Too good to be true? Towards an understanding of the Zone of Proximal development (ZPD) dynamics from a Piagetian perspective: Gender composition and its changing role from early to middle childhood

Anna Zapiti & Charis Psaltis

Department of Psychology, University of Cyprus, Cyprus

The present study revisits the complexities of the Zone of Proximal Development (ZPD) through an experimental investigation of the role of social identity dynamics in asymmetric social interaction around a cognitive Piagetian task in two age groups. Children from two age groups (6 and 10 years old) first solved a spatial transformation task individually (pretest) and then worked in same- or mixed-gender pairs with a partner who was more advanced in task knowledge. In the posttest phase, participants again solved the task individually. At posttest, the six-years old participating in interaction, performed better than those in control groups, who did not engage in interaction. However, there were no differences in the posttest performance of the ten-years old who participated in interaction and those who did not. Moreover, the effect of gender composition on the dynamics of the interaction was different in the two age groups. The social gender identity dynamics formed in the interactions of the six-year olds related to cognitive progress outcomes, but at 10 years social construction of knowledge was equally successful in promoting cognitive development compared to asymmetric social interactions and gender identity dynamics did not have the same formative influence.

Key words: Zone of Proximal Development (ZPD), Vygotsky, Piaget, peer interaction, cognitive development, gender, social identity

Highlights:

- For the children around the age of 6–7, interaction with a more competent partner was more beneficial for progress than individual work.
- Younger children interactions are more competitive but it is when female experts interact with male novices that children benefit more.

- The performance of children around the age of 10–11 working with a partner was not significantly different from the scores of children working individually.
- Older children interactions were more of a co-operative nature. However, gender composition can still affect children's behavior in the interaction.

Serge Moscovici, one of the major proponents of "Genetic Social Psychology" argued (Moscovici, 1990, p. 179) that the Vygotskian formula of cognitive development is "too good to be true". Duveen (1993, 1997), following Moscovici's skepticism, argues that what is missing in Vygotsky's account is an appreciation of the significance of social identities as the structures mediating between the inter-psychological and the intra-psychological. Recent work on the Zone of Proximal Development (ZPD) within the socio-cultural framework (Baucal, 2013) also recognized this complexity since it was argued that interaction between the child and the more competent other is by itself a complex phenomenon since two individuals who collaborate have different personal histories, identities, social status and position, interests, motivation and ways of communication.

Research into the relation between social interaction and cognitive development has emphasized the benefits for a child's intellectual progress of working with a partner with more developmentally advanced cognitive skills (e.g., Azmitia, 1988; Doise & Mugny, 1984; Howe, 2009; Leman & Duveen, 1996; Tudge, Winterhoff, & Hogan, 1992; Psaltis & Zapiti, 2014). Despite the evidence from numerous studies that peer interaction promotes learning, much remains to be known about the interplay between social status and knowledge asymmetries underlying these interactions and the way they are associated with the process of the interaction and development. The present study extends the work of the so called *third generation of research* (Psaltis & Zapiti, 2014) into a comparison of social gender identity dynamics in the ZPD in two age groups (6 and 10 years old). These two age groups were selected to represent the beginning and the end of the concrete operational stage according to Piagetian theory and to this end a single concrete operational task of spatial perspective taking was selected for both age groups. In this study, we manipulate the balance or imbalance of gender status and knowledge asymmetries in the ZPD through the gender composition of dyads with a constant knowledge asymmetry (between a more and a less knowledgeable child) following a well-established experimental design as in Leman and Duveen (1999) and Psaltis and Duveen (2006) which proved to produce diverse social identity dynamics in the communication in mixed-sex dyads around Piagetian tasks.

Peer Interaction and Cognitive Development

Recent work has focused away from content of interactions towards how social dynamics of interaction influence learning and cognitive development. This is grounded in Piaget's (1932) distinction between two forms of social relations: constraint and cooperation. In relations of constraint the child does not question the legitimacy of an authority figure's judgment and knowledge is the product of social transmission. By contrast, relations of cooperation are autonomous relations between equal partners and knowledge is thus acquired through cognitive elaboration in a process of reconstruction. The relations of constraint hinder cognitive development while relations of cooperation enhance it.

For the developmental psychologist Vygotsky (1978), however, ideal partners are not equal and the inequality is in skills and understanding rather than in power or status. The interaction with either adults or peers can bring about cognitive growth as long as the partner is more knowledgeable. In accordance with Piaget then, peer interaction is flagged as having a potentially important role in learning. But whereas Piaget's emphasis was on the status-asymmetry in such interactions, Vygotsky's emphasis was more on the competence-asymmetry (Light & Littleton, 1999).

Piaget's and Vygotsky's ideas inspired the work of various lines of studies such as the work concerning adult and child interaction (Arciadiacono & Perret-Clermont, 2009; Baucal, 2013), peer interaction in the experimental setting (Tartas, Perret-Clermont, & Baucal, 2016; Baucal, Pavlović, & Jošić, 2018) and peer interaction in the classroom setting (Fernández, Wegerif, Mercer, & Rojas-Drummond, 2002; Mercer, Hennessy, & Warwick, 2017). Most relevant to the present study is the work of Doise and colleagues in Geneva (Perret-Clermont, 1980; Mugny, Perret-Clermont, & Doise, 1981; Doise & Mugny, 1984) on the study of cognitive effects of peer collaboration. These researchers conducted a series of experiments on four to seven-year olds using a variety of Piagetian *concrete operations* tasks. This line of research generally revealed that children do indeed benefit from working with another child, especially when their partner is more advanced in his/her understanding of the task. Nevertheless, these studies left unexplored the different asymmetries that may constrain cognitive growth. One such asymmetry is gender which was not treated as an asymmetry in the work of Doise and his colleagues.

Gender in Peer Interaction

Most of the theoretical literature on gender or sex differences makes reference to differences in cognitive abilities or communication skills between men and women (Carli & Bukatko, 2000). However, there are studies (Leaper, 1991; Leaper & Smith, 2004) making a claim that gender group membership creates a social status authority asymmetry which presents a powerful influence upon both interaction and judgment (Leman & Tenenbaum, 2013).

