they refer to the index which is a physical sign connected to the element to which the interlocutor wants to refer. However, pointing is not the only means of indicating: other parts of the body, apart from the hands, are often used (such as the eyes or the head, the voice, or other objects like an ambulance siren or the ringing of the telephone).

The final type of signalling is demonstrating, which uses icons as a type of sign. It refers to a type of selective depiction (Wade & Clark, 1993) – in other words, one only demonstrates certain select aspects of what others have done or said. For example, one doesn't make a direct reference to reported speech, a quote in which one cites word-for-word what the previous person has said, or one doesn't do exactly the same thing as was previously done by another. Furthermore, demonstrating is considered as a non-serious action (Clark & Gerring, 1990), in other words actions which are not real in the sense that the interlocutors pretend, acting out their actions as though they are actors. Let's take the following example to illustrate our ideas, inspired by the work of Clark (1996): when George says to Helen, "Elizabeth drinks her tea like that," he holds an imaginary cup of tea in his right hand, brings it up towards his lips and pretends to drink. Through these actions and by using icons, George is demonstrating to Helen how Elizabeth drinks her tea. He is therefore demonstrating.

Clark (1996) indicates that demonstrating is composed of four different aspects: depictive aspects (the actions which are enacted during demonstrating: in the example cited above, when George reproduces exactly the same gesture of Elizabeth when she drinks her tea); supportive aspects (aspects of demonstrating which are not meant to be represented but which support and

allow for the performance of actions: George doesn't use a real cup of tea, neither does he really swallow and Helen knows that Elizabeth does not drink from an imaginary cup of tea nor pretends to swallow when she drinks. She understands that these are aspects which need to be included by George in his demonstration in order to act); annotative aspects (aspects of demonstrating which are considered to be simultaneous comments to what is being demonstrated. For example, George exaggerates Elizabeth's actions when he acts out her way of drinking tea. These exaggerations are comments on what he is demonstrating); and incidental aspects (aspects of demonstrating which are incidental to the objective of the demonstrator, what is left of the demonstration outside of the depictive, supportive and annotative aspects). In general, the act of demonstrating encompasses an instrument and an act of depiction. Interlocutors mainly use their body (hands, arms, face, voice) as an instrument, in an auditory, visual or tactile manner. The act of depiction therefore involves actions constituting aspects enacted through non-verbal acts as well as directly reported speech. We will further examine this particular notion in the following section of the article.

ACTS OF DEPICTION AND TYPES OF GESTURES

In presenting non-verbal acts associated with the act of depiction, we have highlighted how it is possible to include iconic gestures, facial and vocal, which do not have a linguistic structure (Clark & Gerring, 1990). Iconic gestures refer to those gestures which we use to illustrate our point, normally when we are explaining something. It's what we use, for example, when we give directions to someone to arrive at a precise location: in performing these actions, the individual uses gestures (using hands and arms) to anticipate the words which accompany them and to synchronise them with speech. Facial gestures are done through movements of the face, such as smiles, raised eyebrows or expressions: they express emotion such as surprise, disgust or sadness, or, in conversation, iconic gestures. For example, turning up one's nose could be used in order to show disgust. Vocal gestures involve the tone of voice, onomatopoeia, intonation and prosody. Directly reported speech forms an integral part of using verbal language in terms of demonstrating what the person did in saying something. In terms of the speech of others, the interlocutor operates using acts and selects certain listed aspects which fall into three categories (Wade & Clark, 1993): the delivery using the pitch of the voice (man, woman), age (child, adult or elderly person), quality (hoarse, nasal, etc.) and the emotional state (sarcasm, anger, joy, etc.); the language relates to the language itself (English, French, Italian, Japanese, etc.), accents (Quebecoise, Swiss German, etc.), and the register (formal, informal); the linguistic act mainly relates to the illocution (questions, requests, promises) and locaters (quoted speech).

The elements listed show us how the act of depiction could seem to be and is used in spontaneous interactions. In this article, we aim to explore its uses within the framework of tasks requiring creative problem-solving in situations of testing in school. More specifically, we have chosen the liquid conservation task implying a verbal and gestural interaction among the participants. Our objective is to understand which type of responses the child gives following acts of depiction made by the adult facilitating the task. These aspects could inform us as to the capacity of the child in interaction or the possibility of using different channels of

communication for creative problem-solving through practices of reasoning, explicitation and argumentation.

