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Social context effects in learning and testing

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Introduction

Within academic developmental psychology the dominant view of cognitive development has always had a more or less maturationalist flavour. In the 1940s and 50s cognitive development was frequently characterized as unfolding through stages regulated by internal biological mechanisms (e.g. Gesell 1943). In the 1960s and 70s, under the influence of Piaget, this conception was elaborated into a view of intelligence as a progressive construction involving feedback. The basic ingredients of development (the body with its physiological and psychological regulatory processes) are given at birth. Development proceeds step by step, and involves the integration of the child's experiences into cognitive functioning. However, such integration is constrained by the fact that the child's capacity for experience is itself determined by his or her present intellectual structures or schemas.

This conception of cognitive development bears all the hallmarks of 'cognitivist' approaches in psychology generally. It is focused very heavily upon the *individual* and upon the characteristics of the individual's endogenous mental organization at different stages of development. Development consists essentially in the stage by stage construction of new logical or 'operational' competences. Procedures developed by Piaget and his associates were refined and formalized in order to provide precise diagnostic tests for these various competences. Conservation (the understanding that number, volume, weight, etc. remain invariant across various transformations) emerged for Piaget as perhaps the most critical element in the genesis of operational thought (e.g. Piaget 1968, p. 121), and the conservation test became one of the 'trade marks' of the Piagetian approach in developmental psychology and education. In the present chapter we shall use the conservation test as a case study in an examination of emerging alternatives to the long dominant maturationalist/Piagetian view.

Any essentially maturational view of cognitive development necessarily relegates social factors (language and social experience in the family, the peer group, the school, etc.) to a secondary role. Such factors may facilitate or inhibit but they have no genuinely constitutive function. By contrast, in the

alternative 'sociogenic' tradition reaching back to the work of G. H. Mead and Vygotsky, cognitive development is treated as essentially a social–cultural product. A combination of social and symbolic factors associated with the family, the school, peer groups, mass media, social ritual, and work and play activities are constitutive of cognitive processes. Language is seen as having a crucial part to play. Since the mid 1970s the developmental literature has reflected a marked revival of interest in this approach, with both theoretical and empirical interest centring more and more clearly on the conception of cognitive development as a social/symbolic process. Interestingly, many students of the social conditions of learning and development have found in the conservation test a useful microcosm for the study of socio-cognitive processes. Thus if conservation has continued to hold a central place in the concerns of psychologists, it is partly because it serves as a useful bridge or point of connection between contemporary socio-cognitive work and the large corpus of Piagetian work built up over recent decades.

In the sections which follow we shall focus first on a line of predominantly Swiss research concerned with the developmental potential of child–child interaction in the context of conservation. Then we shall review some predominantly British work in which the conservation test has been examined as a social interaction between tester and child, governed by 'conversational' rules. In the latter part of the chapter we shall explore the recent signs of convergence between these two lines of research and will argue a case for seeing cognitive development (and in particular conservation) in terms of a socially grounded process of co-construction of meanings.

Peer interaction and conservation

In some of his early work (especially *The moral judgment of the child* 1932) Piaget had suggested a privileged role for child–child interaction in 'decentring' the child's thought. At very much the same time Mead (in *Mind, self and society* 1934) and Vygotsky (in *Thought and language* 1934/1962) emphasized the establishment of shared meanings in interaction and the role of play and 'inner speech' in the development of thought. It took some forty years for these ideas to spawn any strong tradition of empirical work on cognitive development. Paradoxically, perhaps, the conservation test, itself a product of Piaget's later much more individualistic psychology, provided one of the main vehicles for this development.

In the mid 1970s in Geneva Doise, Mugny, and Perret-Clermont embarked on a series of experimental studies designed to address the issue of the role of peer interaction in cognitive development (Doise, Mugny, and Perret-Clermont 1975; Perret-Clermont 1976). This work (together with parallel work elsewhere in Europe, e.g. Carugati, De Paolis, and Mugny 1979; Rijsman, Zoetebier, Ginther, and Doise 1980) involved a three-step procedure.

First, individual children, typically 4- to 7-year-olds, were pre-tested. Then some were assigned to pairs or small groups for an interaction session, while others (controls) worked alone. Finally, all children were individually post-tested.

