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Re-conceptualizing "Scaffolding" and the Zone of Proximal Development in the Context of Symmetrical Collaborative Learning

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ABSTRACT

The linked concepts of 'scaffolding' and the Zone of Proximal Development (ZPD) were originally applied to the context of asymmetrical teaching and learning with a teacher or adult explicitly supporting a learner, usually a child, to achieve tasks beyond their ability when working alone. In this paper we investigate how these concepts need to be reconceptualized if they are to be applied to the different context of symmetrical learning amongst groups of peers. We present two separate studies. In the first one we analyze the type of talk used by a group of children from Mexico solving the Raven's Standard Progressive Matrices (RSPM) test together both before and after an intervention program teaching 'exploratory talk'. Our analysis demonstrates a ZPD created by the way in which they talk together. In the second study we present the comparison of the talk of two groups of children, one from Mexico and the other from the UK, solving together a single matrix from the RSPM test. Our analysis shows how the concept of 'scaffolding' can be applied to understand how these groups of children use language to support shared thinking and learning. In both studies we found that applying ideas of 'scaffolding' and the ZPD to symmetrical learning required the re-conceptualization of these concepts as characterizations of dynamic processes within dialogues.

INTRODUCTION

The linked concepts of 'scaffolding' and the Zone of Proximal Development are central to many recent accounts of teaching and learning. Bruner (l978) describes 'scaffolding' as cognitive support given by teachers to learners to help them solve tasks that they would not be able to solve work ing on their own. He goes on to describe this as a form of "vicarious consciousness" in which students are taken beyond themselves through participation in the consciousness of the teacher. This conception of 'scaffolding'

is closely related to Vygotsky's concept of the Zone of Proximal Development (ZPD), which is described in Vygotsky's own words as:

> *The distance between the actual developmental level as determined by independent problem-solving and the level of potential problem solving as determined through problem solving under adult guidance or in collaboration with more able peers. (1978: 86)*

Although collaboration with peers is mentioned here by Vygotsky, it is noticeable that he refers only to "more able peers," thereby implying that an intellectual asymmetry must exist between participants in any joint activity. This is in keeping with Vygotsky's more general account of teaching and learning in which this same asymmetry is assumed. However, as many researchers have noted (Littleton & Light, 1999; Cowie & van der Aalsvort, 2000) learning also occurs in collaboration between students who have similar levels of conceptual understanding. That is, learning and development may also result from 'symmetrical' interactions. Exploring the discourse of participants in this particular situation can help us to understand the process of learning more generally. In this article we will use our analysis of the process of problem solving and learning in small groups of children to re-evaluate the concepts of 'scaffolding' and the Zone of Proximal Development. We begin by considering each concept in turn.

THE ZONE OF PROXIMAL DEVELOPMENT (ZPD)

In Vygotsky's original work (e.g.. 1978; 1987) the ZPD is offered as a dynamic alternative to the models of individual ability used in conventional psychological testing. Instead of assessing what an individual child can do unaided, Vygotsky proposed assessing what an individual was capable of with the help of an adult or teacher. He hypothesised that children who might have reached similar levels of conceptual development might nevertheless differ in their potential or readiness to achieve higher levels of understanding, and such differences would be revealed by offering children structured help. As with so many of Vygotsky's interesting ideas, however, it has been left mainly to others to explore the im plications and potential of the ZPD for psychological and educational research.

Rogoff and colleagues (Laboratory of Comparative Human Cognition, 1983, Rogoff, 1982b, Rogoff, Gauvain and Ellis, 1984; in Rogoff, 1990) have taken the ZPD to be a key element in the culturally based process of learning, whereby children "appropriate" knowledge and skills from more expert members of their society. This is a development of Vygotsky's claim that cognitive processes appear first at the social (intermental) level, and are then internalized and transformed as individual ways of thinking (the intramental level) (Vygotsky, 1987). In this formulation, the ZPD is precisely that dynamic region where the intermental folds in to become the intramental: a region in which the child develops through participating in the solution of problems with more experienced members of his or her cultural group. Rogoff's thesis is that the development of the child towards more able ways of participation in society is carried out through a process of 'guided participation,' which may or may not include explicit teaching.

Wertsch (1978, 1979, 1981, 1985 in Tharp and Gallimore, 1988) has applied the concept of the ZPD to an analysis of the language of interactions between teachers and learners. He describes how a teacher, parent or more capable peer offers directions or modelling to the child, which the child responds to in an imitative way. Similarly, researchers working in classroom contexts have described how a teacher can enable a learner to understand and complete a task using linguistic 'scaffolding tools' such as questions, feedback, and explanations of the structure of the task (Maybin, Mercer, & Stierer, 1992; Mercer, I995). Also drawing on school-based research, Newman, Griffin and Cole (1989) argue for a re formulation of the concept of the ZPD, suggesting that it

needs to be expanded beyond the individual and asymmetrical focus found in Vygotsky. They employ the concept in a more general sense to designate the space or 'construction zone' where culture and cognition create each other. Through 'symmetrical' interactions, they suggest, children can appropriate ways of understanding that are a result of their efforts to apply the tools of their culture. In this way, the culture is regenerated by the efforts of learners as they work together to use and adapt the tools provided by their ancestors. Interactions within the ZPD are considered by these authors as the generators of development and culture, in the sense that such interactions give to each child the opportunity to par ticipate in activities and goals that would be very difficult for them to achieve alone.

SCAFFOLDING

Wood, Bruner and Ross (1976), introduced the notion of 'scaffolding' as a metaphor for the way an expert 'tutor' (such as a parent) can support a young child's progress and achievement through a relatively difficult task. They describe six functions of the tutor in scaffolding of the activity of the child (summarized here in paraphrase):

1. To orientate the child's attention to the version of the task defined by the tutor.
2. To reduce the number of steps that are required to solve a problem, thus simplifying the situation in a way that the learner can handle the components of the process.
3. To maintain the activity of the child as she/he strives to achieve a specific goal, motivating her/him and directing her/his actions.
4. To highlight critical features of the task for the learner.
5. To control the frustration of the child and the risk of failure.
6. To provide the child with idealized models of required actions.