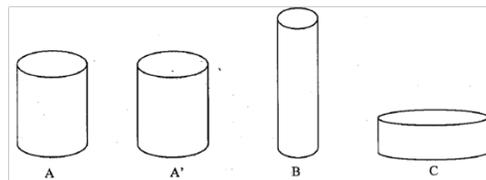
METHODOLOGY

Material for Analysis and Tasks

The study presented here is part of a larger research project¹ which aims to analyze the argumentative capacities of children during tasks requiring reasoning, inspired by Piagetian theory. For this work, we filmed 9 videos (shot between 2009 and 2010 at a primary school in Cernier, Switzerland). These videos are of clinical interviews focused on the task of liquid conservation. For each film, between two and three children of third year HarmoS² (six to seven years old) participated in the task. Two experimenters were present, one facilitating the task and the other in the role of observer. The interactions recorded with the use of cameras were transcribed.

During the execution of the task, the experimenter conducted interviews in order to “*speak freely with the child about a specific theme, consequently in order to follow the detours of their thoughts to bring them back to the theme and get justifications, experience consistency and make contra-suggestions*” (Dolle, 1999, p. 18, our translation). This type of interaction allows children to make explicit their forms of reasoning, rendering them accessible to others and according “*a particular type of rationality*” (Arcidiacono & Perret-Clermont, 2010a, p. 2, our translation).

For the liquid conservation task, the experimenter placed two glasses of equal size (A and A') in front of the child, which both contained the same amount of liquid. After ensuring that the child saw that the two glasses, A and A', were equal, the experimenter poured the liquid from glass A into another container of a different size (B). He/she then asked the child if the amount of liquid in glass B was the same as that in glass A.' The following step consisted of pouring the content of glass A into glass C which had a different shape to glasses A, A' and B. The experimenter asked the child again whether or not the liquid in glass C was the same as that in glass A.' Here is a diagramme of the various containers used for our purposes:



Source: Arcidiacono and Perret-Clermont, 2010b, p. 123.

Figure 1.

For the present research, two further components were added to the research design described above: firstly, three little soft animal toys (a giraffe, a bear and a monkey) were

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² Swiss intercantonal agreement on school harmonization.

animated by the experimenter using a made-up story. The experimenter explained to the children that these characters were at a birthday party and that they all needed to have the same amount of juice to drink in their glasses (“I would you like you to give them all the same to drink”). For the child, the objective was to give all the characters the same amount to drink in order for them all to be satisfied. The other added component was the fact that the experimenter introduced an opinion which was systematically opposed to that of the child during the execution of the task. This was done either through the characters themselves (who were not happy to have less to drink than the other animals) or by another fictional child who had done the task beforehand and who had given a different answer to that of the subject.

Variables

The independent variables for which we controlled are the following: presence/absence of an act of depiction; use/non-use of soft toys; mention/non-mention of a fictional child. In terms of dependent variables, we considered the children’s reactions in response to an act of depiction made by the adult. The variables for which we controlled also included the age of the child and their scholastic level.

Criteria of Analysis

The interactions recorded with cameras during the execution of the tasks were transcribed by using an adapted version of the system elaborated by Jefferson (1985), on the basis of the following schema:

.	descending intonation	,	ascending intonation
?	interrogative intonation	:	elongation
!	exclamatory intonation	()	silence
(())	Comments of the transcriber to explain the context		

Concerning the analysis, we first watched the video sequences and proceeded to a synoptic pre-analysis in order to identify, in the transcriptions, the acts of depiction made by the experimenter. Thereafter, we categorized the aspects of the acts of depiction used within the body of data selected according to the following aspects: iconic and vocal gestures for non-verbal acts; diction, language and linguistic acts for direct reported speech. We then turned to the reactions of the children which followed the acts of depiction made by the adult and we categorized them using an inductive qualitative procedural analysis (Arcidiacono, Baucal & Buđevac, 2011).

RESULTS

What was extracted from the data was classified according to 5 aspects concerning the acts of depiction made by the experimenter: 1) for iconic gestures, the experimenter moved the character each time from left to right according to the rhythm of the speech. This movement already started before the experimenter started to speak; 2) in terms of vocal gestures, the adult changed the tone of their voice to express satisfaction when one character had more to drink than the others, dissatisfaction when they had less to drink, or confusion when the character didn't understand something; 3) in terms of delivery, used a voice which she modulated to make it more shrill. This was used to show that one of the characters was speaking; 4) for language, the experimenter spoke in French without using an accent and applying an informal register in her speech, including the familiar use of abbreviations such as 'I'm' instead of 'I am'; 5) the linguistic acts used were locutory, through the experimenter's statements ('yeah, I'm pleased'), but also interlocutory through the use of questions ('you said 'yes,' why'd you say 'yes'?') and through requests ('ah, but you need to explain to me because I don't understand it very well'). These elements of acts of depiction allowed the experimenter to create an imaginary dimension whereby the characters could interact with the child in solving the task.