In the case of conservation of liquids (Perret-Clermont 1980), for example, the experimental procedure might take the following course. At the pre-test stage a conservation of liquid test is administered to each child individually. Two identical glasses are filled to the same level and the child is asked whether they each contain the same amount. When he or she has agreed that they do, the contents of one are poured into, say, a taller, thinner glass. The child is then asked whether the two glasses still contain the same amount of liquid. Justifications are sought. Other more or less closely related conservation procedures may also be included in the pre-test. About a week later, each child who failed to conserve at pre-test is allocated to an interaction or control condition. The interaction session might for example involve being paired with another child (conserver or non-conserver) in order to 'play a game' involving sharing out juice equally. The adult experimenter gives one child a glass which is taller and thinner than the other child's and tells the non-conserving child to pour out equal shares. A third glass, identical to one of the others, is available for their use. The 'game' ends when the children agree that they both have the same amount to drink. The post-test session a week later mirrors the pre-test.

The results of such studies (e.g. Perret-Clermont 1980; Perret-Clermont and Schubauer-Leoni 1981) show that, under certain circumstances, children who participated in the interaction session show significantly more pre- to post-test progress than control subjects who do not have the opportunity to interact with a peer. Pairing with a partner who presented the *correct* response did not appear to be a necessary condition for progress. Other studies using different conservation tasks or other types of task involving spatial transformations or co-ordinations have obtained similar results (e.g. Ames and Murray 1982; Doise and Mugny 1981; Glachan and Light 1982).

The interpretation of these findings was principally in terms of *socio-cognitive conflict*. In the peer interaction situation, according to this explanation, the child is confronted with alternative and conflicting solutions which, while not necessarily offering the correct response, suggest some relevant dimensions which the child might otherwise have neglected. Moreover, the social context in which these conflicting solutions are proferred is of such a character that each child has to take account of his or her partner's view in order to pursue the social interaction in which they are jointly involved.

Progress occurs through a conflict of centrations which can only be resolved by the achievement of a new 'decentred' cognitive schema which can account for the various points of view. Thus socio-cognitive conflict can occur

whenever partners to an interaction offer differing solutions, whether or not any of these solutions is correct.

Socio-cognitive conflict is an inherently social mechanism, in that progress is envisaged as resulting from interindividual conflict (conflict between the viewpoints of different persons) rather than from intraindividual cognitive conflict or dissonance. However, while this interpretation offers a clear role for social interaction, such interaction remains essentially an 'external' factor, stimulating the child's cognitive development but not determining its content or direction. Put in very simple terms, maybe the child, in this interpretation, does not progress towards operational thinking entirely on his or her own, but only needs a little help from a friend.

There were indications right from the outset that children's responses in these three-step experiments were influenced by wider socio-cultural factors (Mackie 1980; Perret-Clermont 1980, Perret-Clermont and Mugny 1985), but rather than pursue these at this stage we shall introduce in the next section a separate strand of work, also developed through the late 1970s and early 80s, which approached the role of social interaction in a rather different way.

The conservation test as an interactional setting

Doise, Mugny, and Perret-Clermont, in the works to which we have been referring, have been grappling with the problem of how children *learn* to conserve. A rather different concern has been central to the work of Donaldson (1978), and others in Britain and the United States, who have been concerned primarily with how children's understanding of conservation can be validly *assessed*. For this reason, their experimental work has typically involved single-session testing rather than the three-step procedures described in the previous section.

McGarrigle and Donaldson's (1975) 'Conservation accidents' paper remains probably the best known in this literature, and exemplifies very clearly the central concern with how the child represents or understands *what is going on* in the conservation test. Four- and five-year-olds were given a variety of conservation tests in the usual way and, as expected, few showed any understanding of conservation. However, they were also tested using a variation of the procedure in which instead of the transformation of materials (the curling up of string in a length conservation task or the bunching up of counters in a number conservation task) being achieved by a deliberate and focused act of the adult experimenter, it resulted from an apparently haphazard or mischievous action of a Teddy bear. 'Naughty teddy' was in actual fact manipulated by the experimenter, but McGarrigle and Donaldson hoped by using it to avoid a misleading suggestion which they felt was implicit in the usual procedure. They suggested that the usual conservation testing procedure created an ambiguity, since whereas the experimenter referred

verbally (in his questions), to, let us say, number, he referred nonverbally (through his actions in transforming the materials) to a different factor such as spacing or length of rows. Certainly the use of the naughty teddy bear to achieve the transformations resulted in substantially higher levels of correct response.