The issue of the combined effect of social asymmetries is investigated in a line of studies called *the third generation of research* on peer interaction and cognitive development (Duveen & Psaltis, 2008; Leman & Duveen, 1996, 1999; Leman, Ahmed, & Ozarow, 2005; Martin, 2007; Maynard, 2009; Nicolopoulou & Weintraub, 2009; Psaltis, 2005; Psaltis & Duveen, 2006, 2007; Psaltis, 2009; Psaltis, 2011; Zapiti & Psaltis, 2012; Psaltis & Zapiti, 2014).

The work of Leman and Duveen (1999, 2003) was the first that addressed these issues using a moral judgment task. Their results revealed that in the mixed-gender pairs with a male expert, the disagreement was quickly resolved and required less sophisticated forms of justification for arguments of the male to be accepted as legitimate. On the contrary, in the mixed gender pairs with a female expert, conversations were much more extended and females generally had to employ a wider variety of arguments to persuade the partner. Nevertheless, they did not include a posttest so it was not possible to investigate any association between conversation features and cognitive progress.

Another study using the pretest, interaction, posttest design was conducted by Duveen and Psaltis (2006) using the Piagetian liquid conservation task (Piaget, 1941/1952). The results revealed that only males working with a female expert made significantly more progress than the corresponding control group. In mixed-gender pairs with a male expert, the male expert more often imposed his solution with no resistance on behalf of the female partner. However, in opposite-gender pairs with a female expert, the less advanced child made progress from the interaction phase with the use of explicit conservation arguments expressed during the interaction. These children also progress more in the posttest. This was called the *Fm effect*.

The work by Zapiti and Psaltis (2012) using a spatial transformation, revealed that in mixed-gender dyads with a female expert, the partners act on more equal footing by making the same use of interruptions (interrupting action of partner before it is made) and challenges (challenging action of partner after it is made). In mixed-gender dyads with a male expert, the male makes more challenges than the partner and more interruptions in comparison to female experts in the mixed-gender dyads.

This study and other relative work (Psaltis, 2011) reveal the role of a combination of asymmetries like gender and expertise on the direction of conversations as well as on the acquisition of knowledge. Especially for children around the age of six, who are characterized by heteronomous thought and rely on external features of the interaction, the combined effect of gender and expertise as asymmetries may have a stronger effect on their behavior and possibly on their learning. But these studies do not explore what happens in the case of older children. Is peer interaction still more beneficial than individual work? Are the same gender dynamics observed as it is the case with 6–7 year olds?

Age Differences in the Dynamics of Peer Interaction

In a study by Doise (1978) using a motor coordination task, it was found that 7–8 year-old children performed better in the collective condition than working individually whilst there were no such differences for 9–10 year-old children. In another research work by Doise, Perret-Clermont, and Mugny (1981) using the cooperative game paradigm, it was found that the collective condition is not always automatically effective in comparison to the individual condition but there is a difference with age. They interpreted their findings based on the argument that this effectiveness is actually a function of the stage of development of the notion being examined. In the stage where a notion is being initially elaborated, social interaction alone may induce progress but the individual activity is not capable of doing so. But in the case when children acquire the necessary cognitive mechanisms, then both the individual and collective activity may promote cognitive progress.

Leman and Duveen (1996) asked children to compare lines in a visual illusion task. They observed that whilst 7–8 year-old children regard conversation uniquely as a matter of winning and losing, 11–12 year-old children regard it as a forum for establishing the correct or best solution and have more collaborative conversations. They argue that younger children were not able to separate their concepts of gender from notions of expertise and that in a way they confounded epistemic authority with status. The older children on the other hand, do not rely as strongly on features of experimental manipulations but it seems that they are drawing on different forms of reasoning.

In a more recent study by Leman (2014), an age-related shift of orientation to group collaboration was once again revealed. In this study, 8-year-olds and 13-year-olds had to work in groups or individually on a general knowledge quiz. The results confirmed a previous study by Leman and Oldham (2005) and indicated that when 8-year-old children collaborate, their focus is on the information they can obtain from the group. At the age of 13 on the other hand, they are more concerned with coordinated forms of interaction and intersubjective exchange.

This growing body of work suggests that there are age differences in how children collaborate but they do not consider how gender dynamics may shape these behaviors and how they are linked to cognitive progress. Therefore, the contribution of the present work is twofold. First, it examines the combined effect of two asymmetries, gender and expertise, on children's interactions and cognitive development. Gender, however, is not treated as an ascribed category but both gender of one child and the gender of the partner are taken into consideration in order to capture the dynamics of the interactions in which gender is aligned or conflicted with expertise. Second, this exploration includes two different age groups since research work reveals that as children grow older, they develop different concepts for peer interaction and collaboration.

The two main research questions were: 1) is peer interaction more beneficial than individual work for both 6 year-old children and 10 year-old children?; and 2) how does gender composition differentiates six and ten year-old children's behavior in the interaction?

Methods

Participants

243 children of the first grade (age range 6–7) and 245 children of the fifth grade (age range 10–11) from various elementary schools (both urban and suburban) in Cyprus participated in the study. Most children came from lower- and middle-class Greek-Cypriot families.

Procedure

Both studies employed a pretest, interaction, posttest design and the same task, albeit of varying difficulty, was employed for the children of each grade. The interaction and an immediate posttest took part on the same day which was one day apart from the pretest phase. A delayed posttest took place two weeks after the interaction and the immediate posttest. In the pretest and posttest phase each child had to give an independent response. The pretest is a screening device which identifies children's level of knowledge of the task and distinguishes between those who perform at a more developmentally advanced level (total compensator or TC) and those who perform at a less developmentally advanced level (non-compensator or NC). In the interaction phase, children of different knowledge of the task (TC and NC) had to work in mixed- or same-sex dyads in order to solve a task. Therefore, four pair types were formed: male total compensator-female non-compensator (Mf), female total compensator-male non-compensator (Fm), male total compensator-male non-compensator (Mm), female total compensator-female non-compensator (Ff). The design also included control groups divided by gender. The first control group took part in the pretest and immediate posttest phase providing a check on the stability of responses on the same day. A second control group took part in the pretest and delayed posttest phase in order to provide a check on the stability of answers within the 2 weeks that intervene.