As mentioned earlier, 'scaffolding' was described by Bruner as a "vicarious consciousness," a temporary intellectual support which a teacher offers in order to draw the learner up towards a higher level of understanding. This formulation appears to assume a prior understanding of the solution of a problem, or a conception of the ideal outcome of a task, on the part of the person providing the 'scaffold'. This is problematic if we wish to apply the concept to a more symmetrical kind of collaboration (e.g. amongst peers) in which no participant knows the solution to a problem in advance, but they all work together in a group to discover the answer. This problem generates two questions which we aim to answer in this paper: can the concept of scaffolding be made useful for understanding learning in symmetrical groups; and if so, what reconceptualization is required?

THE INTERMENTAL DEVELOPMENT ZONE (IDZ)

Drawing on both the concepts of 'scaffolding' and the ZPD, Mercer (2000) has proposed that a new concept may be useful for understanding how that interpersonal communication can aid learning and conceptual development. He calls this concept the Intermental Development Zone (IDZ). This concept is meant to capture the way in which the interactive process of teaching-and-learning rests on the maintenance of a dynamic contextual framework of shared knowledge, created through language and joint action. This con textual frame supports the mutual orientation of participants to a shared task; and in the case of a productive interaction between a teacher and learner, this frame will be finely at tuned to the extent of the learner's changing understanding as the activity progresses. The concept of the IDZ focuses on the nature of the communicative process whereby the "vicarious consciousness" of Bruner's conception of 'scaffolding' is actually realized; and unlike the original ZPD, the IDZ is not a characteristic of

individual ability but rather a dialogical phenomenon, created and maintained between people in interaction. The IDZ embodies the following claims which may be relevant to symmetrical as well as to asymmetrical teaching and learning: (a) any joint, goal-directed task must involve the creation and maintenance of a dynamic, contextual basis of shared knowledge and understanding; (b) language use during joint activity both generates and depends on the creation of this contextual framework; and (c) the success of any collaborative endeavour will be related to the appropriateness of the communication strategies participants use to combine their intellectual resources. We explore these ideas further later in this paper using empirical data of children working together in small groups.

EXPLORATORY TALK

The transcripts which we use in this article came from research projects in which primary age children in the UK and Mexico were explicitly taught how to talk together effectively. The concept of 'exploratory talk' is important for understanding these projects as it was used as the basis of the teaching programs.

Mercer and Wegerif (Mercer 1995; Wegerif and Mercer, 1996, Mercer and Wegerif, 1998; Wegerif, Mercer and Dawes, 1999; Wegerif and Mercer, 2000) have characterized three educationally significant ways of talking, arguing that the three can be considered as social ways of thinking. The three types of talk that they have defined are the following:

a) *Disputational talk:* characterised by disagreements and individualized decision-making, and short assertions and counter-assertions.
b) *Cumulative talk:* speakers build positively but uncritically on what the other has said; it is characterised by repetitions, confirmations and elaborations and lastly,
c) *Exploratory talk:* participants engage critically but constructively with each other's ideas, offering justifications and alternative hypotheses. Knowledge is made publicly accountable and reasoning is more visible in the talk, and progress results from the eventual agree ments reached.

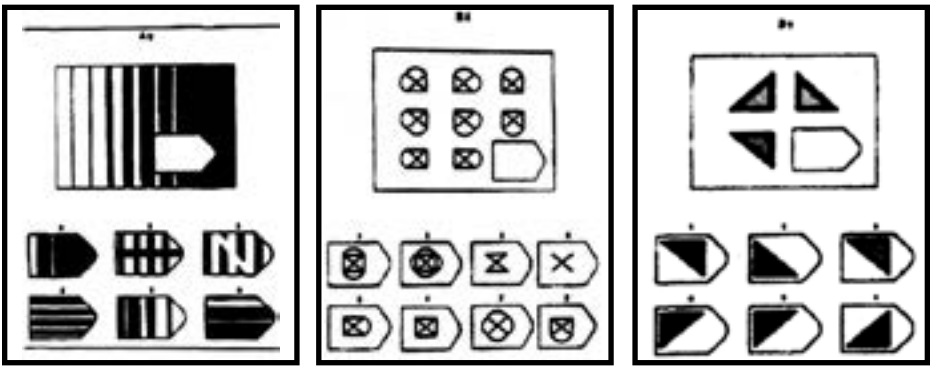
The typology of three types of talk emerged from in vestigations of children talking in groups at a variety of cur riculum tasks and from different countries. Illustrations are given in Mercer (1995), Wegerif and Mercer (1997), and Rojas-Drummond and Fernandez (in press). In this paper we focus on children's talk around problems of the Raven's Standard Progressive Matrices test (RSPM), and the three following examples illustrate how the typology can be applied in this context.

SEQUENCE 1: DISPUTATIONAL TALK

In the first sequence, two British girls and one boy (10 years old) are trying to find the solution to the matrix A9 in the RSPM test together.

Sue: That one is *(pointing to the options)*.
Nicole: Shush. I haven't even had a chance to look at it yet.
Sue: It s that one *(pointing to option 1)*.
Fred: No, it isn i. II Number 1.
Nicole: No, it s not. Cause look *(pointing)*.
Sue: Number A9 is number 1.
Nicole: No it's not. Cause look, that s thin there, and that. II Yes it is, it s that one *(pointing to option 5)*.

Figure 1. Matrix 1, 2, and 3 used in Sequence 1, 2, and 3, respectively.



Fred:	It s that one *(pointing to option 1)*.
Nicole:	No, it s not.
Fred:	lt's that one *(pointing to option 1 and turning the page over)*.
Nicole:	It's your fault. If we get it wrong, it s your fault.
Fred:	It s myfault, why is it myfault? She was the one who said it first!

In the sequence we can see that there are several initiations proposing specific options as the answer for the matrix (i.e., *"it's that one"*). Most of them are followed by challenges (i.e., *"no it isn't"*; *"no it's not"*) without an argument. This resulted in a lack of clear resolution for all the children, as Nicole was not convinced at the end of the sequence that the option finally chosen is correct (*"It's your fault. lf we get it wrong, it's your fault"*). Although the resolution of the prob lem was correct by choosing option 1 as the answer, this was not built directly on the previous utterances and the agree ment of the members of the group.

