



## Complementarity of information and quality of relationship in cooperative learning

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**Abstract.** The effects of resource in(ter)dependence and quality of relationship with the partner on performance were studied during three sessions of cooperative dyadic work in order to examine the conditions under which cooperative learning can be more beneficial. This study was designed to test a hypothesis favouring the superiority of independence of resources (discussing identical information) against a hypothesis favouring the superiority of interdependence of resources (sharing complementary information). In each session, 64 students worked in dyads on two texts. Two roles were defined: summarizer and listener.

Results showed that, though direct performance was higher when students discussed identical information, the quality and generality of information recalled a few months later did not differ between the two conditions. In the interdependence condition, listeners displayed poorer levels for direct performance.

Participants were then dichotomized on the basis of their perceived quality of their relationship with the partner. With respect to direct performance, a more positive relationship allowed listeners in the interdependence condition to perform as well as summarizers, while a less positive relationship was detrimental for listeners. Conversely, as for recall, listeners in the interdependence condition who perceived a more positive relationship performed more poorly than summarizers, while listeners who perceived a less positive relationship performed as well as summarizers. When students shared identical information, neither roles nor quality of relationship affected recall. Results are discussed in terms of degree of partners' dependence and potential effects of socio-cognitive conflict (Doise & Mugny, 1984).

### 1. Introduction

A substantial amount of research has shown that cooperative learning methods can be beneficial at the cognitive level when compared with individual or competitive methods (see Johnson et al., 1981, for a review). These methods enhance performance in such domains as mastery and memorizing of studied materials as well as quality of reasoning; moreover, they allow a positive transfer of acquired competences from group work to individual performance (Johnson & Johnson, 1990). Cooperative methods also lead to greater academic achievement on a wide range of tasks, especially concept attainment, verbal problem solving, categorization, spa-

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tial problem solving, retention, memory, motor, and guessing–judging–predicting (Johnson & Johnson, 1985). The superiority of cooperation is also found at the social and motivational level (Slavin, 1983a) in domains such as ability or predisposition to cooperate, students' mutual concern or liking, students' liking of school, self-esteem, norms concerning academic achievement, and locus of control.

When compared with traditional methods, cooperative methods may involve different structures at different levels. These include the structure of goals, the repertoire of social and academic skills, socialization among students, and the structure of authority in the classroom (Hertz-Lazarowitz & Shachar, 1990, Gettinger, 1992). Even though cooperative methods may differ along with these dimensions, the common feature of all these methods is to emphasize the importance of face-to-face interactions and to promote cooperation between students by implementing a positive interdependence in the learning situation. The underlying hypothesis is that the way in which learning is structured determines the way students interact and that students' interactions affect learning and reinforcement. The quality of students' interactions is therefore an important mediating process (Webb, 1982, Gettinger, 1992).

Despite the superiority of cooperative methods, many differences in efficacy appear in different studies. Johnson and Johnson (1990) pointed out that some precautions are needed to achieve the benefits of cooperative learning. Firstly, students have clearly to perceive a positive interdependence. In addition, they must perceive themselves as personally accountable. Finally, positive interactions must take place. However, several researchers have pointed to the lack of studies investigating variables mediating the benefits of cooperative methods (Johnson & Johnson, 1985; Cohen, 1994). It has been observed that more studies are needed to investigate the different dimensions of cooperative methods directly in order to determine the conditions under which cooperation can be effective (Slavin, 1983b; Knight & Morton Bohlmeier, 1990; Johnson & Johnson, 1990).

Task structure is probably the most basic dimension in a learning situation. Task structure is the set of rules that are needed to carry out the task which therefore determines the way students are going to work as well as the way they should interact (Slavin, 1983b). The interest in studying task structure as one of the founding dimensions in the efficacy of cooperative learning is twofold. From an applied point of view, task structure can readily be manipulated by teachers. From a theoretical point of view, task structure determines the type of relationship between the students, for example, whether they are in an interdependent or in an independent relationship. In fact, one of the first issues with which students are led to deal with when they are brought together in cooperative work is whether they have access to the same resources (or information), that is, whether they are in an interdependent or in an independent relationship. Thus, studying the role of task structure in general, and of in(ter)dependence in the task in particular, can be a first step toward a research paradigm that aims at shedding light on the underlying mechanisms that determine the success of cooperative methods in learning.