Experimental Tasks

In Study 1, the task was the 'village task' which was first used by Doise and Mugny (1984) and was based on Piaget and Inhelder's three mountains task (Piaget & Inhelder, 1956). The principle of the task is that after observing a village consisting of several houses on a base-board, the child must reproduce it using identical houses on an identical base-board, the orientation of which can, however, differ from the perspective occupied by the child. The material consists of two 50 cm x 50 cm cardboard bases. The board is divided into nine equal squares (the plots) and the orientation of it is given by a blue-colored mark (an isosceles triangle formed by a half square with 15 cm long sides) the base of which is placed in a corner of the card-board with the tip pointing towards the middle. The experimenter constructs a village in one of these cardboards (the *model table*) and the child is asked to reproduce it on the other cardboard (the *construction table*). This requires two sets of three Lego houses, one for the experimenter and one for the child. Each house has different color and shape and it is made in such a manner that it can be oriented; the side with a door is regarded as the front (See Appendix A).

In study 2, the children of the fifth grade had to solve the same task but of greater degree of difficulty. The difficulty of the task for fifth graders was regulated after a pilot testing following the criterion of getting about a 50% success at the classroom level as it was the case with the fist graders. This was done not only to make the experimental design feasible but to control for the difficulty level across age group. More specifically, the board was divided in 16 instead of 9 squares and the colored mark was a blue circle instead of a blue triangle. This way it was more difficult for the children to identify the correct orientation for placement on the copy board (See Appendix B).

In the pretest, each child had to solve two problems (items), first a simple and then a complex one. On the simple item, the child was asked to reproduce the village on the construction table which is situated to his/her right at an angle of 90°. The participants who failed at the simple item did not proceed with the complex item and were excluded from the study (as in Doise & Mugny, 1984). The rationale was to establish the minimum cognitive prerequisites necessary for each child participating to benefit from the interaction session. The children who performed on an intermediate level (partial compensator or PC) were also excluded from the study in order for the cognitive asymmetry between the two children that were going to work together in the interaction phase to be clear. The children who proceeded with the complex item were asked to reproduce the village on the construction table rotated 180° in relation to the model table. This item was a screening device which identified children's level of knowledge of the task and distinguished between those who perform at a more developmentally advanced level (total compensator or TC) and those who perform at a less developmentally advanced level (non-compensator or NC).

In the posttest the children were asked to reproduce the village on the construction table positioned with an angle of 180° (as in the interaction phase) and with an angle of 270°. This second item is a complex one, children see it for the first time and it can provide a clearer picture of the reconstruction of knowledge and application to more indirect items which precludes the possibility of a superficial imitation of solutions copied from the interaction on the 180° item (Psaltis, 2011).

The Coding Frame

The interactions were recorded on video camera and the experimenter was not present during the interaction phase. The videos were used in order to transcribe the interactions based on a coding frame that included four broad categories of moves (interruptions, challenges, house-oriented moves, other-oriented moves).

The term *interruptions* refers to the moves that a child makes disrupting the flow of the placements made by the partner. These moves are: 1) pointing towards a square while the partner is making a placement; 2) attempting to grab a house from the other child's hands, and 3) grabbing a house from the partner's hands. The term *challenges* refers to moves a child makes in order to display the disagreement with the strategy already exhibited by the partner: 1) picking up a house already placed by the other child; 2) orientation-fitting of a house that their partner placed, and 3) claiming that a placement is wrong. Challenges can be taken as indicative of creating conflict of solution strategies in interaction whereas interruptions are just disruptive without providing any information regarding a substantial disagreement on the solution of the problem.

Previous work indicated that children may assume different roles in the interaction (Azmitia, 1996; Grossen, 1994). The experts or children assuming expertise may be more interested with the correct solution of the task and therefore be more preoccupied with the material. For the children who are not certain of their beliefs, an attempt to enroll themselves in the process of solving the task might be by addressing their partner directly. Therefore, *house-oriented* and *other-oriented moves* were included in the coding frame.

House-oriented moves are moves on the material of the task such as: 1) Possession of two or three houses; 2) Taking other's hands off the material; 3) Grabing a house from partner's hands, and 4) Picking up a house already placed by the other. The term Other-oriented moves includes moves that are oriented towards the partner. These are: 1) Telling the other that he/she made a mistake; 2) Claiming correctness of own placement; 3) Pointing a square for placement, and 4) Suggesting a square for placement (in a neutral tone, not a demanding one).

The number of *explanations* provided by each partner in order to explain a placement of a house, an intention for a placement or a disagreement on a partner's placement or argument was also included in the coding frame. Explanations given in the interaction were included in the coding frame to shed more light on the process of solving the task.

As can be seen from the coding frame, there is some overlap in the moves included in each category. However, there is no need for the categories to be mutually exclusive since the interruptions and challenges investigate the disagreement in the strategies while house-oriented and other-oriented moves are indicative of the focus of each partner in the interaction.

The inter-rater agreement on all the items of the coding frame was assessed by randomly selecting 32 out of 160 of the transcribed interactions and it was excellent (Cohen's Kappa =.82).

Interaction Types

The moves identified in the coding frame were used for the analysis of moves and conversations taking place in the interaction. However, four interaction types as identified in Psaltis and Duveen (2006) and Psaltis (2011) were also included in the coding frame since it was found that they directly relate to the gender composition of pairs and the cognitive progress of the original non-compensators. These interaction types are based on the behavior of the non-compensators but they take under consideration the interaction as a whole, including both behavior and conversations.