SEQUENCE 2: CUMULATIVE TALK

In the second sequence, another group of British ten year-olds is trying to find together the solution to the matrix E8 in the RSPM test.

Tina:	E8 now.
Gerard:	That and that make that *(pointing to two options)*.
Pat:	I think it is that *(pointing)*.
Gerard:	Yes, so do I.
Tina:	I think it s that too.
Gerard:	Yes, Iagree on it anyway.
Tina:	7?
Pat:	Yes
Tina:	Oh, I'm tired

In the sequence we can find that initiations are accepted without discussion (*"Yes, so do I"; "I think it's that too"*), and the conversation between the pupils consists only of additions that do not develop previous ideas. Gerard attempts to find a solution by suggesting that two elements combined make a third one (*"that and that make that"*). However, the following utterances do not elaborate in this first sugges tion. It is quite evident that the conversation lack of any critical challenge of ideas and arguments to decide about the answer, as Gerard mentions later (*"I agree on it anyway"*). Therefore, the answer decided cumulatively through the exercise is incorrect.

SEQUENCE 3: EXPLORATORY TALK

In the third sequence, Tina, Gerard and Pat try to find the solution to another matrix (B7) in the RSPM test.

Tina:	I think it's that one *(pointing to option 1)*.
Gerard:	No, it can't be that one. I think it s number 6 to be honest. Actually, she is right, I think it is that one *(pointing to option 1)*.
Pat:	No, because look. That's the same side as that one *(pointing to option 1 and one element of the matrix)*.
Gerard:	Oh yes.
Pat:	It has... That one and... That's number 5.
Gerard:	No, it's number 6. Look, because they are going like that *(pointing to the angle of one option)*, turn it upside down and you will find out.
Pat:	No, it's got a straight edge. Look.
Gerard:	If you turn it up like that it will be like that, so...
Pat:	Yes, so it's got to be the triangle, look the triangle is going the opposite.
Tina:	No that's the same as that *(pointing one element in the matrix)*.
Pat:	No, if you look closely. Look, that end ispointing that way, that end is pointing that way *(pointing angles in the options)*.
Gerard:	You haven't got that so it would be going like that. Pat: I think it's number 5.
Tina:	Yes.
Gerard:	I think you are right. OK.

In the sequence is evident that initiations (i.e. *"I think it s that one"*) are challenged and counter challenged with hypotheses which are developments of that initiation (i.e., *"No, because look. That's the same side as that one"*). The solution is achieved through the joint acceptance of the suggestions (i.e. *"Yes, so it s got to be the triangle, look the triangle ..."*) and the continuous modifications of what has been argued initially (i.e., *"No, if you look closely. Look, that end is pointing ..."*). In other words, the way reasons are put for ward by the children about the direction of the triangle in the different options of the matrix, lead them to construct a share understanding of the problem and to achieve a joint agree ment about the answer. This answer, not by chance, happens to be the correct solution to the matrix.

These three types of talk are defined by the orientations of the participants to their social interaction and the normative procedures or 'ground rules' that they adhere to. In their idealized form, they can be distinguished as follows. The orientation of cumulative talk is to solidarity; it achieves agreement without critiques or reasons being voiced. The orientation of disputational talk is more individualized and competitive. Each participant aims to 'win', and so there are no attempts to construct joint understanding or to reason to gether. Exploratory talk, in contrast, is dedicated to the common pursuit of the best solutions; it is orientated to critical, cooperative, situated reasoning. It can be further characterised through the following ground rules followed by participants:

1. All relevant information is shared.
2. Participants strive to reach an agreement.
3. Participants take joint responsibility for decisions.
4. It is expected that participants give reasons for opinions.
5. Alternatives are discussed before a decision is taken.
6. Challenges are acceptable.
7. All the members of a group are encouraged to talk.

Table 1
Situated descriptions for categorizing the talk of groups of children attempting problems of the Raven's Standard Progressive Matrices Test

	Type of Talk		
	Cumulative	**Disputational**	**Exploratory**
Qualitiative Criteria for Classifying the Talk	Addition of ideas without group arguments. Group members propose options one after another without explaining the reasoning for their choice of specific answers. Members try to be friendly and to avoid conflicts.	Contraposition of ideas without arguments. Group members each propose options, challenging others without providing reasons for their own choice of answers. Members try to impose their own viewpoints.	Exposition of ideas and arguments. Group members explore different options and via reasons for suggestions. They talk about the sequences of figures, pointing out the relevant characteristics of the matrices. Members try to collaborate and to understand each other's points of view.

These classrooms ground rules have emerged from our research in classrooms. They are not meant to be a definitive representation of conversational reasoning in general, but rather a normative account of the kind of reasoning we have sought to situate in classrooms. That is, they were developed and used as a pedagogic tool for teaching children to use exploratory talk.

TWO STUDIES

The article presents the results of two separate studies. In discussing both we use examples of transcribed speech taken from video recordings of groups of children working together on the RSPM test of non-verbal reasoning. This test offers a structured set of pattern-based problems which are well suited for exercizing children's collaborative reasoning. The first study was designed to dis cover whether the analysis of participants' language can be used to identify the creation of a Zone of Proximal Development (ZPD) in a given task or situation. The second study was designed to investigate whether, and how, participants in a joint activity use language to provide 'scaffolding' for each other's learning.

In the first study we focus on the talk of one group of children in Mexico. They were video-recorded while solving together problems of the RSPM test, both before and after their involvement in an intervention program teaching exploratory talk. In the second study, we compare the talk of a group of children from Mexico with that of a group from the UK, as both groups attempt the same RSPM test problem.

STUDY 1: EXPLORING THE ZONE OF PROXIMAL DEVELOPMENT (ZPD)

In this study, we focus on the talk of a group of 3 children as they attempt to solve the RSPM test. The group consists of 2 boys and one girl, of 9 and 10 years old from a 4th grade class of a state primary school in a low socioeconomic status area of Mexico City. With the help of the teacher, we selected this triad for video recording as being representative of the range of ability in that class. The children had participated in a four-month program for promoting the use of exploratory talk as a tool for joint reason ing (see Rojas and Fernandez, 2000). Training consisted of nine one-hour sessions where children were encouraged to use the 'ground rules' for exploratory talk while working together, so that they could jointly negotiate alternatives for solving diverse problems and make their reasoning more visible to others.