Other ways have also been found of rendering the transformation of materials 'incidental' to the proceedings. Light, Buckingham, and Robbins (1979) used a badly chipped beaker as a reason for pouring the contents from one container to another. This produced correct conservation judgements from 70 per cent of a sample of 5- and 6-year-olds, compared to 5 per cent success in a control sample tested in the usual way. Similar results have been obtained by Hargreaves, Molloy, and Pratt (1982), Miller (1982) and others.

The central argument underlying these studies was that the young child's non-conserving responses may reflect not so much a misunderstanding of the effects of the transformation (i.e. a lack of grasp of conservation) as a misunderstanding of the experimenter's *intentions*. The confusion is not so much conservational as conversational. From the perspective of an analysis of the conservation task as a piece of discourse, the way that the transformation of materials is handled is by no means the only important factor. Rose and Blank (1974) pointed out that typically in a conservation task the pre- and post-transformation questions are exactly the same. It seemed possible that repetition of the question by the experimenter might lead the child to suppose his or her first answer to have been wrong, and therefore to change the response. Or alternatively, the repetition of the question after the transformation might lead the child to suppose that the transformation must, after all, have been relevant to the question. Rose and Blank showed that, although normally all children answer the pre-transformation question (the question about initial equality of amounts) correctly, simply leaving it out led to a significant increase in the level of correct responding to the crucial post-transformation question. Rose and Blank (1974) used number conservation, and although attempts to replicate this study have not always succeeded, it has been replicated successfully by Samuel and Bryant (1984) not only for number but for several other conservation tasks.

In another analysis of the 'conversational assumptions' which might influence the child's responses to the conservation task, Perner and colleagues (Perner, Leekam, and Wimmer 1984) have drawn attention to the shared knowledge which exists between experimenter and child. The child knows that the amounts were equal before transformation—and the initial questioning ensures that he or she and the experimenter *both* know about this. This being so, Perner argues, the child cannot readily treat the post-transformation question as a straightforward request for information, since everything that the child knows, the experimenter also obviously knows. Of course the

experimenter is really interested not in the equality or otherwise of amount, but rather in *what the child knows*. Perhaps the child's difficulty lies in dealing, not with conservation *per se*, but with this type of 'examination' question which, as Elbers (1986) has argued, involves a significant departure from the patterns of communication to which the child will be accustomed at this age. Perner *et al.* (1984) offered some evidence that, as would be predicted from this argument, the child's difficulty can be alleviated by introducing a second experimenter, apparently naive to the pre-transformation state of affairs, to ask the post-transformation question. Such a 'naive experimenter' can ask about the equality or inequality of amounts as a straightforward request for information, since after the transformation the equality or otherwise is far from obvious perceptually.

Light, Gorsuch, and Newman (1987) have recently confirmed this observation in a study with 5- and 6-year-olds, tested in pairs. The task began with a heap of dried peas on a table. The children had to help the experimenter to divide this heap into two equal piles. The experimenter put the peas from one pile into one glass container and those from the other pile into another, differently shaped container, and then asked whether there was the same 'amount of peas' in each. Less than 20 per cent of children responded correctly. However, another sample of children followed exactly the same procedure except for an interruption which occurred just after the peas had been placed in the glass containers. Another adult, already familiar to the child, popped her head round the door and said that the experimenter was wanted on the telephone. The incoming adult then took over the experimenter's role and asked the crucial conservation question. Even though the wording of the question was exactly the same, over 50 per cent of children succeeded in this condition.

This experiment also provided an opportunity to test the efficacy of another factor which had more or less surreptitiously crept in to a number of previous studies (e.g. Light *et al.* 1979). This concerns the introduction of a *game* between the participants, in which the requirements of fair competition make equality of amounts an important issue. The Light *et al.* (1987) study just described had an alternative format, in which before the heaps of peas were divided up the pairs of children were told that they were going to play a game which involved moving the peas into a target bowl (by sucking them with straws), and that the one who finished first would be the winner. During the initial division into two piles the importance of fairness was reiterated, but otherwise the procedure and the questions were as described earlier. In this game format over 50 per cent succeeded in the single experimenter condition and over 70 per cent when the second experimenter was introduced to ask the post-transformation question. Statistical analysis of the results of this experiment showed significant main effects both for standard versus game context and for the one- versus two-experimenter conditions, with no significant interaction between these effects.