From the four interaction types, the only type ending in an incorrect joint agreement is the *Incorrect Answer* type. The remaining three interaction types describe interactions ending with a correct joint answer. *Explicit Recognition* is an interaction where there are observed indications from the non-compensators that they have grasped the idea of compensation. Specifically, they make at least two correct placements of two different houses or they make a correct placement and propose a second or even third correct placement of different houses. When there is no Explicit Recognition on behalf of the non-compensator, the interactions are classified as *No resistance* or *Resistance*. No resistance is an interaction where the partner makes all the placements and the non-compensator makes none and neither supports verbally his or her own view. When the non-compensator makes only one wrong placement or suggests a wrong placement which is ignored or subsequently changed by the partner without the non-compensator making shared any disagreement, the interaction is again labeled as No resistance. Moreover, an interaction is identified as No resistance when the non-compensator makes a single correct move as a response to a directive by the partner and not as a result of initiatory move. Finally, an interaction is coded as Resistance when the non-compensator makes at least one wrong placement of a house followed by his/her resistance in case the partner tries to change his/her wrong placement.

The inter-rater agreement (between the female author and a post-graduate student blind to the purpose of the study) for the four interaction types was assessed by randomly selecting 32 of the 160 pairs. Cohen's Kappa was excellent ($\kappa = .82$, $p < .01$).

Results

Study 1

Pretest performance and gender. Seventy-eight children were classified as non-compensators on the simple 90° item and 25 as partial-compensators on the 180° item and were excluded from the study. From the remaining 245 children participating in the study, 80 were classified as total-compensators and

165 as non-compensators in the pre-test. The effect of gender on the pre-test answer was not significant ($\chi^2(2) = 2.87$, $p = .41$). Eighty pairs were initially formed. Forty mixed-sex dyads (20 Mf and 20 Fm) and 40 same-sex dyads (20 Mm and 20 Ff) constituted the pairs of the interaction phase. Forty-two children were allocated to the Control group 1 (20 males and 22 females) and 43 to the Control group 2 (21 males and 22 females).

Assignment to group and cognitive progress. Comparisons between the experimental and Control Group 1 provided the opportunity to systematically investigate any gender differences on the task. For example, boys might benefit more from girls when working on the task individually. Therefore, a comparison between C1m and C1f was performed and demonstrated no differences in their performance on both immediate posttest items. A comparison between C2m and C2f on both rotations of the delayed post-test also revealed no differences between the two groups. For this reason, the two control groups C1m and C1f were merged into one control group and the same was done with C2m and C2f.

A comparison of the immediate posttest performance between the experimental NCs and the control NCs of Control Group 1 revealed significant differences for the 180° item ($\chi^2(2) = 0.05$, $p = .022$) as well as for the 270° item ($\chi^2(2) = 13.25$, $p = .001$). On the 180° item of the immediate post test, 31 participants corresponding to 38.8% of the experimental NCs showed progress (PC or TC) whilst only 17.5% of the NCs of the control group participating in the same phase showed progress (PC or TC).

On the immediate 270° item, 44 participants corresponding to 55% of the experimental NCs performed at a PC or TC level whilst only 22.5% of the NCs of the control group participating in the same phase did the same.

A comparison of the delayed post test performance between the experimental NCs and the control NCs (C2m, C2f) revealed significant differences for the 180° item ($\chi^2(2) = 9.39$, $p = .009$) as well as for the 270° item ($\chi^2(2) = 8.61$, $p = .013$). On the delayed 270° item, 42 (45.5%) of the experimental NCs perform at a PC or TC level whilst only 11 (20.9%) of the NCs of the control group participating in the same phase did the same.

Pair type and cognitive progress of NCs. A set of orthogonal planned contrasts (Davies, 2010) was devised for the comparison of the NCs from the opposite- and same-gender pairs to the control NCs (Table 1). The planned contrasts allowed for the examination of the following specific set of hypotheses based on a previous study (Psaltis & Duveen, 2006; Zapiti & Psaltis, 2012): (1) that NCs of the Mf pair type would do significantly better than the NCs of the control group in the immediate post-test since the male TCs may imply their correct answer and the female NCs just replicate this in the immediate 180° post-test; (2) that NCs of the Fm pair type would do significantly better than the NCs of the control group in the immediate 270° post-test since this is a task that the children have not solved previously and its correct solution suggests a deeper understanding of the task as found in the previous study; (3) that NCs of the Fm

pair type would do significantly better than the NCs of the control group in the delayed 270° post-test, suggesting once again a deeper understanding of the task, and (4) that NCs from same-sex pairs would have better performances than the NCs of the control group in the posttest based on the finding from the previous study that interaction is more beneficial than individual work. In relation to the planned contrast 1, the experimental NCs in the Mf pairs ($M = 1.15$, $SD = 0.98$) were found to have better performance than the control NCs ($M = 0.33$, $SD = 0.75$) in the immediate 180° item ($p < .01$). In relation to the planned contrast 2 there was a tendency for the males in the Fm pairs ($M = 0.90$, $SD = 0.85$) to have better performance in the immediate 270° item than the experimental NCs ($M = 0.42$, $SD = 0.80$) ($p = .076$). The experimental NCs in the Mf ($M = 1.37$, $SD = 0.95$) and Fm ($M = 1.05$, $SD = 0.77$) pairs were found to have better performance than the control NCs ($M = 0.46$, $SD = 0.83$) in the delayed 180° item ($p < .05$). In relation to the planned contrast 3, the non compensators of the Fm ($M = 1.26$, $SD = 0.93$) pairs were found to have better performance than the control NCs ($M = 0.46$, $SD = 0.76$) in the delayed 270° item ($p < .01$). In relation to the planned contrast 4, the NCs in the Mm pairs ($M = 1.15$, $SD = 0.93$) were also found to have better performance than the control NCs ($M = 0.43$, $SD = 0.80$) in the immediate 270° item ($p < .01$). The experimental NCs in the Mm pairs ($M = 1.05$, $SD = 0.97$) pairs were found to have better performances than the control NCs ($M = 0.46$, $SD = 0.83$) in the delayed 180° item ($p < .05$). There was a tendency for the female NCs in the Ff pairs ($M = 0.95$, $SD = 0.82$) to have better performances than the experimental NCs ($M = 0.46$, $SD = 0.76$, $p = .067$).