For the sake of the study, the full sixty questions of RSPM test were divided into two different 30-question tests of equal difficulty. One of these reduced 'matched' versions of the test was administered to the groups at the beginning of the program, and the other at the end, following procedures described in detail in earlier studies (Wegerif, 1996). Each of these versions of the RSPM test consisted of 5 sets of problems, increasing in degree of difficulty from set A to set E. For the triad we are concerned with here, we transcribed the video-recordings of their performance for the RSPM test before and after the program, writing down the dialogues and actions that took place for each problem or 'matrix' they tackled. All the matrices were then analyzed to determine whether the type of discourse could be classified as mainly exploratory, disputational or cumulative in each case. In doing so, we used the categorical descriptions in Table 1 (which were designed to reflect the situated nature of the task in question).

RESULTS OF STUDY 1

Correct matrices by scale in pre-intervention test. We now present the distribution of matrices answered correctly by the Mexican triad by scale in the pre-intervention test. This is because we want to show how the children found the degree of difficulty of the matrices by scale before the intervention program.

As we can see in Figure 1, children performed better on the problems involved in scales A and B (the easiest) answering 5 of 6 matrices correctly; less so on scales C and D, answering correctly 2 and 3 matrices respectively; and had a very poor performance on scale E (the most difficult), answering correctly just one matrix. In total, the children answered correctly 16 matrices out of 30.

Type of talk by scale in pre-intervention test. On the basis of the categorical descriptions for analyzing the matrices in the pre-intervention performance of the triad (shown in Table 1 on page 63), Figure 2 presents the variation of the children's talk through the problem sets A-E that constituted the RSPM test.

In Figure 2 we can see that the triad tended to use cumulative talk when solving problems in set A. For set B, consisting of problems which were a little more difficult, the children used cumulative and disputational styles in the same proportion. As the degree of difficulty increased yet again through sets C and D, children began to use more disputational talk and, at the same time, to reduce their use of cumulative talk. The children also showed for the first time in the test an incipient use of exploratory discourse to solve one matrix in each set C and D. In set E, which consisted of the most difficult problems of the test, they attempted 5 out of 6 matrices using a disputational style of interaction. Finally, for the remaining matrix, they used a cumulative type of talk. They used no exploratory talk at all for this set. Correct matrices by scale in post-intervention test. Next, we present the distribution of matrices answered correctly by the Mexican student triad by scale in the post-intervention test. This is because we want to show how difficult the children found the matrices by scale once they had acquired the linguistic tools of 'exploratory talk' taught during the intervention program.

Figure 2. Correct matrices by scale in pre-intervention test

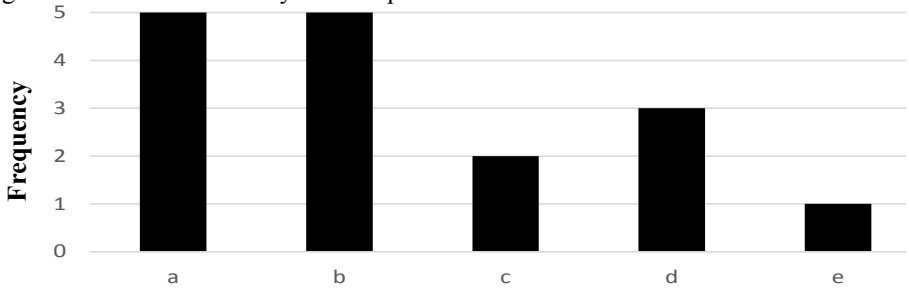


Figure 3. Types of talk by scale in pre-intervention test

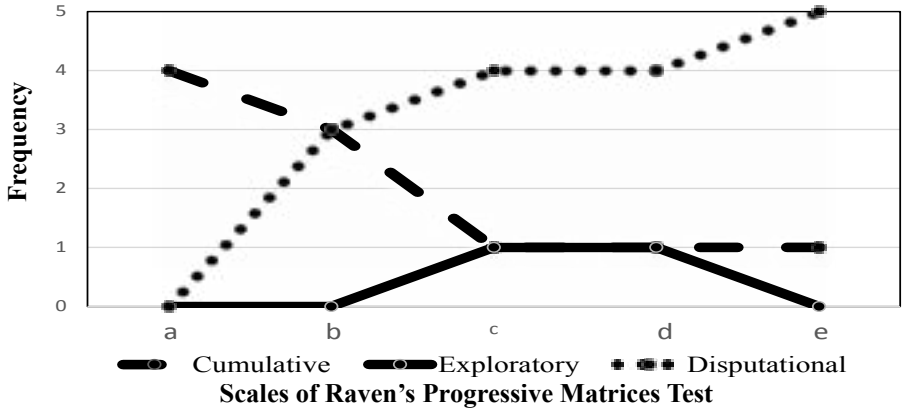


Figure 4. Correct matrices by scale in post-intervention test

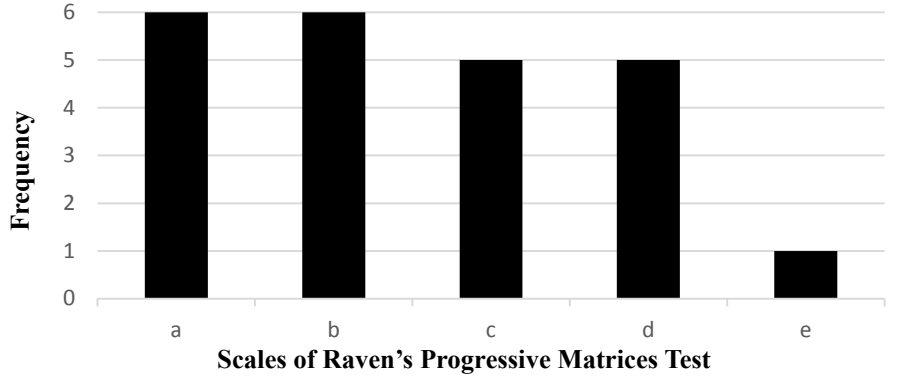


Figure 3 shows that children performed better on the problems involved in scales A and B (the easiest) answering correctly all the matrices in this scale. Just below of the level of performance for scales A and B, children answered correctly 5 of 6 matrices in both scales C and D; whereas they had a very poor performance on scale E (the most difficult), answering correctly just one matrix. In total, this group of children answered correctly 23 matrices out of 30.