## 2. In(ter)dependence in Cooperative Learning

The present study investigates the role of resource in(ter)dependence in cooperative learning. Specifically, the study examines the effect of information in(ter)dependence on cooperative learning and addresses the following question: is it more beneficial to ask students to work on identical or on complementary information? This question is important both at an applied and at a theoretical level. On the one hand, it addresses the problem of the use and sharing of instructional materials. Using and sharing instructional materials can be a problem in the case of limited resource availability, but it can also emerge from the teacher's pedagogical goals. Thus, it is important to assess the differential effect on learning of the use of identical versus complementary teaching materials. On the other hand, from a theoretical point of view, studying the use of identical or complementary materials is a way of examining the relational constraints that the structure of the task impose on the participants of cooperative learning. This task provides a means, however, for studying one of the most basic relational dimensions that can account for effectiveness of cooperative methods in learning.

The present study is designed to test two alternative hypotheses. Indeed, the variety of theoretical propositions and experimental results in the social psychological literature leads to two different predictions regarding the effects of resource in(ter)dependence in cooperative learning. One favours the superiority of resource interdependence; the other favours the superiority of resource independence.

### 2.1. SUPERIORITY OF RESOURCE INTERDEPENDENCE HYPOTHESIS

Lambiotte et al. (1987) have studied interdependence of resources on quantity and accuracy of information retrieval from two texts. In their study, the experimenter scripted cooperative interactions between two students. One of the partners was in charge of summarizing information, while the other listened and asked questions. In the 'cooperative teaching group,' each student read only one of the two texts and had to convey the information to the partner, and students therefore had complementary information. In the 'cooperative learning group,' both students read both texts and had to discuss the information periodically, thus students had identical information. For these two conditions, assigned roles (summarizer and listener) were alternated from one text to the other. In the last condition, labelled 'cooperative micro-teaching,' both texts were split into two parts, and both students read only half of the information contained in one text. Summarizer and listener roles were therefore exchanged several times. Results from this study showed that the quantity and accuracy of recalled information were greater in cooperative teaching groups sharing complementary information than in the two other groups. In sum, summarizers' performances were higher when they were confronted with listeners who had not read the same information (cooperative teaching) than when confronted with listeners who had previously read all the information

(cooperative learning) or half of the information (cooperative micro-teaching). Moreover, listeners' performances were the same regardless of the possibility of reading the information.

Thus, sharing complementary information seems to enhance quantity and quality of information recall. As it is expressed by Lambiotte et al. (1987, p. 428), 'preparing for and teaching information to a naive learner, who had no prior exposure to the materiel, is a powerful method for remembering that information. . . . At the same time, it seems that cooperative teachers playing the learning role, who never read one of the passages directly, were not at a significant disadvantage when compared with partners who both read and discussed each passage in the other group.' These authors proposed an explanation of their results in terms of different attentional requirements. On the one hand, when students have to summarize the information their partner had read, 'the summarizer's goal is not only to cover content, but also to appear competent. Subjects may not be aware of this goal, but it may be distracting enough to prevent deep processing of content information' (p. 429). For Lambiotte and her colleagues, listeners would also be distracted by the fact that while listening they were evaluating their partner and making some social decisions, such as how to intervene. These social activities require attention and could explain the poorer performance when students discuss identical information. The same pattern can be found in the cooperative micro-teaching, in which partners know partially redundant information. In the cooperative learning condition, in which partners discuss complementary information, evaluative and social distraction are less likely to occur either for the summarizer or the listener. Therefore, more attention can be assigned to content information. Thus Lambiotte and her colleagues (1987) suggest an explanation focused on competence evaluation and fear of negative judgments about the poorer performance of students who show identical information.

Other findings of research support the hypothesis that when the evaluation of competence is at stake, the search for an adequate solution can be undermined. Research conducted in the social influence area on conflict of competences has shown that when targets are confronted with an expert source, the targets try to deny the source's competence in order to preserve their own competence (Butera, Gardair, Maggi, & Mugny, 1998, Study 1; see also Butera & Mugny, 2001). Butera et al.'s (1998) experimental results showed that when a competent source threatened the participants' competence, participants invalidated the source's proposition in the service of self-validation. This self-protective strategy can prevent learning. In contrast, when confronted with a non-expert, non-threatening source, participants performed the task in a more diagnostic way and generalized their strategy to a subsequent task. This study illustrates merely relational aspects of the interaction, along with the need for status affirmation and competence evaluation, decreases the likelihood of search for an adequate solution. To sum up, Lambiotte et al. (1987) stressed that sharing identical information focuses its attention on competence evaluation, while Butera et al.'s (1998) results support the

hypothesis that focus on competence evaluation proves to be detrimental to information processing.