Table 1
Post-test performance by pair type for the younger children

		Mean	SD			Mean	SD
Imme. 180° Item				Imm.270° Item			
	Mf	1.15	0.98		Mf	1.70	0.97
	Fm	0.60	0.94		Fm	0.90	0.85
	Mm	0.70	0.97		Mm	1.15	0.93
	Ff	0.55	0.88		Ff	0.75	0.71
	Control	0.33	0.75		Control	0.42	0.80
	Total	0.60	0.91		Total	0.72	0.87
Del. 180° Item				Del. 270° Item		Mean	SD
	Mf	1.36	0.95		Mf	0.73	0.93
	Fm	1.05	0.97		Fm	1.26	0.93
	Mm	1.05	0.87		Mm	0.84	0.89
	Ff	0.55	0.82		Ff	0.95	0.92
	Control	0.46	0.82		Control	0.46	0.76
	Total	0.84	0.94		Total	0.77	0.88

Interaction type and cognitive progress of NCs. A set of three orthogonal planned contrasts was performed that allowed for the examination of the following specific set of hypotheses based again on the previous study

(Psaltis & Duveen, 2006; Zapiti & Psaltis, 2012): (1) that NCs of the Explicit Recognition interaction type would do significantly better than NCs of other interaction types; (2) that NCs of the Incorrect Answer interaction type would perform at a significantly lower level than both of the NCs taking part in the Resistance and No-Resistance interaction types. Based on the planned contrast 1, the investigation revealed that the NCs in the Explicit Recognition interactions ($M = 1.2$, $SD = 0.86$) were found to have better performance than the NCs in the *Incorrect Answer* interactions ($M = 0.38$, $SD = 0.74$) in the immediate 270° item ($t(31.98) = 2.20$, $p < .001$, two tailed). In relation to the planned contrast 2, NCs of the *Incorrect Answer* interaction type performed at a significantly lower level than the NCs taking part in the Resistance and the No-Resistance interaction types (Table 2).

Table 2
Post-test performance by interaction type for the younger children

		Mean	SD			Mean	SD
Imme. 180° Item	Resistance	0.50	0.81	Imm.270° Item	Resistance	1.00	0.81
	No Resistance	0.77	1.00		No Resistance	0.88	0.90
	Explicit Recognition	0.96	1.00		Explicit Recognition	1.20	0.86
	Incorrect Answer	0.66	0.96		Incorrect Answer	0.38	0.74
	Total	0.75	0.96		Total	0.87	0.87
Del. 180° Item		Mean	SD	Del. 270° Item		Mean	SD
	Resistance	0.80	0.94		Resistance	0.80	0.77
	No Resistance	0.82	0.95		No Resistance	1.05	0.89
	Explicit Recognition	1.48	0.87		Explicit Recognition	1.40	0.86
	Incorrect Answer	0.70	0.92		Incorrect Answer	0.40	0.75
	Total	1.00	0.95		Total	0.94	0.90

Further Exploration of the Conversational Dynamics

Interaction type by pair type. A crosstabulation of the four interaction types with pair type in the interaction was performed and revealed a significant relation between the two ($\chi^2(9) = 17.15$, $p = .046$). Since there is a theoretical interest for a comparison between the two mixed-sex dyads, another planned comparison between Mf and Fm was performed which was also significant ($\chi^2(3) = 9.7$, $p = .021$). The Fm pair type was notable for the higher number of Explicit Recognition in relation to the other pair types. Incorrect Answer was more often present in the Mf pairs than in the Fm pairs ($p = .021$, see Table 3).

Table 3
Interaction type by pair type for the younger children

| | | Interaction Type | | | | Total |
		Resistance	No Resistance	Explicit Recognition	Incorrect Answer	
Pair type	Mf	5	3	4	8	20
	Fm	1	3	13	3	20
	Mm	5	6	4	5	20
	Ff	5	6	4	5	20
Total		16	18	25	21	80

Interruptions and challenges by pair type. In the case of interruptions and challenges, no hypotheses were formed since there was no previous research. A 2 (gender of NC) x 2 (gender of TC) x 2 (interruptions of TC vs. interruptions of NC) ANOVA with repeated measures on the last factor was performed. An interaction effect between Interruptions of each partner and Gender of TC was found ($F(1,76) = 9.94$, $p = .002$) and the pairwise comparisons demonstrated that only in the same-sex pairs the two partners differ in the use of interruptions. Specifically, in the Mm pairs, the male experts ($M = 1.55$, $SD = 0.26$) make more interruptions than the male novices ($M = 0.65$, $SD = 0.25$) ($p = .014$). But what is more interesting is that in the Ff pairs, it is the f ($M = 1.55$, $SD = 0.25$) that makes more interruptions than the F ($M = 0.80$, $SD = 0.26$, $p = .039$).

A 2 (gender of NC) x 2 (gender of TC) x 2 (challenges of TC Vs challenges of NC) ANOVA with repeated measures on the last factor revealed that the two partners in the various pair types do not differ in the number of challenges they make.

House- and other-oriented moves by pair type. The number of house-oriented moves made by each partner of a pair was investigated using a 2 (gender of NC) x 2 (gender of TC) x 2 (house-oriented moves of TC Vs house-oriented moves of NC) ANOVA with repeated measures. The analysis, though, did not reveal any significant differences between partners across the different pair types.

The 2 (gender of TC) x 2 (gender of NC) x 2 (other-oriented moves of TC Vs other-oriented moves of NC) ANOVA with repeated measures on the last factor was indicative of a main effect for Other-oriented moves of each partner ($F(1,76) = 5.37$, $p = .023$) and an interaction effect ($F(3,76) = 8.62$, $p = .004$). According to the pairwise comparisons the female TCs in Fm pairs ($M = 1.05$, $SD = 0.25$) make more other-oriented moves than male NCs ($M = 0.25$, $SD = 0.23$, $p = .016$). Additionally, male TCs in Mm pairs ($M = 1.20$, $SD = 0.24$) make more other-oriented moves than male NCs ($M = 0.30$, $SD = 0.23$, $p = .007$). In other words, male NCs are addressed more by their TC partners regardless of the gender of the TC.