Type of talk by scale in post-intervention test. The next graph (Figure 4) illustrates the frequencies observed for each type of talk displayed by the same triad in their post-intervention performance of the test. As we saw in the pre-intervention performance of this group of children, they found the sets of problems from A to E of increasing difficulty; and they adjusted their type of talk accordingly.

The triad showed a preference for using cumulative talk when solving problems in sets A and B (the easiest of the test). For sets C and D, however, whose problems are more difficult, they substantially decreased the use of cumulative talk and increased their use of exploratory talk. The children changed their style again when dealing with set E (the most difficult problems of the test) by diminishing their use of exploratory talk and increasing their use of cumulative talk. At the same time, we also see the first appearance of disputational talk for this more difficult scale.

Comparing performances in pre-test and post-test. Comparing performances in the pre-intervention and post intervention tests (see Figures 2-5) for this triad, we can observe the following interesting features of the variation both in the scores obtained and the talk used before and after the intervention program:

a) The children improved their score in 43.75% from the pre- (score=16) to the post-intervention (score=23) tests. From the 7 new matrices that were answered correctly in the post-intervention test, we found that 5 of these corresponded to the scales C and D, and just 2 to the scales A and B.

b) There is a predominance of a disputational type of talk in the pre-intervention test, and a predominance of an exploratory type of talk in the post-intervention test.

c) The curve that describes the use of exploratory talk along the test appears or increases in the same sets (C and D) in both measures. In other words, the children's use of a certain type of talk appears to be related to the degree of difficulty of the particular set of problems with which they are engaged.

These three observed features suggest that the intervention program was effective in teaching the ground rules of exploratory talk, since there was an increase in the use of this type of talk in the children's post-intervention performance. It also appears that their increased use of exploratory talk was effective in helping them solve the Raven's problems, particularly for sets C and D.

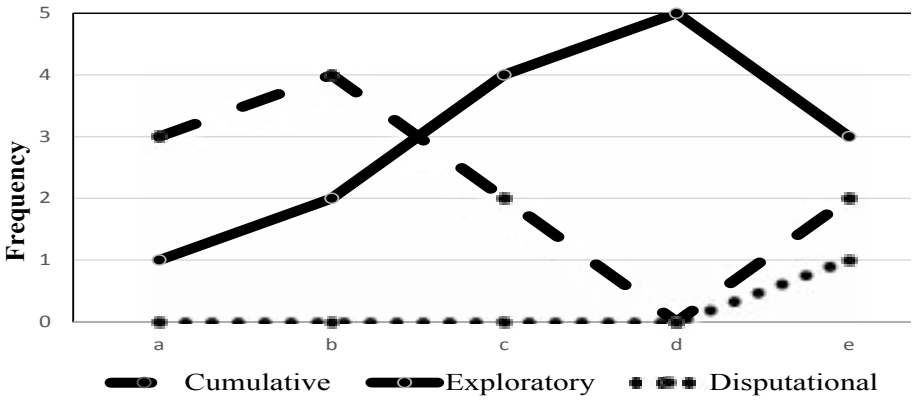
In further support of these findings, we next present the transcript of one of the matrices that was answered incorrectly by the triad in the pre-intervention test in the set C, and then the transcript of an isomorphic matrix in the same set, which was answered correctly by the same children in the post-intervention test. This matrix was chosen from the 7 isomorphic matrices that were answered correctly in the post intervention test compared to the performance of the triad in the pre-intervention test.

COMMENTARY

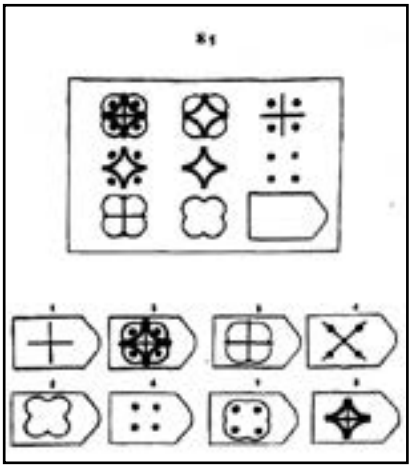
We can see that in the pre-intervention test the children propose several options without stating any reason. Particularly, we can observe a dispute between Hugo and Javier, as they try to impose their point of view as the solution of the matrix, while Ana follows the dialogue in silence. The utterances of the children consist of assertions ("I told you not to!") and counter-assertions ("I say yes!") about the options, and challenges ("Do you want to bet that it's not?") without explanations. All these elements help us to classify the discourse of the matrix as disputational. All our findings show that it is probably not a coincidence that the option chosen as an answer for this matrix was wrong.

In the post-intervention test, we can see that the participants suggest options while stating reasons for each of them. Hugo tries to explain the sequence that he has observed

Figure 5. Types of talk by scale in post-intervention test



E5/Post-test



Rose: £5.
Paul: There (*pointing*), but you are taking that away.
Jane: That goes to there to make that, and that goes to there to make that, that goes there to make that (*pointing*).
Paul: So, it's got to be just dots. Yes it's number 6.
Rose: Watch this (*pointing*).
Jane: It's that one because you add that with the crosses, right? You add that and then you go on to. I think it's five, because number 6 is there Paul.
Paul: Where?
Jane: There (*pointing*).
Paul: Oh yes, so it s got to be number 7.
Jane: There, there, there, what have you got there, 7? You are going down like that? *(pointing)*.
Jane: Oh yes. Look, it goes that, that to make that, that, that, that to make that, so it has to go *(pointing)*.
Paul: It has to be a cross and one of these shapes.
Jane: Yes. That, because then you put it into that and it makes that.
Paul: So I think.
Rose: I think it's number I because look at it Paul.
Paul: Yes, I think it is too.
Jane: Because then it goes into those dots to make that.
Paul: Yes, yes so I think it's number 1.
Jane: Do you agree?
Rose: Yes.
Jane: Do I agree? Paul: Yes.
Jane: Do you agree?
Paul: Yes.