In this section we have considered a family of related empirical studies of conservation testing, which have demonstrated that various more or less subtle 'discourse cues' available in the testing situation can have a major impact on the child's reading of the situation, and on his or her response to it. There is certainly room for doubt as to whether correct judgements given in response to these various modified tasks necessarily indicate a full grasp of the principles of conservation (cf. Gellatly this volume). Donaldson (e.g. 1978) has tended to take the view that the modified procedures show that many 4-, 5-, and 6-year-olds really do understand about conservation, and that their failure in standard Piagetian tests reflects the inherently misleading and confusing nature of these tests. Others (e.g. Light *et al.* 1979) have been more sceptical, arguing that children's correct responses in the modified contexts of task presentation cannot be regarded as independent of the support which those contexts offer. Some broader issues relevant to this debate will be discussed in the final section of the chapter, but first we shall turn our attention back to the peer interaction/socio-cognitive conflict research introduced in the previous section. Our purpose is to outline recent developments in this research, and in particular to explore the ways in which it has converged with the (originally rather separate) research tradition which has been the subject of the present section.

Social interaction and the co-construction of meanings

We sketched out earlier the basic three-step experimental paradigm used in cognitive development. The 'continental' (mostly Genevan) work, up to 1980, concentrated upon identifying the conditions under which cognitive changes occurred (*see* Mugny, Perret-Clermont, and Doise 1981, for a review). In particular, studies were directed at establishing the cognitive prerequisites necessary for progress, the efficacy of different combinations of cognitive level in the pair or group, the importance of assigning particular roles to individuals in the group, and so on.

To counter the criticism that children were merely learning the right response to conservation problems by superficial imitation or cueing, considerable attention was given to demonstrating that at post-test the children who had made gains were able to satisfy all the various Piagetian criteria for conservation. These include justification of responses, generalization to related tests, and durability of gains. So the question of whether success on the standard conservation post-tests was indicative of an understanding of conservation was addressed in detail. By contrast, the complementary question as to whether *failure* on standard conservation pre- and post-tests was indicative of an *absence* of an understanding of conservation attracted little attention.

This issue of the significance of failure on the standard task, which is so obviously raised by the work discussed in the previous section, did come to the surface in one aspect of the Genevan peer interaction work, namely that concerned with socio-cultural differences. Perret-Clermont (1980) observed that working-class children tended to perform significantly less well than middle-class children in conservation pre-tests, but that in the experimental groups this class difference largely or entirely disappeared by post-test. Differential benefit from interaction has also been shown in more recent work in Neuchatel. For example, Nicolet (personal communication) has found recovery from initial disadvantage as a result of the peer interaction session in children from rural (farming) backgrounds compared with those whose parents have more urban occupations.

An explanation of such findings in Piagetian terms might be that the initial disadvantage of working-class children reflected a social milieu less conducive to the development of cognitive structures, and that the interaction sessions provided the requisite stimulation to allow rapid development. But this is hardly convincing. How could an interaction session of perhaps 10 minutes duration compensate for a 'deficient social milieu', and bring about such a profound cognitive advance almost instantly? An alternative approach to interpretation of such findings is to suppose that perhaps the initial pre-test differences may reflect not so much a class difference in the children's understanding of conservation, but rather a class difference in their understanding of the test situation itself.

Grossen (1988) has recently confirmed the finding that at around five years of age, in both conservation of number and (in a separate sample) conservation of liquid quantity, twice as many middle-class as working-class children respond correctly. Role-playing techniques reveal that conservers and non-conservers understand the task differently and their verbal justifications of questions and answers differ not only on cognitive grounds.

Also in Neuchatel, Bell (personal communication) has obtained rather similar results with respect to occidental and non-occidental children in context of an international school. Success rates were substantially higher amongst the former, but there were various indications that this arose from differences in the extent to which the children were able to achieve a shared understanding with the experimenter about the topic and nature of the discourse. For example, the non-occidental children more often asked questions about why the experimenter was pouring the juice, and they more frequently justified their responses in terms which were seemingly irrelevant (or at least would seem so to the classically trained Piagetian experimenter expecting 'logical' interpretation).