In a second experiment, Butera et al. (1998, Study 2) induced for half of the participants a representation of the usefulness of complementarity in judgment. This manipulation led participants to reduce focus on themselves, thus decreasing the threat of self-evaluation induced by an expert. Results showed that in the absence of this manipulation, the same results were found as in the first study – a high-competence (therefore more threatening) source was more likely than a low-competence (therefore less threatening) source to induce a relational regulation of the conflict which did not lead to learning. When participants were led to focus more on complementarity and less on themselves, participants confronted with a high-competence source felt less threatened and displayed the same amount of learning as those confronted with a low-competence source. Thus, this last study showed that inducing a representation of knowledge as a coordination of complementary points of view, thereby reducing competence threat, can enhance deeper information processing, as per the results from Lambiotte and her colleagues.

All these results seem to indicate that sharing complementary information is more beneficial for learning than discussing identical information. However, other results support the hypothesis that working on identical information could lead to enhanced performance.

## 2.2. SUPERIORITY OF RESOURCE INDEPENDENCE HYPOTHESIS

Support for the superiority of resource independence can be found in the literature on socio-cognitive conflict (Doise & Mugny, 1984). This research tradition contends that working on identical information can promote confrontation of various points of view between different partners; indeed, these individuals can understand the same information in different ways. This could lead to a socio-cognitive conflict, which is believed to be beneficial in cognitive development and problem solving. Such conflict is viewed by Doise and Mugny (1984) as the confrontation with a different response proposed by a partner in cooperative work. One way to promote this kind of conflict is to put children together whose cognitive levels differ because a difference in cognitive level would presumably enhance the expression of different propositions. Results have interestingly indicated that both the child at the lower level and the one at the higher level can progress (provided that the difference is not too big). The fact that the higher-level child also makes progress that suggests the higher performance induced by socio-cognitive conflict is not merely an effect of imitation. This idea is supported by additional research involving the confrontation of two children at the same (low) level in a spatial coordination problem (Doise & Mugny, 1984). In the latter study, each child was placed in front of the other, ensuring that their spontaneous responses were contradictory due to the opposition of their respective points of view. Results showed that, although children are confronted with a partner at an equivalent cognitive level who

proposes an erroneous response, they progress on an individual post-test. In sum, these experiments indicated that progress is not due to the imitation of a superior model, but that it is conflict itself – the confrontation of various points of view – that can induce progress.

To summarize, different results in the literature can lead to the formulation of different predictions regarding resource in(ter)dependence in learning. On the one hand, working with complementary information can reduce the stakes of competence evaluation, promote decentration (Lambiotte et al., 1987; Butera et al., 1998), and therefore favour learning. On the other hand, working on identical information can bring confrontation of various points of view and give rise to socio-cognitive conflict, beneficial to cognitive elaboration and learning (Doise & Mugny, 1984). One aim of the present study was to test these two alternative hypotheses with regard to the effect of resource in(ter)dependence in cooperative learning.

### **3. Impact of the Quality of Relationship During Cooperative Work**

Another aim of the study, which derives from the first, was to explore the impact on performance of the quality of relationship between partners during cooperative learning. In this respect, both the alternative hypotheses underline the importance of the relationship during cooperative learning. On the one hand, as far as Lambiotte and her colleagues (1987) are concerned, poorer performance of students sharing identical information can be explained by distraction induced by competition over competence affirmation. Similarly, Butera and his colleagues (1998) noted that conflict over status affirmation can be detrimental to cognitive elaboration. But on the other, Doise and Mugny's work (1984) suggested that benefits from dyadic interaction depend on conflict regulation. For instance, in one experiment, children were confronted with an adult proposing a model at a lower level than that of the child. The strength of the conflict was directly manipulated. Results suggested that a strong conflict led to greater progress which was stable over time and generalized to a related task. In contrast, a moderate conflict allowed a stable improvement but with little generalization, while when the intensity of conflict was weak, children confronted with an adult showed no more progress than those working alone. These results suggest that when children can avoid conflict with the adult's response by being compliant, progress is smaller.