On the basis of this observed data, we identified the following types of reactions (in response to the adult's acts of depiction, isolated or grouped), as well as the arguments used by the children in their reactions:

- Argument of identity, when the child based their responses on the identity of the object (the size of the glass) with the liquid (amount of liquid)

63 Experimenter: okay but I'm right so I've definitely got less, right? I don't understand very well.

64 Child: that's a smaller glass (*glass B*) so you would think that there's more to drink but actually there isn't.

- Argument of reversibility, when the child reverses the transformation (pours the liquid from one glass to another)

173 Experimenter: okay so we can all have something to drink, and then Line (*the second child*) does she agree? can you also explain to me?

174 Child: that one's bigger over there (*glass B*) and that one (*glass A*), we poured what was in it into that one (*into glass B*) and so it's the same thing.

- Argument of compensation, when the child reasons based on the apparent changes or on the reversibility through relational reciprocity

81 Experimenter: do you know how to say that? do you think we can help you? because the little bear is saying, he says that he thinks it's the same thing as before, because if I drink out of this glass, if the monkey drinks out of this glass and the giraffe out of his glass, she'll have more to drink than me again.

82 Child: I have an idea

83 Experimenter: ah, you have an idea? explain it to me

84 Child: okay so that one ((*glass C*)) is bigger than that one ((*A*)) so we should pour it into that one. ((*A*)) ((*cf. Figure 1*))



Figure 1.

- Argument of equality, used by the child when he or she says that all of the glasses have the same quantity of liquid because the juice is found at the same level, independent of the circumference of the containers

176 Experimenter: ((*the giraffe*)) but how can I decide? you say yes, ((*child 2*)) you say no ((*child 1*)) and you say yes ((*child 3*)) can you explain to me?

177 Child: in fact you saw there ((*in C*)) it's not the same size ((*compares one of the two glasses with the same shape to that of glass C*)) ((*cf. Figure 2*))



Figure 2.

- Declaration of ignorance, when the child responds to a question of the experimenter by saying 'I don't know'

44 Experimenter: yeah? giraffe are you happy? ah yes yes, I'm happy, I've got a lot to drink and I love juice. ah, the giraffe is happy. little mokey, are you happy? ah yes, I'm very happy, I really like my juice. little bear, are you happy? ah no, I'm not happy - I've got less to drink than giraffe. ah. they're not happy, what do you think about that? mh?

45 Child: I don't know

- Gestural reaction: the identified elements are associated with moments in which the child manipulates the containers, often following a command of the experimenter, for example to pour the liquid from one container into another

39 Experimenter: yes, are they all happy? ah no, I'm not happy, because I've got less juice *((the teddy bear's voice))*

40 Child: *((takes the flask of juice, adds some for the teddy bear))* we've given everyone

- Continuing the act of depiction, when the child also makes the stuffed toys speak or when he or she stays in a fictitious world, speaking to the characters as if they had feelings, intentions and a certain level of reflection

134 Experimenter: okay little bear, do you think that you have the same to drink as little monkey? oh yes, I think I have the same thing to drink. and you little monkey, do you have the same to drink as little bear? yes, I'm happy with it.

135 Child: *((speaking in the place of giraffe, cf. Figure 3))* I've got nothing.



Figure 3.

- Expression of opinion which consists of confirming or affirming a hypothesis formulated by the experimenter or when she asks the child if the stuffed toy is right

Experimenter: *((giraffe))* okay, I can drink from this one *((shows glass C))*

Child: yes

- Demand for an explanation as a reaction to the act of depiction

33 Experimenter: well I don't think I have the same thing. *((speaking as the monkey, cf. Figure 4))* little giraffe, do you think that you have the same amount to drink as little bear and little monkey? I don't think so. *((speaking as the giraffe this time))* I don't think that we have the same. I think that I've got more than moneky. little bear, do you think that you have the

same amount to drink as little giraffe and little monkey? yes, I think all three of us have the same thing *((speaking as the bear))* they don't agree...

34 Child: these two: *((the monkey and the giraffe))* this one and then this one?



Figure 4.

– No reaction to the act of depiction of the adult

67 Experimenter: so we all have the same amount?

68 Child I: uhum: *((affirming, cf. Figure 5))*

69 Child II: yes.

70 Experimenter: but,

71 Child II: ()



Figure 5.

DISCUSSION

In terms of acts of depiction made by the adult, there is only one overarching type which is composed of different aspects: iconic gestures, facial and vocal cues in the category of non-verbal aspects, and the delivery, language and linguistic acts in the category of directly reported speech. We have observed that the different aspects in the act of depiction do not have the same impact on children's reactions since, despite the fact that the aspects involved in the act of depiction remain the same each time, children's reactions are varied and diverse. Nevertheless,

we acknowledge the role of gestures which contribute to creating and maintaining an image in space and time (Gibson, 1966). In fact, this allows the establishment of a direct relationship between the act of depiction and the object itself, and contributes to the development of communication between the people concerned (adult-child or child-child). This phase related to signs related to the context would therefore provide a preliminary means towards the capacity for decentralization and referral to a more reflexive system of thought and communication.