Another pointer to the fact that the conservation test is not functioning as a neutral 'litmus test' of logical reasoning comes from the observation that differences in the presentation of the test have differential effects for

different social class groups. Thus Perret-Clermont and Schubauer-Leoni (1981) showed that for a middle-class sample it did not make any difference whether a liquid conservation task was presented in terms of juice having to be shared between two identical dolls or between the experimenter and the child. For the working-class sample not only did the children do worse overall, but they also found the dolls condition significantly more difficult. Grossen (1988) found similar results in a conservation of liquid task in which the type of beaker received by the non-conserving child was manipulated in such a way that in one condition the non-conserving child always had the illusion of having *more* juice than his or her partner (advantage condition) and in the other always *less* juice (disadvantaged condition). The results show that the conditions of beakers attribution did not have the same effects for every social class and that the working-class subjects were the only ones to react to the difference of conditions, giving more conserving judgments in the disadvantage condition.

The issue of *sharing*, and the associated norms of equality and of fairness, may themselves be very important factors contributing to the efficacy of peer interaction in stimulating correct conservation responses. We saw evidence in the previous section on contextual modifications of the conservation test that setting the test within the context of a competitive game, with explicit reference to the norm of fairness, led to significantly better results. As indicated in the second section of this chapter, the typical procedure for a peer interaction experiment involves explicit reference to establishing equal shares. Even where this is not explicitly the objective of the peer interaction session, the issue of fairness will almost inevitably arise (at least implicitly) whenever children are working together on the distribution of quantities. Thus it may be that the efficacy of the peer interaction procedure arises not (or not only) from the socio-cognitive conflict mechanism outlined earlier, but from the introduction of a norm of equality which serves to support correct responses which are then carried over to the individual post-test.

This interpretative shift has indeed been evident in much of the recent European work. The concept of 'social marking' has been introduced to describe the way in which the ease or difficulty of a cognitive task can be affected by the extent to which it can be mapped on to social norms or rules with which the child is familiar (e.g. Doise and Mugny 1981; Doise 1985; Girotto 1987; Roux and Gilly 1984). In the case of conservation the importance of the norm of equality is becoming increasingly apparent. Doise, Rijsman, Van Meel, Bressers, and Pinxten (1981) showed that pairs of 'nonconserving' children given a series of liquids conservation tests were significantly more likely to succeed if they were told at the outset that since they deserved equal rewards they should have equal amounts of juice. This superiority carried over to individual post-test.

Nicolet and Iannaconne (in press) found that the norm of fairness did not act '*in vacuo*' nor did the setting of the conservation task in the context of a game suffice to produce high levels of conservation, but that the impact of the recall of the norm depended on the type of interpersonal relationship (co-operative or competitive) experienced previously in the game. Zhou (1987) has independently obtained very much the same results.

Doise *et al.* (1981) also included an individual condition in their study. Here the child worked alone with the experimenter, but an emphasis on equality of rewards was introduced in terms of equality with another child 'who will come in a minute'. This condition proved to be just as effective as its two-child counterpart. This finding perhaps serves to highlight the difference between the position we have now arrived at and that described (in terms of socio-cognitive conflict) at the end of our second section. Socio-cognitive conflict is, as we suggested earlier, a mechanism which reflects the importance of the 'social other' as embodying an alternative perspective to the child's own. Social marking, by contrast, is a mechanism which does not require the physical presence of others, but it is social in the wider and perhaps more fundamental sense that the child's social experience elicited by symbolic means (e.g. the evocation of a norm) provides the framework within which the problem is understood.

Work with the 'three step' experimental paradigm is actively continuing,at Neuchatel and elsewhere. For example Perret-Clermont and Brossard (1985) have been examining where (or at whom) the subjects *look* at critical points in the procedure. But (as is evident from this example) the interpretative framework within which these three-step studies are viewed has shifted substantially. Ten years ago we were thinking primarily in terms of conflicts of pre-operational centrations within the pair or group of interacting children—an essentially cognitive analysis still. Today our concern is more with the way in which just the fact of interacting with others (*inclusive* of being confronted with different centrations) transforms the experience of the situation for the children. Moreover, we are conscious that not only in the 'interaction session' but also in the pre- and post-tests the child is in an interactive setting, and in these situations too the child's experience in the test is modulated in subtle ways by the conditions of his or her encounter with the experimenter. And we are alive to at least some of the ways in which the wider network of roles and relationships from which we draw our 'subjects' will impinge upon their readings of the situations we create for them (Hinde, Perret-Clermont, and Stevenson-Hinde 1985).