Thus, it is important to note that the above findings of research are not really contradictory in their implications for the role of conflict in cooperative work. Conflict is detrimental to cooperative work when, as Lambiotte and her colleagues pointed out, it takes the form of competition over status recognition. The same phenomenon is named 'conflict of competences' by Butera and his colleagues and 'relational conflict' by Doise and Mugny. However, if competence is not at stake, conflict is generally beneficial in cooperative work, as reported both by Doise and

Mugny (see also Mugny & Doise, 1978) and by Butera et al. (see also Butera & Mugny, 1995). In fact, it appears that when conflict is oriented toward the resolution of the task, it leads to better performance and to generalization.

## 4. Method

### 4.1. PARTICIPANTS

One hundred and fifty-two second-year psychology students at Grenoble University (in France) participated in this study. It is worth noting that in France there are no 'majors,' thus a student enrolled in the Faculty of Psychology specializes in psychology from the first year onwards. This experiment took place during regular social psychology workshops. In France, lectures are complimented by small group courses or workshops, composed of between 30 and 40 students per group, in order to involve students more actively and deepen their understanding of lectures. Regarding social psychology courses for second-year students, 18 h are allocated to lecture and 10 to small group courses or workshops. Six of the 10 h devoted to workshops were used for this study. In order to introduce resource in(ter)dependence in these small group courses, groups were reorganized so that students worked in dyads during three 2-h sessions. Students were randomly assigned to one of the two experimental conditions (resource independence vs. resource interdependence). Experimental dyads were formed with same-sex students who did not know each other. Same-sex dyads were constituted in order to avoid seduction and dominance phenomena which could interfere with learning without being controllable. Also, as Driskell, Olmstead, and Salas (1993) noted, women are perceived as less competent and have less influence in mixed-sex groups. Similarly, Webb (1985) suggested that patterns of interaction processes can be quite different between the sexes in mixed-sex groups.

Since the experiment required working in the same dyad for three sessions, only dyads in which students worked with the same partner during all three sessions were retained for the analyses. In other words, if one student missed a session, both students of the dyad were dropped from the analyses. Accordingly, the experimental sample was cut to 64 students, 16 dyads (32 students) in each experimental condition. Among these 16 dyads, only three were composed of males (two in the resource interdependence condition, and one in the resource independence condition). This low proportion of male students reflected the typical gender balance within the psychology student population. The age of the experimental sample ranged from 20 to 47-year-old (with  $Me = 21$  and  $M = 22.64$ ). Ages were similar in the two experimental conditions ( $M = 22.09$  vs.  $23.18$ ;  $F(1, 62) = 0.80$ ;  $p > 0.10$ ).

### 4.2. PROCEDURE

The same teacher was in charge for all three sessions. At the first session, the aim of the three sessions was presented. Students were informed that, for each workshop

session, they would work on two social psychology texts related to the content of the lecture. Students were requested to read the texts and share their ideas in order to master the texts' content as much as possible. Students were also informed of the instructional aim of the study, namely, exploring the impact of two different pedagogical methods. It was explained that two cooperative learning methods would be tested (dyads working on identical information and dyads working on complementary information). It was also explained that, at the end of each session, students would have to answer a multiple choice test on the content of each text. This test would allow the teacher to assess the impact of the two methods and would train them for the final exam. Students were informed that the three tests were a means of self-evaluation but would not count for their official evaluation. This level of transparency was needed since this experiment was for the students a real course, replacing the regular one, and this practice is not usual in France. Normally, students are asked to take part in experiments if they want to get additional credit points; therefore experiments do not take place in regular courses. Moreover, even at the university, individual learning methods predominate in France. Learning is often organized around a teacher who transmits the information that students have to master. Students are not used to regarding other students as reliable helpful persons and tend to be reluctant to regard them otherwise. An explanation of the instructional aim was therefore needed to secure students' commitment. However, as all students were informed of the instructional aim of the study in the same way, this advice did not interfere with the experimental manipulations.

As for the texts, students were asked to assimilate the content and facilitate their partner's understanding. They were told to work in cooperation with their partner (i.e., to learn how to explain information and how to use their partner as a support). Then it was explained how they would actually work. Resource in(ter)dependence was introduced at this juncture (see the 'independent variables' section).

