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Do children need to learn to collaborate?

The effect of age and age differences on collaborative recall

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Abstract

We used a collaborative recall task to explore the nature and consequences of children's interaction with another child at the same or different age. Ninety-six children memorised word lists for recall. In a first condition children recalled collaboratively: in a pair with another child. In a second condition children recalled words independently (this made possible the creation of "nominal" pairs for comparison). Pairs were either composed of two 7-year-olds, two 9-year-olds, or a 7- and a 9-year-old. Older pairs, like adults, showed a net negative effect of collaborative recall. However, younger children showed no effects of collaboration. Analyses of the different contributions offered by each child in a pair, and of measures of social dominance suggest that older children dominate social aspects of interaction and recall when paired with a younger child. We argue that younger children may lack full awareness of the role of interaction as a forum for the co-construction of knowledge.

Keywords: age, collaboration, peer, recall, social interaction

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Peer collaboration.

Over many years a wealth of research has demonstrated the role played by collaboration in children's cognitive development (Ames & Murray, 1984; Doise & Mugny, 1984; Gauvain & Rogoff, 1989; Howe, Duchak-Tanner & Tolmie**,** 2000; Tudge, 1992). However, there remains debate over the means through which these gains are achieved (Kruger, 1993; Leman, 2002; Tudge, 2000). Some have argued that developmental benefits are a consequence of a process of knowledge induction, from a more to a less advanced peer (e.g. Rogoff, 1987). Others have suggested that benefits of interaction can result from interaction between two "novice" peers through joint activity on a given task (Schwarz, Neuman & Beizner, 2000). Tudge & Rogoff (1989) suggest that there are two routes to the acquisition of knowledge through interaction – what could be termed processes of "transmission" and "construction".

The proposed role of peer collaboration in cognitive development (Vygotsky, 1978), and the existence of a zone of proximal development (ZPD), points to the importance of communication and joint activity in children's interactions (Wertsch, 1998). Most contemporary accounts of the process of internalisation of knowledge involve some form of reconstruction as knowledge (Tudge, 1997). Nevertheless Vygotskian and neo-Vygotskian approaches can be characterized as transmission accounts since what underlies them is a sense of asymmetry in knowledge or skill between two individuals. Thus knowledge is transmitted from one individual (an expert) to another (a novice). Often, expertise corresponds to age – older children and adults generally are more developmentally advanced and have superior knowledge than younger children. Empirical studies from a neo-Vygotskian or socio-cultural

perspective have identified the ways in which adults "frame" (or scaffold) a child's activity in a particular area and hence guide forward the child's social and cognitive functioning (e.g. Rogoff, 1998).

Knowledge and the social dynamics of interaction.

Asymmetries in knowledge can promote learning but are not the only form of asymmetry in interaction. The social dynamics of interaction would also appear to be important. For instance, Doise, Mugny and Pérez (1998) have claimed that certain forms of conflict can advance reasoning. Of course, not all conflict is associated with development (Damon & Killen, 1984). But the dynamics of interaction have been associated with cognitive advancement (or the lack of it) in a number of studies (see for example Kruger, 1992; Leman & Duveen, 1999). In fact, Piaget (1932; 1966) also noted the importance of peer interaction for social and cognitive development. For Piaget, interaction between peers offers the opportunity for the exchange of perspectives through communication within relations of cooperation. However, adult-child interaction is asymmetric not only in terms of knowledge but also in terms of authority in social relations. In adult-child interaction (relations of constraint) the free exchange and integration of perspectives is obstructed because the adult's social authority or power results in the adult perspective dominating.

Recent research has probed the importance of the social dynamics of interaction and of argumentation (Anderson, Chinn, Waggoner & Yi, 1997; Chambliss & Murphy, 2002; Felton & Kuhn, 2001; Kuhn & Udell, 2003; Leman, Ahmed & Ozarow, in press). This research adds to a considerable body of evidence that has identified variation in interaction dynamics in children's play, everyday talk and problem-solving from preschool onwards. Sources of asymmetry in interaction include gender (Howe & McWilliam, 2001; Maccoby, 1990) ethnicity (Leaper,

Tenenbaum, & Shaffer, 1999; Verba, 1998) and age (Duran & Gauvain, 1993; Leaper, 1991). The last of these, age, is particularly important since a key claim of transmission accounts of knowledge acquisition is that asymmetry in knowledge (expert-novice) interaction is required for developmental advances. However, as we have seen, age differences often confound asymmetries in knowledge with asymmetries in the social dynamics of interaction. In other words, it is difficult to disentangle whether asymmetry in social dynamics or asymmetry in knowledge is the effective ingredient in interaction that leads to social influence and connects with cognitive advancement.

Using a collaborative recall paradigm to study children's interaction.

The current study uses a collaborative recall task to examine the effects of age and age differences on children's interaction and recall. Collaborative recall, put simply, is joint recall of the same list of items by two or more people. The task contrasts with paradigms used in much previous research that have focused on the benefits of interaction and have used tasks testing developmentally relevant skills and knowledge such as conservation ability (e.g. Ames & Murray, 1984; Doise & Mugny, 1984). The aim of the current study was not to see if learning took place between peers. Rather, the aim was to see how processes of collaboration might work at different ages and between children of different ages. A distinctive aspect of collaborative recall is that studies with adults show that there is a net *negative* effect (e.g. Clark, Hori, Putnam & Martin, 2000): generally speaking, fewer items are recalled in pairs than alone (or in fact in comparison pairs made up of individuals who recall individually). In addition, whilst there are well-known age differences in memory ability (Kail, 1990), no previous study has explored whether age differences exist in collaborative recall. Thus the focus on the effects of collaboration in the

current study constitutes a novel approach to study of the relationship between collaboration and cognitive performance.