Conclusion

Where does all this work leave conservation? To some extent we have just used the conservation task as a convenient point of departure, or point of reference, for studies of the operation of interpersonal/contextual cues in testing and learning situations. But much more interesting is the way in which some of these cues (especially the notion of fairness at the outset of a game, or of equality of reward) *map on* to the conservation problem specifically, providing a rationale for it and supporting a correct reading of the questioner's intent. We would like to suggest that these various 'mappings', between the logic of the conservation task on the one hand and the practical social activities of exchanging and sharing on the other, may be important not just for the expression of an understanding of conservation but for the genesis of that understanding.

If for a moment we widen our perspective on 'the social context' we can see the child as being, in effect, an apprentice to his or her culture. The child is immersed in a language and a culture which are themselves grounded in practical and social human purposes. The concepts of amount, number, area, volume, weight, and so on exist in that language and culture because they have long served just such practical purposes, associated with sharing, distributing, or transacting various commodities. And the various conservations are *embodied* in these concepts, since they refer precisely to those properties which are conserved across particular kinds of transformation.

Conservation concepts can thus be thought of not as transcendent logical entities but as historically elaborated products of certain practical and social purposes (Light 1986; Russell 1978). The conservation of liquids task to which we have made such extensive reference in this chapter, is really neither a matter of logic nor of exact science. When we pour juice from one beaker to another we conveniently forget differential evaporation, or the residues left behind in the 'empty' beaker. We disregard such things because for practical purposes the amounts can be regarded as the same. In this case the 'practical purposes' concern the sharing out of the juice.

In general terms, then, our argument is that in mastering conservation the child's task is to gain access to certain subtle, culturally elaborated abstractions. Although these are embodied in language, they are not 'merely linguistic'. The language that we use cannot readily be sanitized or separated from the practical purposes to which it relates. Language is not just a matter of agreements in meaning, but also of agreements in doing (shared forms of life, in the Wittgensteinian sense). Thus the child's task in mastering conservation concepts is arguably only possible to the extent that he or she is able to share in the purposes and practices to which these concepts relate. We have seen that where children's interpretation of the meaning of the situation is supported in this way, they can often give correct judgements. Rather than worrying too much about the status of these precocious judgements as 'true' indicators of the 'presence' of conservation we should perhaps concentrate on what these modifications of the conservation task

have to tell us about the way in which children can be inducted into such socially supported correct performances, which bridge from the familiar to the unfamiliar, from the known to the unknown (cf. Rogoff Chapter 6, this volume).

In this chapter we have reviewed two lines of research on conservation which have been prominent in the last ten or fifteen years. What we have taken from the British and American work of the late 1970s and early 1980s is a concern with interpersonal and discursive cues in the assessment context. What we have taken from the 'continental' work of the same period is a concern with social mechanisms of cognitive change. The more recent work which we have discussed illustrates both the convergence of these two lines of research and the emergence of an alternative conception of *what develops*. Here, in place of a Piagetian focus on cognitive development as a sequence of emerging logical competences, pragmatic, intersubjective agreements-in-meaning are seen as lying at the heart of the developmental process. Such agreements (established in and through the child's day-to-day interpersonal behaviour) are envisaged as both the source and the substance of conservation itself.

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References

Ames, G. and Murray, F. (1982). When two wrongs make a right: promoting cognitive change by social conflict. *Developmental psychology* **18**, 894–7.

Carugati, F., De Paolis, P., and Mugny, G. (1979). A paradigm for the study of social interactions in cognitive development. *Italian journal of psychology* **6**, 147–55.

Doise, W. (1985). Social regulations in cognitive development. In *Social relationships and cognitive development* (ed. R. Hinde, A. N. Perret-Clermont and J. Stevenson-Hinde). Oxford University Press, Oxford.

Doise, W. and Mugny, G. (1981). *The social development of the intellect*. Pergamon Press, Oxford.

Doise, W., Mugny, G., and Perret-Clermont, A. N. (1975). Social interaction and the development of cognitive operations. *European journal of social psychology* **5**, 367–83.

Doise, W., Rijsman, J., Van Meel, J., Bressers, I., and Pinxten, W. (1981). Sociale marketing en cognitieve ontwikkelling. *Pedagogische Studien* **58**, 241–8.

Donaldson, M. (1978). *Children's minds*. Fontana, London.

Elbers, E. (1986). Interaction and instruction in the conservation experiment. *European journal of psychology of education* **1**, 77–89.