Next, students had to become acquainted with the roles they were to play during the discussion. Two roles were defined for the learning session: summarizer and listener (see the 'roles' section). These roles were supposed to encourage partners' participation and improve the quality of interaction during discussion (O'Donnell, Dansereau, Hall, & Rocklin, 1987; Dansereau, 1988; Cohen, 1994).

Dyadic groups were then dispatched to different locations. Twenty minutes were devoted to reading the first text silently, followed by 10 min of discussion regulated by assigned roles. The second text was then silently read for 20 min and discussed for 10 min with roles reversed between the two students. At this point students were presented with an individual test on the two texts. At the end of the session students assessed on a questionnaire the perceived quality of their relationship with the partner.

The three experimental sessions were identical in format; students worked collaboratively on two different social psychology texts, filled out a multiple choice test, and assessed the perceived quality of their relationship with the partner.



Three-week intervals separated the three sessions. In sessions two and three, students received feedback on their performance for the previous session along with feedback on their partner's performance.

The texts were collected in the end of each session so that students could not do additional work between sessions. Students had opportunity to take notes but not on the texts. All documents (texts, tests, and test corrections) were distributed during the fourth, non-experimental, workshop session in which students worked in the traditional way.

It is worth noting that students were asked to work cooperatively during three sessions in order to allow them to become acquainted with cooperative work. Indeed, some studies have shown that cooperative work requires some distinctive social abilities and that students from traditional schools have few opportunities to acquire them. Butler and Kedar (1990) have pointed out that children from traditional schools are likely to adopt an individualistic and competitive strategy, not only in competitive contexts but also in non-competitive ones. Requiring students to work in a cooperative way during three sessions was intended to enhance the likelihood that true cooperation would take place.

#### 4.3. MATERIALS

Students worked on social psychology texts related to the topic of the second-year social psychology lecture (introductory social psychology – part two: groups, inter-group relations, and social influence). Six texts were extracted from the same social psychology handbook (not the one used for the lecture). The teacher rewrote some parts so that they could be read independently in less than 20 min. A pilot study showed that the mean reading time was homogeneous and ranged from 13–16 min and 45 seconds ( $F(5, 21) = 0.55, p > 0.05$ ). Reading time included taking notes. The perceived difficulty level varied from 2 to 3 on a 4-point scale ranging from 1 (easy) to 4 (difficult). The text content studied in each session was independent of the content of the other sessions.

#### 4.4. INDEPENDENT VARIABLES

##### 4.4.1. *Resource In(ter)dependence*

Two experimental conditions were introduced on the basis of the in(ter)dependence of the texts given to students<sup>1</sup>. In the resource independence condition, both students silently read the first text for 20 min. Thus, both students had identical information. One of the students played the summarizer role in the 10-minute discussion following the reading, and the other student played the listener. Then both students read the second text silently for 20 min. The student who played listener for the first text became the summarizer for the second text, and vice versa.

In the resource interdependence condition, in the first step, one of the partners read the first text (20 min), and played the summarizer in the 10-min discussion.

In the second step, the other student – who previously played the listener – read the second text (20 min) and played the summarizer. In this condition, each student had complementary information, since the text they completed contained questions on both texts. Each student played the summarizer role for one text and learned the other text from his or her partner. In order to maintain a good level of attention for the listener who did not read the text, the listener was asked to read a newspaper article. Students were informed that this newspaper article would not be discussed afterwards, the purpose being just to maintain the listener's attention during the reading period.

These two experimental conditions allowed examination of whether it is more beneficial to ask students to work on identical or on complementary information. In both conditions, they were informed that they would individually answer a multiple choice test on the two texts. Therefore, reinforcement was independent. A historical rationale determined this choice. Indeed, in Western academic evaluations, learning assessment is individual; teachers willing to implement some forms of cooperative instructions are likely to be constrained by the necessity to give an individual evaluation. For this first study, the choice was made to introduce little instructional reorganization.

#### 4.4.2. *Perceived Quality of Relationship with the Partner*

Perceived quality of relationship was assessed through seven questions measured by a 7-point scale at the end of each session. Some items were recoded so that a higher score reflected a more positive relation. The questions concerned the relationship with the partner (perceived degree of cooperation, spontaneous agreement, agreement after discussion, competition, conflict, collaboration, and quality of relationship within the dyad). This measure was intended to allow exploration of the impact of quality of relationship between partners during cooperative learning on performance.