Research on collaborative recall has tended to focus (with one notable exception, Andersson, 2001) on adult performance. A number of findings have emerged. First, and unsurprisingly, collaborative groups recall more correct information than an individual does (Andersson & Ronnberg, 1995; Meudall, Hitch & Kirby, 1992; Meudall, Hitch & Boyle, 1995). As a result, studies of collaborative recall employ a 'pooling' of items (see Lorge & Solomon, 1955). If one person remembers items a, b, c, d and e, and another remembers items a, b, c, f and g, the total recalled by the dyad is seven items (higher than the individual recall of five). But although collaboration is superior to individual recall, pairs and groups do not perform as well as predictions based on pooling. When "nominal" pairs are created by combining individuals' independent scores they perform rather better than "real" pairs in which two individuals have tried to recall the same items together (see Bouchard & Hare, 1970 for more details on this methodology).

Explaining the negative effects of collaborative recall.

Explanations for individuals' poorer levels of recall when in pairs than when alone have focussed on the ways in which collaboration might inhibit recall (Weldon & Bellinger, 1997). Social processes appear important. Basden, Reysen and Basden (2002), for instance, found that false memories could be transmitted socially, in a collaborative recall group.

Geen (1991) argues that two social psychological processes underlie the effects seen in collaborative recall tasks. Under certain conditions individual performance is facilitated by the presence of others (social facilitation) whereas in others performance is inhibited (social loafing). Yet whilst there are undoubtedly

situations in which collaboration can facilitate learning (for example in cognitive development), Geen provides no clear explanation as to why loafing rather than facilitation dominates in collaborative recall tasks. Moreover, collaborative inhibition is unaltered by variations in motivation and incentives (such as the offer of money, Weldon, Blair & Hitch, 2000) so social and motivational processes can explain only part of the negative effects of collaborative recall.

Diehl and Stroebe (1987) suggest another possible explanation. They argue that 'production blocking' is responsible for nominal groups out-performing real groups in recall tasks. Production blocking occurs when interaction interferes with an individual's ability to express his or her ideas. In a similar vein Basden and Basden (1995) argued that the negative effects of collaborative recall stem from the way in which hearing another recalling items disrupts an individual's particular retrieval strategy. Evidence appears to support the retrieval strategy disruption theory. Finlay, Hitch and Meudall (2000), in a series of studies, found that collaborative inhibition occurred in pairs *unless* partners had learned items together (in which case recall was improved or no different from the nominal pairings).

Children's memory and the social dynamics of collaboration.

No previous research has explored age differences in children's collaborative recall and the possible effects of collaboration on recall between children of different ages.

However, Andersson (2001) did explore how far three factors – friendship, age and gender – could *reduce* the negative effects of collaborative recall. Andersson found that when friends were able to share encoding and retrieval strategies they showed fewer negative effects of collaborative recall than non-friends. Moreover, this was true for friends in both older (15 years) and younger (7 years) age groups. Gould,

Osborn, Krein and Mortenson (2002) however found no differences in recall between married and unacquainted couples although in their study, pairs did not encode together. A further finding from Andersson's (2001) study was that pairs of the older children were better able to reduce the negative effects of collaborative recall than younger children. Andersson argued that this was due to the younger ones' inferior cognitive abilities and in particular poor strategic understanding at the encoding stage.

A good deal of evidence indicates that children's use of recall strategies improves with age (Sodian & Schneider, 1999). However, even young children (in second grade) can use at least one strategy for recall (Coyle & Bjorkland, 1997). In a study involving multiple measures of three different memory factors DeMarie & Ferron (2002) found that the number of strategies used by children on different tasks increased with age. Amongst other results there were consistent age-related improvements in digit span and speed of recall.

Individual memory abilities are not of empirical interest in the current study – the current study focuses on the effects of *collaborative* recall. So although from preschool children possess at least one recall strategy, younger children's use of recall strategies is probably not as well established as that of older children. As a consequence, we might expect younger children's recall to be more vulnerable to interference by another strategy in a collaborative recall paradigm.

Experimental outline and hypotheses.

In the present study children from two age groups (7 years and 9 years) were placed in one of three pairs. Pairs were either the same age peers or consisted of an older and a younger child. Of empirical interest were age differences in collaborative recall and the ways in which the social dynamics of interaction (comparing same age and different aged pairs) might affect collaborative recall and peer interaction.

As a result of their weaker strategic understanding of memory processes we expected that pairs of younger children would show more negative effects of collaboration in recall than older pairs. No specific predictions were made about the effects of collaborative recall in different-aged pairings. We also hypothesised that age differences in a pair would create asymmetry and lead to social dominance in interaction and recall. This asymmetry would be visible both in terms of interaction and in terms of the number of items recalled by the older and the younger child within this pairing.

Method

Participants.

A total of 96 children (47 girls and 49 boys) were recruited from schools in predominantly middle-class areas of London and Manchester, UK. The 48 children in the youngest group had an average age of 7 years, 0 months. The 48 children in the oldest age group had an average age of 9 years, 4 months. All children spoke English as their first language.

Materials.

Twenty words were randomly selected from the MRC Psycholinguistic database Interface. These twenty words were used to create two lists (A and B, see Appendix). Words in each list were matched for imagery (Paivio, Yuille & Madigan, 1968) and frequency (Thorndike & Lorge, 1944). Participants' interaction was video-recorded.

Design and independent measures.

A 2 x 3 mixed factorial design was employed. There were two independent variables - the between subjects factor of pair-type and the within subjects factor which was the recall condition. The independent variable pair type had three levels:

pairs consisting of two 7-year-olds, pairs consisting of two 9-year-olds and pairs consisting of one 7-year-old and one 9-year-old. The within subjects factor was recall condition (real or nominal pairs) which gauged responses of a pair in collaboration and in a hypothetical pairing made up of participants' independent responses. See procedure (below) for more details on the complexion of real and nominal pairs.