Gessell, A. (1943). *Infant and child in the culture of today*. Harper, New York.

Girotto, V. (1987). Social marking, socio-cognitive conflict and cognitive development. *European journal of social psychology* **17**, 171–86.

Glachan, M. and Light, P. (1982). Peer interaction and learning: can two wrongs make a right? In *Social cognition* (ed. G. Butterworth and P. Light). Harvester, Brighton.

Grossen, M. (1988). La construction sociale de l'intersubjectivité entre adulte et enfant en situation de test. Ph.D. thesis, Université de Neuchâtel.

Hargreaves, D., Molloy, C., and Pratt, A. (1982). Social factors in conservation. *British journal of psychology* **73**, 231–4.

Hinde, R., Perret-Clermont, A.-N. and Stevenson-Hinde, J. (eds.) (1985). *Social relationships and cognitive development*. Oxford University Press.

Light, P. (1986). Context, conservation and conversation. In *Children of social worlds* (ed. M. P. M. Richards and P. H. Light), pp. 170–90. Polity Press, Cambridge.

Light, P., Buckingham, N., and Robbins, A. (1979). The conservation task as an interactional setting. *British journal of educational psychology* **49**, 304–10.

Light, P., Gorsuch, C., and Newman, J. (1987). Why do you ask? Context and communication in the conservation task. *European journal of psychology of education* **2**, 73–82.

Mackie, D. (1980). A cross cultural study of intra- and inter-individual conflicts of centrations. *European journal of social psychology* **10**, 313–18.

McGarrigle, J. and Donaldson, M. (1975). Conservation accidents. *Cognition* **3**, 341–50.

Mead, G. H. (1934). *Mind, self and society*. University of Chicago Press, Chicago.

Miller, S. (1982) On the generalisability of conservation. *British journal of psychology* **73**, 221–30.

Mugny, G., Perret-Clermont, A.-N., and Doise, W. (1981). Interpersonal coordinations and sociological differences in the construction of the intellect. In *Progress in applied social psychology, vol. 1* (eds. G. Stephenson and J. Davis). Wiley, Chichester.

Nicolet, M. and Iannaconne, A. Norme sociale d'équité et contexte relationnel dans l'étude du marquage social. In *Interagir et connaitre* (eds. A.-N. Perret-Clermont and M. Nicolet). Peter Lang, Berne (in press).

Perner, J., Leekam, S., and Wimmer, H. (1984). The insincerity of conservation questions. Paper presented to B.P.S. Development Section Annual Conference, Lancaster, September, 1984.

Perret-Clermont, A.-N. (1976). L'interaction sociale comme facteur du développement cognitif. Doctoral thesis, University of Geneva.

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

Perret-Clermont, A.-N. and Brossard, A. (1985). On the interdigitation of social and cognitive processes. In *Social relationships and cognitive development* (eds. R. Hinde, A.-N. Perret-Clermont, and J. Stevenson-Hinde). Oxford University Press.

Perret-Clermont, A.-N. and Mugny, G. (1985). Effets sociologiques et processes didactiques. *Psychologie sociale du développement cognitif* (ed. G. Mugny). P. Lang, Bern.

Perret-Clermont, A.-N. and Schubauer-Leoni, M. (1981). Conflict and cooperation as opportunities for learning. In *Communication in development* (ed. W. P. Robinson). Academic Press, London.

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

Piaget, J. (1968). *Six psychological studies*. University of London Press, London.

Rijsman, J., Zoetebier, A., Ginther, A., and Doise, W. (1980). Sociocognitief conflict en cognitieve ontwikkeling. *Pedagogische Studien* 57, 125–33.

Roux, J.-P. and Gilly, M. (1984). Aide apportée par le marquage social dans une procedure de résolution chez des enfants de 12–13 ans. *Bulletin de psychologie* 38, 145–55.

Rose, S. and Blank, M. (1974). The potency of context in children's cognition. *Child development* 45, 499–502.

Russell, J. (1978). *The acquisition of knowledge*. Macmillan, London.

Samuel, J. and Bryant, P. (1984). Asking only one question in the conservation experiment. *Journal of child psychology and psychiatry* 25, 315–18.

Vygotsky, L. (1934/1962). *Thought and language*. MIT Press, Cambridge, MA.

Zhou, R. (1987). Marquage social, conduites de partage et construction de la notion de conservation. Unpublished PhD thesis, University of Provence, Aix-en-Provence.