#### 4.4.3. *Roles*

Two roles were defined (see Lambiotte et al., 1987). The summarizer role consisted of explaining the information contained in the text as clear as possible. Students were informed that this role was quite similar to the teacher's role in the sense that summarizers had to facilitate their partner's learning. As for listeners, they had to ask questions for clarification and identify mistakes or lack of information while listening to the summarizer. The listener's role was structured to facilitate the partner's summary. Students were informed that, within the dyad, each individual would be in charge of summarizing one of the two texts and that roles would be reversed for the second text. Order of roles and role for each text were counterbalanced.

## 4.5. DEPENDENT VARIABLES

### 4.5.1. *Direct Performance*

Direct performance was assessed via a multiple choice test at the end of each session. These tests included 10 questions per text, that is, 20 questions for each session. One point was allocated for a good answer, zero for no answer, and  $-0.25$  for mistakes. These criteria were the same as those used in official tests and were repeated to students before they took the tests. Three scores were computed for each session: a mark from  $-5$  to 20 for overall performance, a mark from  $-2.5$  to 10 involving questions on the text participants summarized, and a mark from  $-2.5$  to 10 involving questions on the text for which participants played the listener role.

### 4.5.2. *Recall*

Before they started the traditional, non-experimental, fourth session<sup>2</sup>, and students were given an *ad hoc* booklet in which they were asked to write all the pieces of information they were able to retrieve from memory about the six texts studied during dyadic work. The booklet contained one sheet per text. This written recall task took place 1–4 months after the dyadic work, depending on the texts. Students were not forewarned of this latter task. Thirty minutes were allocated for the task, 5 min per text.

## 5. Results

### 5.1. DIRECT PERFORMANCE: THE MULTIPLE CHOICE TEST

#### 5.1.1. *Effect of Resource In(ter)dependence*

An initial 2 (resource in(ter)dependence)  $\times$  3 (sessions) ANOVA was performed on overall (20 questions) performance on the multiple choice test. This analysis directly tested the two alternative hypotheses, that favouring resource interdependence superiority and that favouring resource independence superiority. The means and standard deviations we obtained are shown in Table I.

The ANOVA showed a significant resource in(ter)dependence effect ( $F(1, 62) = 9.42, p < 0.01$ ). Overall performance in the resource independence condition was higher ( $M = 14.09$ ) than performance in the interdependence condition ( $M = 12.61$ ). The session effect was also significant ( $F(2, 124) = 97.93, p < 0.001$ ). A Scheffe test ( $p < 0.05$ ) indicated that performance in Session 1 was poorer ( $M = 11.41$ ) than performance at Session 2 ( $M = 12.44$ ), which in turn was poorer than performance in Session 3 ( $M = 16.22$ ). Finally, the effect of interaction between session and resource in(ter)dependence tended towards significance ( $F(2, 124) = 2.42, p < 0.10$ ). No difference was apparent in Session 1. However, performance differed significantly between experimental conditions in the second and third sessions (Scheffe test,  $p < 0.05$ ). In other words, there was a more rapid increase in performance in the independence than in the interdependence condition.

Table 1. Mean direct performance during the three sessions as a function of resource in(ter)dependence

Resource	<i>n</i>	Sessions		
		1	2	3
Interdependence	32			
M		11.12	11.42	15.30
SD		2.32	2.46	2.04
Independence	32			
M		11.68	13.45	17.12
SD		2.61	3.34	2.30

Performance means range from  $-5$  to  $20$ . One point is allocated for a correct answer, zero for no answer and  $-0.25$  for a wrong answer.

This initial set of results seems to give support to the superiority of resource independence hypothesis, as far as cooperative work on written information is concerned; students discussing identical information did perform better than students sharing complementary information. However, it is worth noting that the superiority of the independence condition was apparent only from the second session. This seems to suggest that the difference in performance between the two conditions was due to the development of the relationship between the partners. It is therefore important to explore the effect of resource in(ter)dependence with respect to the two relationship variables, namely, roles played and quality of relationship.