Study 2

Pre-test performance and gender. From the two hundred and fifty-three children participating in the study, 80 were classified as total-compensators and 173 as non-compensators in the pre-test. Twenty-four children were classified

as non-compensators in the simple 90° item and 2 as partial-compensators in the 180° item and were excluded from the study. The effect of gender on the pre-test answer was not significant ($\chi^2(2) = 5.27$, $p = 0.15$). Eighty-two pairs were initially formed. Two pairs were excluded from the study because they did not comply with the instructions of the experimenter and they rotated the construction board. Forty mixed-sex dyads (20 Mf and 20 Fm) and 40 same-sex dyads (20 Mm and 20 Ff) constituted the pairs of the interaction phase. Forty children were allocated in the Control group 1 (20 males and 20 females) and 53 in the Control group 2 (23 males and 30 females).

Assignment in group and cognitive progress. A comparison between C1m and C1f was performed and demonstrated no differences in their performance on both immediate post-tests. The same comparison was made between C2m and C2f on both rotations of the delayed post-test also revealed no differences among the two groups. Thus, the two control groups C1m and C1f were merged into a single group. C2m and C2f were merged in the same way.

The same analytic strategy was followed as in the study with the 6-year-old children. On the immediate post test performance, the comparison between the experimental NCs and the control NCs of Control Group 1 revealed no significant differences for the immediate 180° item and 270° item. The investigation of the performance on the delayed post-test also indicated that the NCs did not perform better than the corresponding control group.

Pair type and cognitive progress of NCs. The score on the post test items of the NCs participating in the different pair types was also explored using the same set of orthogonal contrasts as in Study 1. Interestingly, the orthogonal planned contrasts revealed that the score of the NCs on all the posttest items does not differ between the four pair types (Table 4).

Table 4
Post-test performance by pair type for the older children

		Mean	*SD*			*Mean*	*SD*
Imme. 180° Item				Imm.270° Item			
	Mf	0.50	0.88		Mf	0.75	0.91
	Fm	0.80	1.00		Fm	0.85	0.93
	Mm	0.70	0.98		Mm	0.75	0.96
	Ff	0.30	0.73		Ff	0.65	0.87
	Control	0.52	0.87		Control	0.67	0.91
	Total	0.55	0.89		Total	0.72	0.90
Del. 180° Item		*Mean*	*SD*	Del. 270° Item		*Mean*	*SD*
	Mf	0.80	0.80		Mf	1.05	0.88
	Fm	1.15	1.15		Fm	0.84	0.95
	Mm	0.65	0.93		Mm	0.85	0.98
	Ff	0.52	0.90		Ff	0.78	0.91
	Control	0.66	0.91		Control	0.96	0.90
	Total	0.73	0.95		Total	0.91	0.91

Interaction type and type and cognitive progress of NCs. The investigation of the score on posttest items of NCs of different interaction types used the same set of orthogonal planned contrasts as in Study 1. In relation to the planned contrast 1 and in line with Study 1, the NCs in the Explicit Recognition interactions ($M = 1.26$, $SD = 0.96$) were found to have better performance than in the *Incorrect Answer* interactions ($M = 0.42$, $SD = 0.82$) in the delayed 180° item ($t(12) = 2.25$, $p < .001$, two tailed; see Table 5).

Table 5
Post-test performance by interaction type for the older children

		Mean	SD			Mean	SD
Imme. 180° Item	Resistance	0.28	0.75	Imm.270° Item	Resistance	0.71	0.95
	No Resistance	0.57	0.97		No Resistance	0.85	0.89
	Explicit Recognition	1.15	1.00		Explicit Recognition	0.84	1.00
	Incorrect Answer	0.25	0.66		Incorrect Answer	0.67	0.85
	Total	0.57	0.91		Total	0.75	0.90
Del. 180° Item		Mean	SD	Del. 270° Item		Mean	SD
	Resistance	0.85	1.06		Resistance	1.00	1.00
	No Resistance	0.85	1.06		No Resistance	.28	0.75
	Explicit Recognition	1.26	0.96		Explicit Recognition	1.11	0.95
	Incorrect Answer	0.42	0.82		Incorrect Answer	0.81	0.89
	Total	0.78	0.97		Total	0.85	0.92

Further Exploration of the Conversational Dynamics

Interaction type by pair type. A crosstabulation of the four interaction types with pair type in the interaction was performed and no significant relation between the two was found ($\chi^2(9) = 7.69$, $p = .56$) (Table 6). Despite this, it is very interesting that whatever the pair type, the interaction type tends to be of Explicit Recognition or Incorrect Answer while there are few interactions of Resistance or No Resistance. This might be indicative of less conflicting interactions between the children of the fifth grade and less instances where a child takes control over the problem space and imposes a solution.

Table 6
Interaction type by pair type for the older children

		Interaction Type				
		Resistance	No Resistance	Explicit Recognition	Incorrect Answer	Total
Pair	Mf	3	1	6	10	20
type	Fm	0	1	10	9	20
	Mm	2	3	6	9	20
	Ff	1	2	5	12	20
Total		6	7	27	40	80

Interruptions and challenges by pair type. A2 (gender of TC) x 2 (gender of NC) x 2 (interruptions of TC Vs interruptions of NC) ANOVA with repeated measures on the last factor revealed that there are no significant differences between the two partners of the different pair types. Once again, pair composition does not seem to have an effect on the intention of a child to interrupt the movement of his or her partner.

A similar analysis for the use of challenges, that is a2 (gender of TC) x 2 (gender of NC) x 2 (challenges of TC Vs challenge of NC) ANOVA with repeated measures on the last factor revealed that there are no significant differences between the two partners of the different pair types. Once more, pair composition does not seem to have an effect on the intention of a child to challenge a movement by his or her partner.

House- and other- oriented moves by pair type. The number of house-oriented moves made by each partner of a pair was investigated using a 2 (gender of TC) x 2 (gender of NC) x 2 (house-oriented moves of TC Vs house-oriented moves of NC) ANOVA with repeated measures but results did not reveal any significant differences between partners across the different pair types.

The 2 (gender of TC) x 2 (gender of NC) x2 (other-oriented moves of TC Vs other-oriented moves of NC) ANOVA with repeated measures on the last factor gave a main effect for Other-oriented moves of each partner ($F(1,76) =$ 8.83, $p = .004$). Specifically, the NCs make more other-oriented moves ($M =$ 1.18, $SD = 0.14$) than their TC partners ($M = 0.65$, $SD = 0.10$).