Procedure.

In the first phase of the study - "real pairs" - children were seen in pairs a quiet room at their school. Both children were read the same word list (either A or B) along with the following instructions; "I am going to give you a list of words. I want you to try to remember them. In two minutes I will ask you to try and remember the words together. I am going to read the list to you and if you do not understand the words or have any questions feel free to ask. Please do not talk to one another until I say that you can." Children were asked to remain silent for two minutes after the final item of the list had been read out. After this time, children were told: “You can now talk to each other. I would like you to try and remember as many of the words as you can. Please let me know when you are finished.” Children were then free to recall the words together. No time limit was imposed on this process (in the event, it was clear for all pairs when they had concluded recall).

In the second phase of the study - "nominal pairs" - the procedure was similar for that in the first phase although participants were seen and recalled items individually rather than with another child. Each child was taken to the testing room alone and given a word list (either A or B, whichever they had not seen in the first phase) and the following instructions; "I am going to give you a list of words. I want you to try to remember them. In two minutes I will ask you to try and remember the words on your own. I am going to read the list to you and if you do not understand the

words or have any questions feel free to ask." After two minutes children were told: "I would like you to try and remember as many of the words as you can."

The procedure for phases one and two was counterbalanced with half of the sample receiving word list A when tested in pairs and list B when tested individually, whilst the other half received list B when tested in pairs and list A when tested individually. Whilst it may also have been desirable, practical constraints made it difficult to counterbalance the order of the phases.

One the basis of their responses in the different phases of the study, participants were given a paired recall count for real and nominal pairs. For real pairs this was simply the total of items correctly recalled. For nominal pairs this value was obtained by comparing the items recalled independently by each child in the second phase with those of their partner in the first phase. The total number of items "collectively" recalled by this nominal pair was then recorded. The total number of items recalled by both children was recorded but where the two children had independently recalled the same word this was counted as just one item.

Pairs (both real and nominal) were constructed according to three different pair types - determined by the ages of the participants. There were two pair types involving children of the same age - one with two 7-year-olds (henceforth 7 & 7 years) and one with two 9-year-olds (henceforth 9 & 9 years) in the pair. There was one pair type where a 7-year-old was paired with a 9-year-old (henceforth 7 & 9 years). There were 16 pairs in each of the three different pair types. All pairs were same sex and, following consultation with the teacher, did not consist of close friends.

Dependent measures.

Recall scores: To identify any differences in recall scores the dependent variable was the number of items recalled in the nominal and real pairs and across

pair types. It was also desirable to identify where the differences in recall by pair type existed (between nominal and real pairs); to identify the net negative effects of collaborative memory in different pairs. To this end a difference score was calculated which was the total number of items recalled in the real pair minus the total number of items recalled in the nominal pair. This measure made possible a one-way ANOVA of difference scores by pair type and gave an indication of the negative effects of collaboration.

Contribution to recall: A second set of analyses sought to establish the relative contribution of each half of a dyad (again in real and nominal pairs) to the total number of items collectively recalled. In real pairs a child was deemed to have recalled an item if he or she said it first during the collaborative recall session. A measure of the balance or symmetry of contribution (or of difference in contribution) of each half of the dyad was obtained by subtracting the number of items recalled by the child who recalled least from the child who recalled most. A contribution score of 0 meant, therefore, that each child had correctly recalled the same number of items. If one child recalled 5 and another 3, the contribution score was 2 (5-3). A 2 x 3 mixed factorial design was again used with the difference scores as the dependent variable.

The use of difference scores in this study (and in other studies) is important from both a statistical and a conceptual perspective because it allows us to preserve the pair as the unit of analytic interest. This issue of non-independence (see for example Gonzalez & Griffin, 2000) arises in analysis of dyadic interaction because the contribution of one child is not independent of his or her partner. A statistical focus on the paired outcomes (real and nominal) allows us to avoid difficulties that occur for analyses of individual and partner effects in interaction (see Kraemer & Jacklin, 1979). However, the focus on the pair is also desirable from a conceptual

basis since, following Vygotsky (1962, 1978), it is the product of the social process rather than its individual correlates which possess developmental significance.

Social dominance: Two independent judges watched the videotaped data of children's interaction. Judges were asked to rate the balance in interaction by scoring each child on a scale from 1 (submissive) to 10 (dominant). The scores of both children in the dyad had to equal 10, i.e. if a score of 5 was awarded to one child in a dyad a score of 5 had to be awarded to the other, but if a score of 7 was awarded to one a score of 3 had to be awarded to the other. Thus social dominance was measured not as a personality characteristic or trait but rather a feature of a specific episode of interaction. Agreement between judges was good (93%). Again, the difference was calculated between individuals in a dyad as a measure of balance (or imbalance) in a pair's interaction and analysed for real pairs only using a one-way ANOVA. Thus, again, the pair was treated as the unit of statistical and conceptual interest.

Results

Pair type and recall.

An analysis of variance (ANOVA) was performed to examine the effects of pair type by recall condition ("real" or "nominal"). Analysis revealed a main effect of recall condition ($F(1, 93)=7.38$, $p<.001$) indicating, as with research on collaborative memory amongst adults, that collaborative recall (recall in "real" pairs) has a negative effect in terms of the number of items recalled (see again Table 1). There was also a main effect of pair type ($F(2, 93)=33.30$, $p<.001$). Post hoc Tukey HSD ($p<.05$) tests indicated that 7 & 7-year pairs recalled significantly fewer items overall than the other pairs. Finally the ANOVA also revealed a significant interaction between pair type and condition ($F(2, 93)=3.12$, $p<.05$). Table 1 reports the mean and standard deviation of recall scores for different pair types in both real and nominal pairs.