In terms of the types of reactions of children following an act of depiction made by an adult, we identified a large variety: arguments of identity, reversibility and compensation refer directly to the capacity of children to solve the proposed task of conservation. The equality argument completes this aspect and was expressed during the periods in which children thought that it was only when the liquid in different containers was at the same level that each contained the same amount - independent of the difference in circumference. This is a typical argument presented by children who are not yet at the conservation level. In terms of gestural reactions, we observed that the children, in the majority of cases, were pouring the liquid from one glass to another only following the command of the experimenter, and not out of their own accord. We could therefore ask ourselves whether or not the act of depiction could enable certain gestural activities in the child in these types of situations which require problem-solving tasks with the possibility of manipulating the objects at the child's disposition.

Sometimes, acts of depiction do not in fact enable argumentation. This is what we observed when the child claimed ignorance, which could also be a strategy used by the child in order not to have to give a response. We also observed that the child enters into an imaginative space during the times in which the adult produces acts of depiction. In fact, the adult manipulates the stuffed toys by giving them words, emotions, reflections, gestures and so the child enters into a space of 'parallel reality' by him- or herself engaging in acts of depiction in turn, taking the place of the stuffed toys or attributing intentions to them. We could also consider that when the child expresses an opinion when the experimenter asks him or her to confirm or refute a hypothesis which she formulates, or asks him or her to give an opinion, is also related to particular acts of depiction which demands that the child expresses an opinion. We also propose that the act of depiction has an effect on children's speech when they state a hypothesis which others must confirm or refute or when they're asked about the opinion of someone else. We also observed that children have a tendency to declare their knowledge using certain formulations as 'me, I know': they are used as a prelude to the explanation but also as a way of having the floor by attracting the attention of their interlocutor.

In light of these results, the role played by acts of depictions in the reflections of the child through the liquid conservation task are multiple. Firstly, the act of depiction could enable the emergence of opinions and argumentation in the child. This is what we observed in different instances, concerning arguments of compensation and equality. This aspect is an interesting element to take into consideration in the implementation of educational activities by the teacher. In fact, what the adult asks the child and the contingent manner in which acts are represented in the problem-solving of a task constitute forms of interaction which could enable reflection and reasoning in the child. Teachers who find themselves in situations of having to "test" the child with tasks that require the implementation of different forms of reasoning (as well as the capacity to argue their choices when formulating a response) could possibly benefit the use of a variety of different verbal and non-verbal forms of language accompanied by acts of depiction. One needs to be conscience of the effects of these acts (of different forms) could

produce in specific interactions created with children and using different objects for experimental tasks at school.

CONCLUSION

The question raised in this study is to understand the role of acts of depiction, as made by adults in children's reflections during a liquid conservation problem-solving task. We observed that the act of depiction is composed of a variety of gestures, including both non-verbal and directly reported speech, themselves composed of a variety of sub-types. To identify which type of response the child was giving, in response to acts of depiction made by an adult, it is important to take into account the various aspects used in each act of depiction and the subsequent reaction of the child. These elements constitute fundamental aspects for implementing interactive situations in the classroom when asking children to engage in problem-solving requiring different levels of reasoning.

To conclude, we could highlight the fact that the act of depiction enables children to express their opinion as well as to produce arguments, provided that the adult is able to use a wide range of possible modalities. In order to widen the scope of this research, it would be interesting to compare the reactions of children in the presence or absence of acts of depiction to corroborate these results. In our opinion, these aspects are key elements to consider in the implementation of tools aimed at enhancing argumentation and various forms of reasoning among children in experimental problem-solving easily done in a classroom context. Further reflection on these elements could also be linked to a deeper understanding of 'what the teacher actually does' (in terms of practices, actions, activities) in interacting with students engaging in experimental tasks. Therefore, the objective would be to put the different theoretical frameworks into perspective, alongside the linguistic and gestural forms of interaction in learning situations (Peterfalvi & Jacobi, 2003). As shown by Filliettaz and Schubauer-Leon (2008), this interest in interactional processes in the domain of education involved a ternary organization (including two people interacting and objects of knowledge) which goes beyond a student-teacher relationship. A thorough analysis of exchanges allows us to identify the meanings constructed during the interaction, to distinguish between different communicative gestures which accompany, guide and complement the verbal productions and praxis actions directly linked to the achievement of the task. The analysis of multiple modes of communication among students and teachers contributes to the expansion of this analytic approach towards teaching and learning in the classroom in different forms of interaction, particularly in test situations.

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