Discussion

This work investigated the role of social gender identity dynamics in the ZPD and their relation in mediating the internalization process from the inter-psychological to the intra-psychological. For younger children at the beginning of the concrete operational stage this influence has been indeed formative. The present findings replicated previous findings from the third generation of research (e.g., Psaltis & Duveen, 2006) and the Fm effect since progress on indirect and delayed measures were particularly pronounced for the delayed 270° item adding on a long tradition of Genetic Social Psychology and minority influence findings where low status groups are particularly successful in bringing up change in targets of influence on delayed and indirect measures.

As in previous research, for 6–7 year-old children, peer interaction was more beneficial than individual work. This was not the case for the 9–10 year-old children since the performance of children working with a partner were not significantly different from the scores of children working individually. Such a finding adds support to earlier findings by Doise, Perret-Clermont, and Mugny (1981) where in the stage where a notion is being initially elaborated (here – concrete operations), social interaction alone may induce progress but the individual activity is not capable of doing so. On the contrary, in the late stages of the concrete operational stage, on a concrete operational task individual work and social interaction in dyads seems to be equally successful.

The second hypothesis was partly confirmed. Gender composition of the pairs did not differentiate the behavioral patterns in the interaction but the dynamics were found to differ across age groups. Specifically, results from children of the first grade revealed that non-compensators from all pair types had better performance than non-compensators of corresponding control groups in all post-test items. This beneficial effect of peer interaction varied across the different pair types. Specifically, females in Mf pairs had better performances than females in corresponding control group in the immediate and delayed 180° items of the post test. On the other hand, males from Fm pairs had better performances than males from the corresponding control group in both the delayed 180° and 270° items. Having in mind that the 180° rotation is the same item as in the interaction phase, it could be argued that the case of females working with male experts is probably the result of more superficial engagement and imitation. Males working with female experts display signs of deeper knowledge and understanding of the task since they show progress on items that they have not seen in previous phases of the experiment. This is a well-established finding called the Fm effect. Previous work indicated that more balanced communication between the interlocutors in dyadic interaction of female expert-male novice (Fm) in which there is conflicting nature of gender status and knowledge asymmetry. This communication is linked with more flexible and novel forms of knowledge, interiorization of operations and in depth understanding of the object under discussion (see Psaltis & Zapiti, 2014).

This is also related to the finding that Fm pairs were notable for the higher frequency of Explicit Recognition in their interactions. This provides further support to the findings of previous studies (Duveen & Psaltis, 2006, 2007; Zapiti & Psaltis, 2012). It also provides discrimination power to the interaction types suggesting that gender composition relates to different dynamics in the interaction and different profiles in the post-test performances.

The picture that emerged from the investigation of the interaction behavior of 6-year-old children suggested that children's behavior is affected by gender composition. Specifically, the Ms in the Mm pairs made more interruptions than their partner but in the Ff pairs it is the fs that make more interruptions. Results for these same-gender pairs are interesting since they indicate that the intention for these choices is the same as in the mixed-gender pairs since shared gender norms have a strong impact on children's behavior (Carli, 1990). This may also indicate a different behavioral style of boys and girls when they are in the knowledgeable position. Specifically, girls seem less confident and sure of themselves to act as experts compared to males.

Moreover, females in the Fm pairs make more other-oriented moves than their partners. In the work of Leman and Duveen (1999, 2003) it was found that in the Mf pairs boys dominated the conversation and interactions ended quickly in the absence of sophisticated argument. Likewise, in the work of Psaltis and Duveen (2006), interactions of No Resistance are more frequent in the Mf pairs. The findings of this paper do not contradict these previous findings since the nature of the village task is quite different from the Piagetian moral stories and

the liquid conservation task. The village task due to the fact that children have to place three houses gives more action space to start with compared to moral stories or the liquid task in which an answer can be enforced immediately from the more advanced partner. In the village task one might not expect so much compliance of the females in the Mf pairs as found in these previous studies for this reason. Still, gender composition might not differentiate the behavioral patterns in the Mf pairs but the unproductive results in the posttest suggest that a basic dynamic that is not as favorable as the one present in Fm.

The results from the 10-year-old children indicated that the performance of the experimental NCs did not differ from the performance of control NCs in any of the post-test items. The non-significant findings were a result of both groups making progress on the items of the post-test. This is in line with the finding of the study by Leman (2014) that the performance of the 13-year-old children in the group did not differ significantly from the performance of the control group.

Moreover, as was the case with first grade children, Explicit Recognition was the only interaction type related to better performance on the post-test. This indicates that for both age groups, the explicit signs that they have grasped the idea of compensation by making at least two correct placements are not superficial but relate to actual understanding of the task and thus progress. Although Explicit Recognition was more frequent in the Fm pairs in children of the first grade, the same was not the case for children of the fifth grade.

No significant differences emerged in the examination of interaction moves of partners of different pair types of fifth-grade children. This is in line with the study by Leman and Duveen (1996) in which they examined age differences in children's understanding of expertise and found that 7–8 year-old children engage in debates in their interactions but they are more sensitive to pair composition than 11–12 year-old children.

Results from both age groups revealed that gender knowledge and representations can be expressed in children's behavior and determine the motives behind this behavior, especially for 6-year-old children. For these children, interaction with a more competent partner is more beneficial for progress than individual work while gender composition and the consequent gendered behaviors shape the course of these interactions. The recognition of the beneficial or detrimental effect of gender in this young age is of vital importance since it appears that these are the years that collaborative work is more beneficial than individual work, at least on concrete operational tasks. On the other hand, the interactions of 10-year-old children were conflicting as was the case for the 6-year-old children but it was not gender knowledge that shaped their behavior in the interaction. The children of the fifth grade were more occupied with their strategy and the way to apply it in a mental level without the need to interact with the material or deal with the external features of the interaction including the partner's gender and behavior. Therefore, gender has a diminishing effect on behavior without ruling out an influence for highly stereotypical children (see Psaltis & Zapiti, 2014).