--Insert Table 1 about here--

A one-way ANOVA by pair types was conducted on the difference in number of items recalled in real and nominal pairs. Since the difference value is merely the difference between real and nominal scores this repeated the earlier ANOVA. However this manipulation made possible the use of Tukey t-tests ($p<.05$) to identify differences between pair types. This *post hoc* analysis indicated that, in terms of the negative effects of collaboration, there was a significant difference between 7 & 7 years pairs and 9 & 9 years pairs only.

It is worth noting, also, that although there appear to be no negative effects of collaborative recall in the 7 & 7 years pairs, these pairs recall fewer items overall than the other pairings. Thus although recall in real pairs may be unimpaired relative to nominal pairs in this younger age pairing, overall recall is poorer than in pairs containing at least one older child.

Analysis of contribution.

Contribution scores were the number of items calculated by subtracting the number of items recalled by one partner from the number of items recalled by the other (the value was always greater than or equal to zero). Thus these contribution scores gave an indication of the balance or symmetry of contribution - the greater the score the greater the asymmetry (inequality or imbalance) in the contribution of each half of a dyad to recall.

Table 2 reports the means and standard deviations of (symmetry of) contribution scores for different pair types in both real and nominal pairs. An ANOVA performed on symmetry of contribution scores revealed a significant main effect of recall condition ($F(1, 93)=21.33$, $p<.01$) suggesting that "real" pairs were, overall, rather less balanced or equal than nominal pairs in terms of the contribution

of each half of the dyad. There was also a significant main effect of pair type ($F(2, 93)=4.06$, $p<.05$). Post hoc Tukey HSD tests ($p<.05$) reveal a significant difference between the 7 & 7-year pairs and the 7 & 9-year pairs, and also between the 7 & 7-year pairs and 9 & 9-year pairs. Finally, there was a significant interaction between pair type and recall condition (nominal vs. real), ($F(2, 93)=4.06$, $p<.05$).

--Insert Table 2 about here--

A further analysis was conducted to see if the difference in contribution in the 7 & 9-year pairings could be attributed to a balance in favor of children from one particular age group (i.e. the 7 year old or the 9 year old. A similar analysis was not, of course, possible in the same-age pairs). Thus a two-way ANOVA was conducted on children's individual recall scores in the 7 & 9-year pairs only comparing the total recalled by each child in a pair in real and nominal groups. There was a main effect of recall ($F(1, 30)=10.06$, $p<.01$). The resulting interaction was also significant ($F(1, 30)=4.47$, $p<.05$). The mean numbers of items recalled by older and younger children in this pair are displayed in Figure 1.

--Insert Figure 1 about here--

Analysis of social dominance.

Analysis of social dominance scores across pair types (in real pairs only) also revealed significant differences. For each pair type the means for the differences between the dominance scores of individuals in each dyad are shown in Figure 2.

A one-way ANOVA with revealed a significant difference between pair types in social dominance difference scores ($F(2, 93)=174.47$, $p<.001$). *Post hoc* Tukey HSD tests ($p<.05$) indicated that the 7 & 9-year pairs differed from both other same age pair types (7 & 7 years and 9 & 9 years).

A final point of interest is whether the older or the younger child is the more dominant partner in the 7 & 9 years dyads. To explore this an independent sample t-test was conducted on simple dominance scores (not the difference scores) just in this pair type, with age group (7 years or 9 years) as the independent variable. This analysis revealed that it was the 9 year old children who were more socially dominant (mean social dominance score =7.63) than the younger 7 year old children (mean score =2.38), $t(30)=9.90$, $p<.001$.

--Insert Figure 2 about here--

Discussion

In the current study we explored collaborative recall between children in two same-age pairings (7&7 years and 9&9 years), and one mixed-age pairing (7&9 years). We tested two central hypotheses. Our first prediction, that pairs of younger children would show more pronounced negative effects of collaborative recall than older pairs, was not supported. Our second prediction was that pairs of children of different ages would display dominance in recall and interaction. This second hypothesis was supported.

The finding of a marked age difference in the effects of collaborative recall was unexpected. A negative effect was also found amongst the older children in this study. However, children at age 7 years, when paired with another 7 year old, show no effects of collaboration on recall. One explanation for the effect of age in the current study lies in suggestions that production blocking (Diehl & Stroebe, 1987) or disruption of retrieval strategies (Finlay, Hitch & Meudall, 2000; Weldon, Blair & Heubsch, 2000) underlies the negative effects seen in adult collaborative recall. However, if retrieval strategy disruption underpins the negative effect amongst the older (9-year-old) children, it is either absent or its power extinguished amongst the

younger children (7 years) where there is no similar negative effect. In fact, there is no effect at all of collaboration on recall in the younger age group.

There are at least three possible explanations for the absence of a negative effect of collaborative recall amongst the younger children. First, there is no disruption because younger children possess no retrieval strategies. However this first explanation is unlikely because previous research indicates that even from preschool children use at least one recall strategy on simple tasks (DeMarie & Ferron, 2003). And, as we have seen, it seems likely that poorer strategy use amongst younger children would lead to *greater* negative effects of collaboration on recall compared with older children (see also Andersson, 2001). A second explanation is that older children may be more cynical about the value of joint work or are, for some other reason, less likely to try their best in collaborative contexts. However, there are two good reasons for rejecting this form of social loafing explanation to account for age differences in the negative effects of collaborative recall. Firstly, previous research has pointed away from such an account because amongst adults motivational factors appear not to impact upon the negative effects of collaborative recall (see again Weldon, Blair & Hitch, 2000). Secondly, if the tendency to loaf increases with age we should expect to see evidence of this in the mixed-age, 7 & 9 years pairing. However, if anything in this pair the opposite is the case – older children contribute far more than younger children to the collective recall and moreover there is no significant difference between the older child's recall in real and nominal pairs.