### 5.1.2. Effects of Role Played

In order to explore the impact of resource interdependence on performance as a function of assigned roles, test questions for each text were considered separately. This allowed for computation of two scores per session for each student (one concerning the text for which they played summarizer and one for text for which they played listener role). A  $2$  (resource interdependence)  $\times 3$  (sessions)  $\times 2$  (roles) ANOVA was performed. The effects described above did not change; moreover, ANOVA showed a main effect of role ( $F(1, 62) = 16.27, p < 0.001$ ), indicating that summarizers' performance was better ( $M = 7.15$ ) than that of listeners ( $M = 6.21$ ). Additionally, as shown in Figure 1, there was a resource interdependence  $\times$  role effect ( $F(1, 62) = 9.17, p < 0.01$ ). This effect reflected the fact that the poorer performance in the resource interdependence condition was due to poorer direct performance when subjects were in the listener role (i.e., when the student had not read the text) ( $M = 5.48$ ) than when in the summarizer role ( $M = 7.13$ ; Scheffe test,  $p < 0.01$ ). In contrast, in the resource independence condition, roles had no effect ( $M = 6.93$  for listeners and  $M = 7.16$  for summarizers, n.s.).

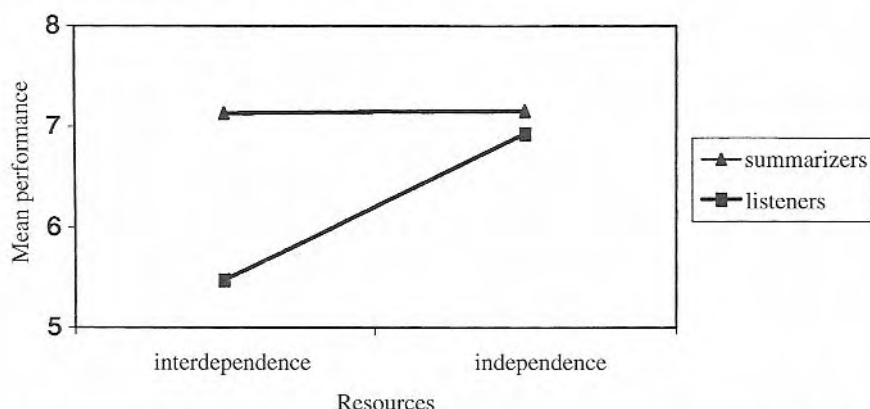


Figure 1. Mean direct performance as a function of resource in(ter)dependence and roles. Note: Mean performance ranges from  $-2.5$  to  $10$ .

These results indicate that students who had no direct access to the information seemed to be at a disadvantage when compared to students who read the texts. In fact, students who depended on their partner to learn the information (listeners in the interdependence condition) performed in a significantly poorer way. It seems clear that, in this dependent situation, the quality of the relationship between the two partners was an important factor accounting for transfer of information and thus performance.

### 5.1.3. Perceived Quality of the Relationship

The perceived quality of the relationship with the partner was assessed by questionnaire as described above. Cronbach alphas for the seven questions in each session were respectively 0.73, 0.81, and 0.82. The inter-item reliability therefore allowed computation of a 'quality of relationship' score (the higher the score, the more positively the relationship was perceived, on a scale from 1 to 7). Participants were dichotomized on the basis of a median split ( $Me = 5.86$ ). Two subject groups were then created, namely those who perceived the relation as less positive ( $M = 5.41$ ) and those who perceived the relation as more positive ( $M = 6.32$ ;  $F(1, 55) = 136.24$ ,  $p < 0.001$ ). A 2 (resource in(ter)dependence)  $\times$  2 (roles)  $\times$  2 (quality of relationship) ANOVA was performed on MCT performance score. In addition to the already mentioned effects, the ANOVA revealed a significant roles  $\times$  quality of relationship interaction effect ( $F(1, 53) = 9.77$ ,  $p < 0.01$ ). As shown in Figure 2, within a less positive relationship, listeners performed more poorly ( $M = 5.80$ ) than summarizers ( $M = 7.48$ ; Scheffe test,  $p < 0.01$ ), whereas when the relationship was perceived as more positive, being in the listener role was not detrimental to performance (although the listener had not read the text), since they performed as well ( $M = 6.76$ ) as summarizers ( $M = 7.01$ ; n.s.). It is also worth noting that the