in the problem to his partners by talking about the presence of elements in the matrix (he points these out to them from left to right). He talks about "completing" a pattern. However, Ana seems to have taken a different perspective when she explains that they must observe that there is an element that is first on the left matrix, then in the middle, and finally on the right. If we look at the matrix, we can see that in fact the little black square changes its position in each row from left to right. Ana identified this pattern. After her explanation, Javier and Hugo realise what she is talking about and agree in choosing option 5 as the answer, which is correct. The children's offering of reasons and arguments while exploring the options of the matrix, as well as the collaboration and the agreement finally achieved, helps us to classify the discourse of the triad as exploratory.

DISCUSSION OF STUDY 1

From analyzing the performance of the children in these two examples, we can infer that the children's use of an exploratory type of talk helped them to solve problems that they were not able to solve when their discourse was disputational. We would also note that teaching the group to use exploratory talk did not have the effect of making them use this talk all the time, but only when it was useful. Cumulative talk was appropriate enough as a mode of communication when dealing with easy problems (i.e. those whose solution did not need the distributed cognition of the group). Exploratory talk was also not useful for the really hard problems that this group simply could not solve, however hard they tried. However, exploratory talk helped the group to solve problems in sections C and D that they did not solve in the pre-intervention test. The results show

E5/Post-test

SPANISH		**ENGLISH**	
Maria:	Aqui le quitan los puntitos y la esta // la cruz (*senalando el primer renglon*).	**Maria:**	Here they take out the little dots and this // this cross (*pointing to the first row*).
Gabriel:	No pero perate, no, no queda.	**Gabriel:**	No, but wait, no, no doesn't fit.
Luis:	No. Aguanta.	**Luis:**	No. Hold on.
Gabriel:	No.	**Gabriel:**	No.
Maria:	Vamos viendo la secuencia: aqui tiene asi, quitan la equis y los puntitos (*senalando de nuevo el primer renglon*). Aqui ya no, aqui (*senalando*).	**Maria:**	Let's look at the sequence: here it is like this, they take out the 'x' and the little dots (*pointing again to the first row*). Here there are no more, here (*pointing*).
Luis:	Aqui le quitan solo los circulitos.	**Luis:**	Here they take out only the little circles.
Maria:	Aja, los circulitos // y esa parte, como la estrellita, nada mas (senalando la primera columna).	**Maria:**	Yeah, the little circles // and this part, like the little star, nothing else (*pointing to the first column*).
Gabriel:	Seria este, miralo (senalando).	**Gabriel:**	It would be this, look at it (*pointing*)
Luis:	Lo que le quitaron.	**Luis:**	What they took out from it.
Gabriel:	Seria este, porque mira va asi. asi (senalando la opcion 1).	**Gabriel:**	It would be this, because look, it goes like that, like that (*pointing to option number 1*).
Maria:	Pero como? Si no tienen puntitos.	**Maria:**	But how? If they don't have little dots?
Luis:	No tiene puntitos. Quedaria nada mas la cruz.	**Luis:**	It doesn't have little dots. There would remain nothing else bu the cross.
Maria:	Aja // Si, por lo que le quitaron.	**Maria:**	Yeah // yes, because of what they took out from it.

no improvement in section E where the problems were simply too hard for this group and very little improvement in sections A and B where the problems were mostly too easy for this group to require exploratory talk. These results are summed up in Table 2.

We can relate these results to the concepts discussed earlier in the paper, as follows. First, the observed differences in the types of talk used by the children in sets C and D of the RSPM provide strong evidence that the ways in which they were talking together in the pre- and post-intervention tests created Intermental Development Zones of different quality. The superior strategies they used for combining their intellectual resources in the post-intervention tests helped them as a group to solve the problems they could not otherwise solve. To pursue this further, one could say that their increased use of exploratory talk expanded their joint Zone of Proximal Development, enabling them to achieve a better mutual understanding of the problems than they could otherwise have done. This is an important result because it represents a measurable 'ZPD effect' in the joint activity of a symmetrical group.

STUDY 2: EXPLORING 'SCAFFOLDING'

In this second study we present the transcribed talk of two triads of children: one from Mexico and the other from the UK. The triad from Mexico was selected from a larger group of children from a state primary school who participated in a follow-up study which implemented a similar training program as that described for the first study. It consisted of one girl and two boys of eleven and twelve years old.

The triad from the UK consisted of two girls and one boy of 9 and 10 years old

Table 2

Level of expertise, socio-cognitive level, and type of discourse of the participants in a task, accoriding to the degree of task difficulty

	Degree of difficulty of the task		
	Easy	***Medium***	***Hard***
Degree of experience and comprehension of the task	*High* (The task can only be easy if you comprehend clearly what you are doing)	*Variable* (Some participants understand some aspects of the task while other don't, but together it is possible to solve it)	*Low* (Just some aspects of the task are understood by the participants and it is not possible to solve it together)
Socio-cognitive level	Skills already mastered	ZPD is created here	Skills not possible to acquire yet
Discourse	Cumulative	Exploratory	Any type

from a state primary school in the town of Milton Keynes. This group of children were members of a class who had participated in a similar intervention program for promoting exploratory talk as that which took place in Mexico (see Wegerif and Mercer, 2000). Both Mexican and British selected groups were video-recorded in the discussions they had while solving problems from the RSPM test; and both took this test before and after participating in the intervention programs.

To explore how language may be used as 'scaffolding' in the solving of problems, we compared the transcribed talk of the two triads in the post-intervention test, while working on the same matrix problem. The matrix was chosen from those in set E, so as to represent a difficult problem whose solution would require the co-operative 'collective thinking' of the members of the groups.

RESULTS OF STUDY 2

We next present the discourse of the British triad around the matrix E5 in the post-intervention test.