A third possible explanation is that in this younger age group there is little or no strategic disruption (or production blocking). In the younger age group, children behave in "real" pairs just as they do in "nominal" pairs – as individuals who independently recall the items they learned. In view of the problems with the other

possible explanations, and given that evidence indicates the production blocking account to best fit the adult data (see again Diehl & Stroebe, 1987), this third account appears the most plausible. However, one implication of this suggestion is that 7 year-olds regard the purposes and maybe the processes of conversation in a very different way from 9 year-olds. Amongst the older pairs (and adults) production blocking occurs because children view collective recall as a process that involves the joint co-ordination of resources (or, if you like, perspectives). Thus, because these children see their partner's contribution as relevant to the recall process, when one child starts to recall this recognition has the effect of disrupting the other child's retrieval of items from the word list. In contrast, the younger children appear not to regard joint recall as a process involving the co-ordination of resources. Thus, the two younger children recall as individuals and their recall in real pairs does not differ from recall in nominal pairings.

Support for the assertion that the younger children are less able to reason in ways that involve the co-ordination of perspectives comes from more traditional studies of collaborative problem-solving. For example, in a study of age differences in a joint decision-making task, Leman and Duveen (1996) found that six year-old children lacked an awareness of conversation as forum for the communication and construction of knowledge and tended to treat the "correctness" of an answer as matter of each individual perspective winning or losing out. Eleven year-olds, on the other hand, had a clearer sense of how debate, argument and the exchange of perspectives offered a route into understanding a problem or situation better. These older children were less concerned with personal success or loss in the argument and more interested in establishing the answer that was correct in its own right. In conversation older children therefore possess an awareness of intersubjectivity – a

sensitivity to the possibilities of constructing better understanding by co-ordinating different perspectives - which younger children may not fully appreciate. Importantly, this is a shift that appears to happen between the ages of 8 and 9 years (Leman and Duveen, 1999).

Further support for the assertion that younger children's poorer understanding of the role of interaction and communication as a means to acquire and legitimise knowledge comes from Andersson's (2001) study that examined how the negative effects of collaborative recall could be reduced. Andersson allowed children to encode (learn) items together on a task which required 7 and 15-year-old children to memories the location of items in a 5x5 grid. Older children were better than younger children at reducing the negative effects of collaboration at the encoding stage. In this sense, older children appear better able to use communication to their advantage. But, compared with the younger children, they are also prone to the (unexpected) negative effects of retrieval strategy disruption on performance.

The ability to engage in effective collaboration is an important social and cognitive skill. Indeed, a key aspect of Piaget's (Piaget, 1932; 1966) account of the role of social interaction in social and cognitive development is that it is the primary means through which differences in perspective may be communicated and resolved (see Leman & Duveen, 2003; Müller & Carpendale, 2000). However, this ability appears not to be automatic but to come with age, experience and above all development. And whilst typically collaboration entails positive consequences for children's social and cognitive development a peculiarity, and from an experimental perspective a strength, of current task is that recall is poorer when undertaken in pairs (collaboratively) than individually.

Of course, it would be inaccurate to suggest that at 7 years children are unable to engage in any meaningful collaborative activity at all. Plainly, they are able to do so and this is evidenced by numerous studies of conservation and aspects of collaborative cognition (e.g. Ames & Murray, 1984; Doise & Mugny, 1984). This study of the microgenetic processes involved in interaction and joint recall suggests that the younger children's grasp and application of collaborative strategies may be less well developed that the older ones'. In a similar vein, different tasks may inspire different forms of collaborative activity and different levels of engagement and discussion from children at different ages. In this sense, it would be unwise to generalize the results here across the range of ages and tasks just as it would be unwise to generalize findings of the benefits of collaboration in other tasks to all episodes of peer interaction. More research is required to establish which tasks are associated with benefits in collaboration, why this association occurs (or does not occur) and how far the age of the children involved is an important concern.

No specific predictions were made about the negative effects (or otherwise) of collaborative recall in pairs of children of different ages. There was no significant difference in the effects of collaborative recall between same-age pairs and the mixed-age pairing (although there were significant differences in the social dynamics of interaction). Given the asymmetry in the different aged pairs, it is tempting to consider whether something akin to a social loafing explanation (c.f. Geen, 1991) might account for the 7 year-old child's inhibition in contributing to real paired recall. More accurately, asymmetry in the social dynamics of the pair may have led to the older child's dominance that, in turn, inhibited the younger child from contributing to shared recall. In this respect younger children may "loaf" (or more properly "defer") when with an older partner. But with a same age peer, the younger children's lack of

awareness of the potential for interaction to facilitate performance ("facilitation" which actually has negative effects on this recall task) leads to no visible effects of collaboration (Basden & Basden, 1995; Findlay, Hitch & Meudall, 2000).

The second hypothesis, that there would be greater imbalance in amount recalled by each half of dyad in 7 & 9 years (age asymmetric) pairs than other pairs, was supported. The number of items recalled by the 9 year-old child in this pairing was only slightly lower in real compared with nominal pairs. However half as many items were recalled in real pairs than were recalled in nominal pairs by the 7 year-old. (Same age pairs showed no real differences between real and nominal pairs in terms of contribution to recall.) This finding points to imbalance (or asymmetry) in terms of recall in age-asymmetric pairs. Indeed, it is almost as if both the older and the younger child treat the mixed age pairing as very particular form of collaborative arrangement – not one between equals but one in which there is a clear leader and (almost silent) supporter. In this sense, the relationship is clearly asymmetric not only in terms of how children view the process of interaction, collaboration and recall. The younger child's deference might stem from unequal authority or social power relations between children of different ages or from a belief that older children have better memory than younger children. In this sense, allowing the older child to dominate in recall and interaction could be seen as constituting a sensible division of labour on the task (although it is worth noting that younger children tend to *overestimate* what they can recall, Flavell & Wellman, 1977).