Conclusion

In conclusion, for the 6-year-old children, interaction with a more competent partner is more beneficial for progress than individual work. Their interactions are more competitive but it is actually in the interactions where gender composition allows for more equality among partners, as is the case of the female experts working with male novices that children benefit more. Thus, children around the age of 6–7 can be affected by external features of an interaction in such a degree that interactions are more beneficial for cognitive development than individual work. On the other hand, children around the age of 10–11 use more explanations and justifications in their interactions which are more of a co-operative nature. Gender composition can still shape children's behavior in the interaction but the dynamics affect more the internal and abstract level of thinking since the presence or absence of a partner as an external feature does not critically determine the outcomes. Therefore, the effect of gender does not diminish but changes across age appearing to *go underground* in older children.

The present findings do add support to Baucal's (2013) claim that there are two and not one ZPD at play. There is indeed both joint construction and individual construction in the ZPD. Motivational processes seem to encourage participation by the less competent child and individual construction, however, the presence of more advanced views in the ZPD can both promote imitation (reduced possibility for deep elaboration and novelty in the post test period) and socio-cognitive conflict (facilitating participation, deep elaboration and novelty in the post test period). Both processes are largely regulated by social identity dynamics of balance or imbalance of various asymmetries adding support to the Piagetian (1932) distinction between social relations of co-operation and social relations of constraint.

We argue, based on the present findings, that a more complex reformulation of the ZPD can be offered, which incorporates key Piagetian insights. An important sign or symbol in the internalization process is the whole triadic configuration of *subject–object–other*, which creates further possibilities for decentration in the post-interaction period, with increased or decreased possibilities for reflection on the object depending on the triadic configuration internalized. This is suggested by the presence of incubation effects, or in Piagetian terms the reequilibration process, in the delayed post-test measures. In short, depending on the sense of control and the recognition of the other as a thinking subject during social interaction, interiorisation in Piagetian terms becomes more or less possible for the subject.

The present study has shed light to the process of explicit or implicit influence influence of gender on peer interaction and cognitive outcomes but even this suggests that gender needs further exploration. Specifically, the investigation should examine the interaction of gender with other social factors that could affect peer interaction such as ethnicity and socioeconomic status. Finally, the hypothesis that the productive role of social interaction over individual work will reemerge in adolescence once they discuss a formal operational task should be further explored.

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Suviše dobro da bi bilo istinito? Doprinos razumevanju zone narednog razvoja iz pijažeovske perspektive: polni sastav i kako se njegova uloga menja od ranog do srednjeg detinjstva

Anna Zapiti & Charis Psaltis

Department of Psychology, University of Cyprus, Cyprus

Ova studija se vraća istraživanju kompleksnosti zone narednog razvoja kroz eksperimentalno ispitivanje uloge dinamike društvenog identiteta u asimetričnoj interakciji dve uzrasne grupe (dece, prim. prev.) oko pijažeovskog tipa kognitivnog zadatka. Deca iz dve uzrasne grupe (grupe od 6 i grupe od 10 godina) rešavala su zadatak prostornog transformisanja, prvo individualno (pretest), a onda u parovima istog ili različitog pola sa partnerom čije je poznavanje zadatka bolje od njihovog. U posttestu, šestogodišnjaci koji su učestvovali u interakciji su imali bolje rezultate od šestogodišnjaka iz kontrolne grupe koji nisu učestvovali u interakciji. Međutim, nije bilo razlike u uspehu na posttestu između desetogodišnjaka koji su učestvovali u interakciji i onih koji nisu. Štaviše, efekat polnog sastava (para dece koji je radio zajedno, to da li su deca unutar para istog ili različitog pola, prim. prev.) na dinamiku interakcije je bio različit u dve uzrasne grupe. Dinamika društvenog polnog identiteta formirana u interakciji šestogodišnjaka bila je u vezi sa kognitivnim napredovanjem, ali je kod desetogodišnjaka društvena konstrukcija znanja bila podjednako uspešna u podsticanju kognitivnog razvoja koliko i asimetrična socijalna interakcija, a dinamika polnih identiteta nije imala isti formativni uticaj.

Ključne reči: zona narednog razvoja, Vigotski, Pijaže, interakcija sa vršnjacima, kognitivni razvoj, pol, društveni identitet.

Appendix A:
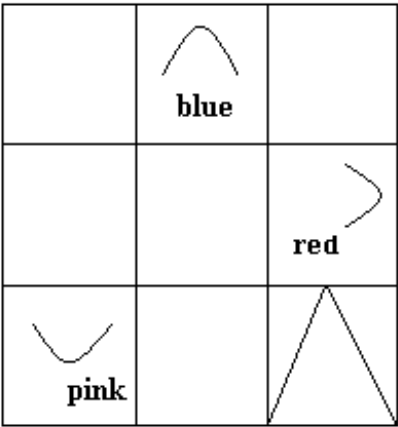**The Interaction Phase of the Village Task for the 6 year-old Children**

Copy card-board
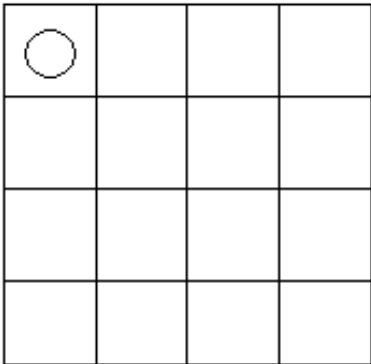

Position of the TC

Model card-board

Position of the NC

Appendix B:
The Interaction Phase of the Village Task for the 10 year-old Children
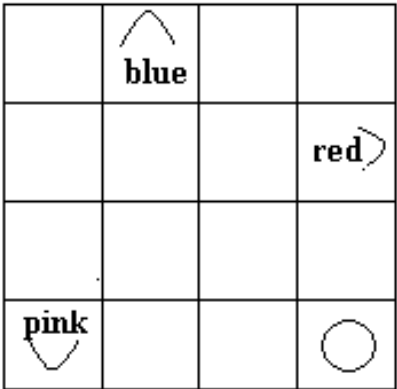
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Position of the TC

Model card-board

Position of the NC

180° in relation to copy