COMMENTARY

In the transcript we can see that Paul and Jane are explaining what they think is happening in the matrix. The video shows that Rose watches and listens carefully to what they are saying. Suddenly Rose reacts by pointing at the correct answer saying "I think it s number I because look at it Paul." Following this intervention, Paul agrees with Rose and Jane adds the reason that has been implicit in the previous dialogue: "Because then it goes into those dots to make that". We can say that, in this example, each of the three participants has something to say that helps solve the task.

First Jane states that the logic implicit in the task is an addition of figures when she says: "you add that with the crosses, right? You add that and then you go on to ... " Paul states that "it has to be a cross with one of these shapes... " and finally Rose adds the solution by pointing out the correct answer while she says: "I think it s number I because look at it Paul". In this example we cannot say that one of the children dominates in solving the problem, or in leading others to understand it, but rather, that each of them understands a part of the problem and share this with their peers. The correct solution,

then, is a joint achievement, generated by the collective thinking activity of the three participants. We might therefore say that we are observing a conversation situated in a joint Zone of Proximal Development, in which language is enabling them to provide mutual intellectual support or 'scaffolding.'

Next, we present the transcribed talk of the Mexican student triad while working on the same problem, matrix E5, also in the post-intervention test (The talk may be made more comprehensible by referring back to the illustration of matrix E5 in the previous section).

In tackling this matrix, the Mexican triad searches for a solution based on how the elements are "taken out", from left to right and from the top to the bottom of the matrix. Language may be considered to function as a 'scaffolding' tool when for example, Maria shares her understanding of the sequence: "Let's look at the sequence: here it is like this, take out the 'x' and the little dots. Here there are no more, here". In this way, Maria uses language to make the others see what she is seeing in the first row of the matrix. Later on, Maria elaborates more on this explanation when she adds: "Yeah, the little circles // and this part, like the little star, nothing else", while she points to the first column of the matrix, again trying to clarify her point of view to the others. After that, Gabriel points to the right answer of the matrix (number 1), and Luis adds the reason why this answer is correct: "It doesn't have little dots. There would remain nothing else but the cross". If we analyze the whole sequence, it is clear that language was used to create a 'scaffold' which helped the group as a whole to solve the problem. Step by step, their conversation led them to develop a shared perspective on the problem, to understand the logic implicit in this matrix and so to choose the correct option

DISCUSSION OF STUDY 2

It is interesting to return now to the definition of the functions of a tutor when 'scaffolding' given by Wood, Bruner and Ross (1976) and referred to by us early in this paper.

1. To orientate the child's attention to the version of the task defined by the tutor.

In both of these transcripts we can see that the type of talk the triad used lead them to develop a shared perspective on the problem. Both transcript extracts begin with some children saying what kind of problem they think it is and how they should go about solving it. Other children have different ideas and as a group they negotiate a shared strategy. Thus, this first function of orientating and defining is found in the symmetrical talk of the children.

2. To reduce the number of steps that are required to solve a problem, thus simplifying the situation in a way that the learner can handle the components of the process.

Almost each turn of talk in the above transcript extracts represents a different perspective on the problem. The problem is broken down into components and distributing responsibility across the group makes the task of understanding easier for each child.

3. To maintain the activity of the child as he/she strives to achieve a specific goal, motivating him/her and directing his/her actions.

In both Mexico and the UK we found much more enthusiasm for the task of solving problems of the RSPM test once children had been taught 'exploratory talk'. We have evidence on video in both countries of groups who rushed through the task in the pre-intervention test to get it out of the way. In contrast, we observed children working through their own free time in the post-intervention tests. Rather than simply accepting the conventional view that children's motivation for carrying out a group activity will

influence the quality of their talk together, we would suggest that it may be at least as likely that the way in which children are enabled to talk together can effect their level of motivation.

4. To highlight critical features of the task for the learner.

If we redefine this as 'highlighting critical aspects that might help partners solve the problem', we do find this in the talk. For example, when Maria in the second example says "let's look at the sequence" she is pointing to a critical aspect before he knows the solution. Of course in symmetrical talk, when partners are trying to solve a problem for the first time, it is always possible that the apparently critical aspect highlighted turns out to be the wrong one.

5. To control the frustration of the child and the risk of failure.

Working in a group means that both risk and frustration are shared and therefore can be reduced for the individual. When the groups were talking disputationally, as many did in the pre-intervention test, the failure to solve problems was often blamed on individuals. We can see an example of this individualized decision making and blaming in the first transcript extract given in this paper, where Hugo repeatedly calls Javier an "idiot" ("tonto") because of his suggestions. However, an essential ground rule of explor atory talk is that responsibility for decisions is shared, and this sharing serves to reduce individual risk and any sense of frustration.

6. To provide the child with idealized models of required actions.

This function assumes asymmetry and knowledge of the answer and so is not found in symmetrical talk. However, if we translate it as 'to produce an idealized version of the action taken in solving the problem' then we often find this at the point where one member of the group has to explain to another how the solution was arrived at. This might be assumed to be tutor to student type of asymmetrical talk, except that it is often clear that explaining the solution in idealized terms to a peer helps the speaker to understand it and how they arrived at if for the first time. In both transcripts the function of language in producing idealized or abstract versions of the problem in order to share understanding across perspectives is apparent. In the first the UK children talk in terms of the abstract process of addition using the phrases "to add" and "that and that make that". In the second one, they understand the same problem in terms of subtraction using the verb "quitar," meaning "to take out." In symmetrical talk the language used can therefore produce an abstract or idealized version of the problem as part of the process of sharing perspectives and explaining views.