The results relating to social dominance add weight to the suggestion that older children dominate the dynamics of interaction. The measure of social dominance sought to gauge the balance of power or dominance in interaction - e.g. turn-taking etc. - and thus was not a measure of recall. It is crucial to stress that the

measure of social dominance was a measure relating to the *balance of interaction* in the pair: the focus of the analysis was on the collaborative relation and symmetry and asymmetry in the social dynamics of communication. The focus, in the current study, was not on the temperament or behavioural style of individual children. The analysis of social dynamics demonstrated that there was a greater imbalance in age asymmetric (7 & 9 years) pairs than in same age pairs. In other words, age differences led to asymmetry in the style and social dynamics of interaction. It was, as expected, the older child who dominated. The results and the findings of the current study are important because they suggest that simple transmission accounts of the link between peer communication and cognitive development may be complicated by at least one further factor – the social dynamics of argument and interaction. Moreover, if asymmetric communication promotes development because the younger child observes or imitates the older child as a model it is crucial to note that the older child may not always be modelling a symmetric social relationship.

One limitation in the current study was that, because of practical constraints, we were unable to counter balance the different phases of the experiment. All children first engaged in collaborative recall (real pairs) and then in individual recall of a separate word list. However, whilst counterbalancing of phases would have been the ideal, it seems very unlikely that the ordering of the different phases (real pairs then nominal pairs) would have a significant impact on results here. For a start, participants received different word lists for each phase and so any practice effects could be attributable only to improved recall strategy rather than better knowledge of the content (words) to be recalled in the nominal phase. Moreover, whilst the 9 & 9 years pairs performed rather better in the nominal than in the earlier real pair condition we cannot attribute this superior performance to any possible age difference

in the effects of such practice because there is no difference in recall in real and nominal conditions by the 9 year old child in the mixed age pairing. Thus it is the dynamics of the pair, rather than age differences in practice effects, that lead to the results we see here.

Results from the current study highlight two central points. First, that there are age-related differences in terms of children's orientation to interaction and collaboration – younger children appear to lack a sense in which interaction is a forum for the joint use of strategic and informational resources to address a task. The younger children need, if you like, to learn how to collaborate or, to follow Berkowitz and Gibbs (1982); they need to know how to be "facilitated" by conversation and discussion. The older children here show negative effects of collaborative recall. In other words, there is evidence of a more mature understanding of collaboration between individuals at 9 years. Second, alongside constructive forms of collaboration in the older pairs, there is a more asymmetric character to collaboration in mixed-age pairings. In this asymmetric pairing recall and the social dynamics of interaction are dominated by the older child. Such dominance would appear to correspond to a form of collaboration that involves a process of transmission. Further research is required to unpick the extent to which asymmetries in knowledge and in the social dynamics of the pair affect processes of cognitive change in longer-term development.

References

Ames, G. J. & Murray, F. B. (1984). When two wrongs make a right: promoting cognitive change by social conflict. *Developmental Psychology, 18*, 894-897.

Anderson, R., Chinn, C., Waggoner, M. & Yi, H. (1997). On the logical integrity of children's arguments. *Cognition and Instruction, 15*, 135-167.

Andersson, J. & Ronnberg, J. (1995). Recall suffers from collaboration: Joint recall effects of friendship and task complexity. *Applied Cognitive Psychology, 9*, 199-211.

Andersson, J. & Ronnberg, J. (1997). Cued memory collaboration: effects of friendship and type of retrieval cue. *European Journal of Cognitive Psychology, 9*, 273-287.

Andersson, J. (2001). Net effect of memory collaboration: how is collaboration effected by factors such as friendship, gender and age? *Scandinavian Journal of Psychology, 42*, 367-375.

Basden, B. H. & Basden, D. R. (1995). Some tests of the strategy disruption interpretation of part-list cueing inhibition. *Journal of Experimental Psychology: Learning, Memory and Cognition, 21*, 1656-1669.

Basden, B. H., Reysen, M. B. & Basden, D. R. (2002). Transmitting false memories in social groups. *American Journal of Psychology, 115(2),* 211-231.

Berkowitz, M. W. & Gibbs, J. C. (1982). Measuring the developmental features of moral discussion. *Merrill-Palmer Quarterly, 29*, 399-410.

Bouchard, T. J. Jr. & Hare, M. (1970). Size, performance and potential brainstorming in groups. *Journal of Applied Psychology, 54*, 51-55.

Chabliss, M. & Murphy, P. K. (2002). Fourth and fifth graders representing argument structure in written texts. *Discourse Processes, 34*, 91-115.

Clark, S. E., Hori, A., Putnam, A. & Martin, T.P. (2000). Group collaboration in recognition memory. *Journal of Experimental Psychology: Learning, Memory and Cognition, 26*, 1578-1588.

Clark, S. E., Stephenson, G. M. & Kniveton, B. (1990). Social remembering: quantitative aspects of individual and collaborative remembering by police officers and students. *British Journal of Psychology, 81*, 73-94.

Coyle, T. R. & Bjorkland, D. F. (1997). Age differences in, and consequences of, multiple and variable strategy use on a multitrial sort-recall task. *Developmental Psychology, 33*, 372-380.

DeMarie, D. & Ferron, J. (2002). Capacity, strategies, and metamemory: tests of a three-factor model of memory development. *Journal of Experimental Child Psychology, 84*, 167-193.

Diehl, M. & Stroebe, W. (1987). Productivity loss in brainstorming groups: towards the solution of a riddle. *Journal of Personality and Social Psychology, 53*, 497-509.

Doise, W. & Mugny, G. (1984). *The social development of the intellect*. Cambridge: Cambridge University Press.

Doise, W., Mugny, G. & Pérez, J. C. (1998). The social construction of knowledge: social marking and socio-cognitive conflict. In U. Flick (Ed.), *The psychology of the social*. Cambridge: Cambridge University Press.

Duran, R.T. & Gauvain, M. (1993). The role of age versus expertise in peer collaboration during joint planning, *Journal of Experimental Child Psychology, 55*, 227-242.

Felton, M. & Kuhn, D. (2001). The development of argumentative discourse skills. *Discourse Processes, 32*, 135-153.

Finlay, F., Hitch, G. J. & Meudall, P. R. (2000). Mutual inhibition in collaborative recall: evidence for a retrieval based account. *Journal of Experimental Psychology, Learning, Memory and Cognition, 26*, 1556-1567.

Flavell, J. H. & Wellman, H. M. (1977). Metamemory. In R. V. Kail & J. W. Hagan (Eds.), *Perspectives on the development of memory and cognition.* Hillsdale, NJ: Erlbaum.

Gauvain, M. & Rogoff, B. (1989). Collaborative problem solving and children's planning skills. *Developmental Psychology, 25*, 139-151.

Geen, R. G. (1991). Social motivation. *Annual Review of Psychology, 42*, 377-399.

Gonzalez, R. & Griffin, D. (2000). The statistics of interdependence: treating dyadic data with respect. In W. Ickes & S. W. Duck (Eds.), *The social psychology of personal relationships*, pp.181-213. Chichester, UK: Wiley.

Gould, O. N., Osborn, C., Krein, H. & Mortenson, M. (2002). Collaborative recall in married and unacquainted dyads. *International Journal of Behavioral Development, 26(1),* 36-44.

Howe, C.J., Duchak-Tanner, V. & Tolmie, A. (2000). Coordinating support for conceptual and procedural learning in science. In R.W. Joiner & D. Faulkner (Eds.), *Rethinking Collaborative Learning.* London: Free Association Press.

Howe, C. J. & McWilliam, D. (2001). Peer conflict as an educational resource: the implications of gender, class and context differences at nursery level. *Journal of Language and Social Psychology, 20*, 61-80.

Kail, R. V. (1990). *The development of memory in children* (3rd ed.). New York: Freeman.

Karau, S. J. & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 65*, 681-706.

Kraemer, H. C. & Jacklin, C. N. (1979). Statistical analysis of dyadic social behaviour. *Psychological Bulletin, 86*, 217-224.

Kruger, A. C. (1992). The effect of peer and adult-child transactive discussions on moral reasoning. *Merrill-Palmer Quarterly, 38(2)*, 287-315.

Kruger, A. C. (1993). Peer collaboration: conflict, cooperation of both? *Social Development, 2*, 165-182.

Kuhn, D. & Udell, W. (in press). The development of argument skills. *Child Development*.

Kuhn, D., Shaw, V. & Felton, M. (1997). Effects of dyadic interaction on argumentative reasoning. *Cognition and Instruction, 15(3)*, 287-315.

Leaper, C. (1991). Influence and involvement in children's discourse: Age, gender, and partner effects. *Child Development, 62,* 797-811.

Leaper, C., Tenenbaum, H. R., & Shaffer, T. G. (1999). Gender effects on the communication strategies of African-American children from low-income, urban backgrounds. *Child Development, 70*, 1489-1503.

Leman, P. J. (2002). Argument structure, argument content and cognitive change in children's peer interactions. *Journal of Genetic Psychology, 163(1)*, 40-57.

Leman, P. J., Ahmed, S. & Ozarow, L. (in press). Gender, gender relations, and the social dynamics of children's conversations. *Developmental Psychology*.

Leman, P. J. & Duveen, G. (2003). Gender identity, social influence and children's arguments. *Swiss Journal of Psychology, 62(3)*, 149-158.

Leman, P. J. & Duveen, G. (1999). Representations of authority and children's moral reasoning. *European Journal of Social Psychology, 29(5-6)*, 557-575.

Leman, P. J. & Duveen, G. (1996). Developmental differences in children's understanding of epistemic authority. *European Journal of Social Psychology, 26(5)*, 383-397.

Lorge, I. & Solomon, H. (1955). Two models of group behaviour in the solution of eureka type problems. *Psychometrika, 20,* 139-148.

Maccoby, E. E. (1990). Gender and relationships. *American Psychologist, 45,* 513-520.

Meudall, P. R., Hitch, G. J. & Boyle, M. M. (1995). Collaboration in recall: do pairs of people cross-cue each others to produce new memories? *The Quarterly Journal of Experimental Psychology, 48A(1),* 141-152.

Middleton, D. & Edwards, D. (1988). Conversational remembering and family relationships: How children learn to remember. *Journal of Social and Personal Relationships, 5(1),* 3-25.

Müller, U. & Carpendale, J. I. M. (2000). The role of social interaction in Piaget's theory: language for social cooperation and social cooperation for language. *New Ideas in Psychology, 18,* 139-146.

Newman, L. S. (1990). Intentional and unintentional memory in young children: remembering versus playing. *Journal of Experimental Child Psychology, 50,* 243-258.

Paivio, A., Yiulle, J. C. & Madigan, S. A. (1968). Concreteness, imagery and meaningfulness for 925 nouns. *Journal of Experimental Psychology Monographs, 78(1,* Pt. 2).

Perret-Clermont, A-N. (1980). *Social interaction and cognitive development in children*. London: Academic Press.

Piaget, J. (1932). *The moral judgement of the child*. London: Routledge & Kegan Paul.

Ratner, H. H., Foley, M. & Gimpert, P. (2002). The role of collaborative planning in children's source-monitoring errors and learning. *Journal of Experimental Child Psychology, 81(1),* 44-73.