Analysis of the transcripts of children solving the Raven's problems together has therefore shown that all the 'scaffolding' functions ascribed to tutors by Wood, Bruner and Ross can be found in some types of shared language use, particularly in the type of talk we call exploratory talk. This does not imply an intentional guiding role on the part of participants. Where, as an example of an 'asymmetrical' interaction, a teacher might explicitly plan how to show children an idealized version of a problem to help them understand it, in symmetrical talk the idealized version often emerges in an unplanned way through attempts by children to share understandings and to explain solutions as they work together. The children in symmetrical talk may not be consciously trying to scaffold the development of each other's understanding (as might a tutor), but the implicit ground rules that they are following have this effect anyway (without needing any conscious intention). There is an analogy here with Rogoff 's (1990) view that 'guided participation' may not be a matter of self-conscious teaching by a cultural

expert. The children in the transcripts give explanations but not as teachers might; they simply respond to questions according to the ground rules of exploratory talk as peers working together on a common task. In this way, they all support each other and so travel further, in an intellectual sense, than they would have infusing other types of talk or when working alone. (See Wegerif and Mercer, 2000 for more evidence to support this claim).

CONCLUSION

Although associated with the interaction between a teacher and learner, the Zone of Proximal Development was first presented by Vygotsky as an individual characteristic. So, to take a hypothetical example, just as a child would conventionally be ascribed a particular score on a reasoning test, so they might be given a more dynamic assessment of their potential by observing how much they were able to achieve on the test with a teacher to help them. However, we have used the study of the talk of a group of Mexican children engaged with problems of the RSPM reasoning test problems to argue that the concept of the ZPD can be usefully applied to group processes. Our first study showed that one way of talking (disputational talk) restricts the group's ZPD while another (exploratory talk) expands it. This group version of the ZPD is no longer the product ofa teacher's conscious intention. It is better understood as a symmetrical version of the concept of the Intermental Development Zone, in which language is used in a dynamic and dialogical way to maintain and develop a shared context.

The second study, in which we focus on the idea of 'scaffolding', shows how the way in which children talk together can mutually support each other's progress through a difficult problem-solving task. This may be an automatic and unconscious effect of following certain ground rules for talk. That is, the children may not be trying to 'scaffold' each other's learning, yet they achieve this simply by using effective communicative strategies for solving a problem together. While apply ing the concept of 'scaffolding' helped us to understand in more detail the ways in which language can be used to support joint thinking and learning this concept itself can no longer be directly applied. The metaphor of a 'scaffold' implies a temporary support that is removed once the construction work has been completed. The ways in which language is used in sym metrical groups to support shared thinking and learning are not temporary. In contrast to the notion of 'scaffolding' the way in which language can support learning in symmetrical groups is dynamic and continuous.

In re-conceptualizing both the concepts of the ZPD and 'scaffolding' to take account of collaborative group learning we have found it necessary to move from a concept based on the idea of a teacher's conscious intentions outside of a dialogue, to concepts based on a characterisation of dynamic processes maintained by the reciprocal and responsive way in which participants use language within dialogues. ■

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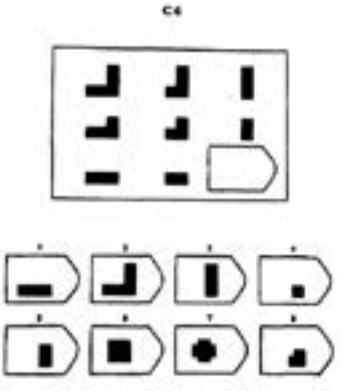
APPENDIX 1

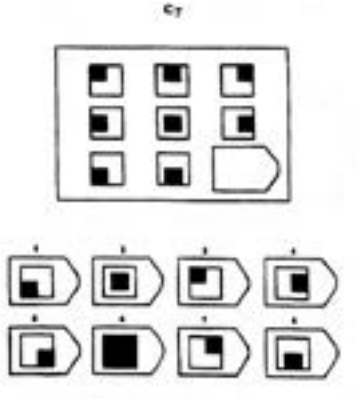
Pre-test



SPANISH		**ENGLISH**	
Hugo:	(...) Pues tu siempre dices, tonto.	**Hugo:**	(...) Then you always say, idiot.
Javier:	2 (*senalando*).	**Javier:**	2 (*pointing*).
Hugo:	1 (*senalando*).	**Hugo:**	1 (*pointing*).
Ana:	No! (*moviendo la cabeza*).	**Ana:**	No! (*shaking head*).
Hugo:	No, no es cierto, no es la 1, ies la 2!	**Hugo:**	No, it's not true, it's not 1, it's 2!
Javier:	Que t dije, es la 2.	**Javier:**	I told you, it's 2.
Hugo:	Es la 7 (*senalando*), es la 3 (*senalando*).	**Hugo:**	It's 7 (*pointing*), it's 3 (*pointing*).
Javier:	La 3 (*senalando*).	**Javier:**	It's 3 (*pointing*).
Hugo:	Es la 5, pon 5, 5, pon.	**Hugo:**	It's 5, put 5, 5, put.
Javier:	Ah, que no!	**Javier:**	Oh, I told you not to!
Hugo:	Es la 5, tonto!	**Hugo:**	It's 5, idiot!
Javier:	(...) Que no!	**Javier:**	(...) I told you not to!
Hugo:	A que si!	**Hugo:**	I say yes!
Javier:	Cuanto a que no?	**Javier:**	Do you want to bet that it's not?
(Ana escribe 5 en la hoja de respuestas)		*(Ana writes number 5 in the answer sheet)*	

APPENDIX 2

Post-test



SPANISH		**ENGLISH**	
Hugo:	Este (*sefialando*) // Si, porque mira. Aqui ya esta, aqui ya esta. Despues aqui se acompletan ya estos. Aqui se acompletan ya estos. (*senalando de izquierda a derecha lasfiguras de la matriz*).	**Hugo:**	This (*pointing*) // Yes, because look. Her it is already there, it's already there. Afterwards, here you complete them. Her you complete these others (*pointing to the figures in the matrix from left to right*).
Ana:	Yo digo que la 5 porque primero esta aqui (*senalando la columna derecha*), luego ya esta en media, y luego ya esta aca (*senalando la columna izquierda*).	**Ana:**	I say it's the 5 because first it's here (*pointing to the right column*), after it's in the middle, and then it's over there (*pointing to the left column*).
Hugo:	Ah, si es cierto! La 5. // La 5 si esta bien.	**Hugo:**	Oh, it's true! It's number 5. // The 5 is right.
Javier:	Si, pongamos la 5.	**Javier:**	Yes, let's put 5.