Rogoff, B. (1998). Cognition as a collaborative process. In W. Damon, D. Kuhn & R. S. Siegler (Eds.). *Handbook of child psychology: cognition, perception and language*. New York: Wiley.

Rogoff, B. (1987). *Apprenticeship in thinking*. New York: Academic Press.

Schwarz, B., Neuman, Y. & Beizner, S. (2000). Two wrongs make a right… if they argue together. *Cognition and Instruction, 18(4),* 461-494.

Sodian, B. & Schneider, W. (1999). Memory strategy development – gradual increase, sudden insight, or roller coaster? In F. E. Weinert & W. Schneider (Eds.), *Individual development from 3 to 12: Findings from the Munich longitudinal study* (pp. 61-77). Cambridge: Cambridge University Press.

Thorndike, E.L. and Lorge, I. (1944). *The Teacher's Word Book of 30,000 Words*. New York: Teachers College, Columbia University.

Tudge, J. (2000). Theory, method, and analysis in research on the relations between peer collaboration and cognitive development. *The Journal of Experimental Education, 69,* 98-112.

Tudge, J. (1997). Internalization, externalisation and joint-carving: commenting from an ecological perspective. In B. Cox & C. Lightfoot (Eds.), *Sociogenetic perspectives on internalisation* (pp.119-131). Mahwah, NJ: Erlbaum

Tudge, J. R. H. (1992). Processes and Consequences of Peer Collaboration: A Vygotskian Analysis. *Child Development,* 63, 1364-1379.

Tudge, J. & Rogoff, B. (1989). 'Peer influences in cognitive development: Piagetian and Vygotskian perspectives', In M. H. Bornstein & J. S. Bruner (Eds.), *Interaction in human development*. (pp. 213-348). Hilsadale, NJ: Erlbaum.

Verba, M. (1998). Tutoring interactions between young children: how symmetry can modify asymmetrical interactions. *International Journal of Behavioral Development, 22,* 195-216.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.

Vygotsky, L. (1962). *Thought and language*. Cambridge, Mass.: MIT Press.

Weldon, S. & Bellinger, K. D. (1997). Collective memory: collaborative and individual processes in remembering. *Journal of Experimental Psychology: Learning, Memory and Cognition, 23(5),* 1160-1175.

Weldon, S., Blair, C. & Huebsch, P. D. (2000). Group remembering: Does social loafing underlie collaborative inhibition? *Journal of Experimental Psychology: Learning, Memory and Cognition, 26(6),* 1568-1577.

Wertsch, J. V. (1998). *Mind as action*. New York: Oxford University Press.

Wertsch, J. V., McNamee, G. D., McLane, J. B. & Budwig, N. A. (1980). The adult-child dyad as a problem-solving system. *Child Development, 51,* 1215-1221.

Wilson, M.D. (1988) The MRC Psycholinguistic Database: Machine Readable Dictionary, Version 2. *Behavioural Research Methods, Instruments and Computers, 20(1),* 6-11.

Appendix

Standardized word lists

LIST A: ELEPHANT, FENCE, SHOE, BATH, LAMP, APPLE, WINDOW, PENCIL, PAINT, DRUM

LIST B: DOOR, FLOWER, PLATE, FARM, BANANA, BOAT, TABLE, PAPER, RAIN, SCHOOL

Table 1. Mean and standard deviation (in parentheses) of recall in "real" and "nominal" recall conditions and "difference" score by pair type

Recall condition	7 & 7 years	9 & 9 years	7 & 9 years	Total
Real	6.50 (2.00)	7.75 (1.46)	7.63 (1.43)	7.29 (1.73)
Nominal	6.44 (1.19)	9.00 (1.02)	8.19 (1.31)	7.88 (1.58)
Difference				
(real - nominal)	0.06 (2.55)	-1.25 (1.95)	-0.56 (1.72)	-0.58 (2.15)

Table 2. Mean and standard deviation (in parentheses) of contribution (symmetry or balance) in "real" and "nominal" recall conditions and "difference" score by pair type

Recall condition	7 & 7 years	9 & 9 years	7 & 9 years	Total
Real	1.94 (1.16)	2.50 (1.80)	4.06 (2.65)	2.83 (2.15)
Nominal	1.38 (1.60)	2.56 (1.71)	2.56 (1.52)	2.17 (1.71)

Figure 1. Number of items independently recalled by 7-year-olds and 9-year-olds in the 7 & 9 years real and nominal pairs

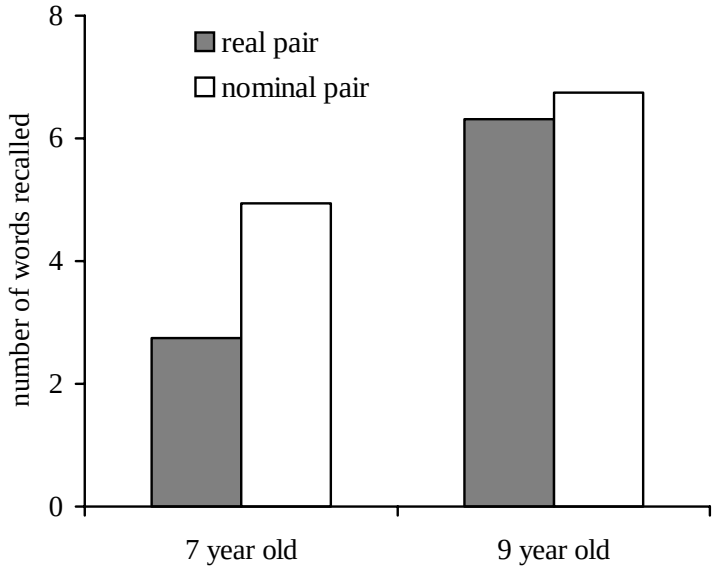

Figure 2. Mean and standard deviation (in parentheses) of social dominance difference scores by pair type