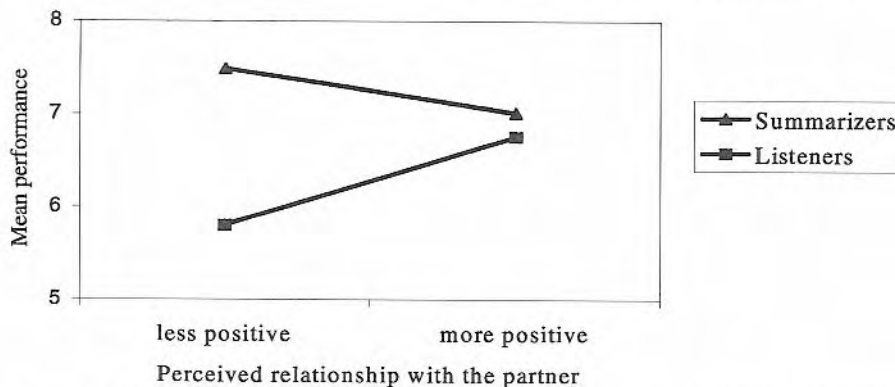


Figure 2. Mean direct performance as a function of roles and perceived quality of relationship with the partner. Note: Mean performance ranges from  $-2.5$  to  $10$ .

listeners' performance was significantly higher when the relationship was more positive than when it was less positive (Scheffe test,  $p < 0.01$ ).

Thus it appears that when the listener was dependent upon the summarizer for access to information, a more positive relationship between partners was needed in order to achieve a similar performance for the two. If the relationship was perceived as less positive, the listener performed more poorly than the summarizer.

## 5.2. INFORMATION RECALL

In order to assess comprehension and long-term memory, students were asked to recall all the pieces of information they could retrieve for all the texts covered in dyadic work. These pieces of information were then coded by two social psychology teachers on a 'quality' scale (1 = wrong, 2 = incomplete general idea or not exactly formulated, 3 = complete general idea, 4 = correct, 5 = correct and precise) and on a 'generality' scale (1 = key word, 2 = part of an experiment or example without context, 3 = experimental results, 4 = detailed concept, 5 = inference and integration with prior knowledge). A zero was assigned when no piece of information was recalled for one text. Ambiguous information or information for which teachers could not agree were not taken into account in the analysis.

Of the 64 students, 47 were present for the recall task during the fourth session (26 for the resource interdependence condition and 21 for resource independence).

### 5.2.1. Quality of Recalled Information

A 2 (resource in(ter)dependence)  $\times$  2 (roles)  $\times$  2 (perceived quality of relationship) ANOVA showed a significant resource in(ter)dependence  $\times$  roles interaction effect ( $F(1, 38) = 10.69$ ,  $p < 0.01$ ). In the resource interdependence condition, listeners' quality score ( $M = 1.86$ ) was lower than that of summarizers ( $M = 2.53$ ; Scheffe test,  $p < 0.05$ ), whereas quality of information did not differ as a function of role

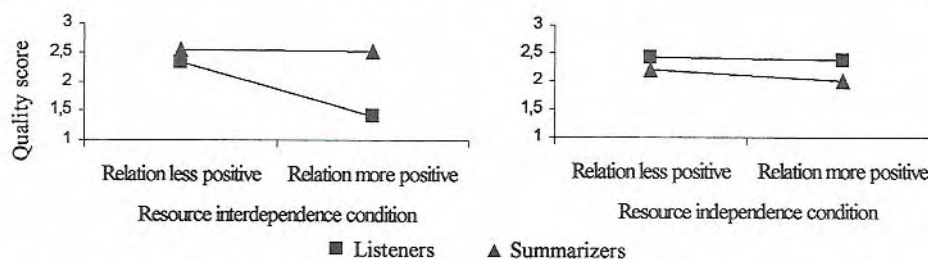


Figure 3. Quality of information recall as a function of resource in(ter)dependence, roles, and perceived relation with the partner. Note: Quality score ranges from 1 (wrong) to 5 (correct and Precise).

in the resource independence condition ( $M_s = 2.09$  vs.  $2.40$ ;  $p < 0.10$ ). This effect reproduces that found for the direct performance score.

However, the two-way interaction ( $F(1, 38) = 3.15$ ,  $p < 0.09$ ), illustrated in Figure 3, indicated that the listeners' lower quality of recall, as compared to the summarizers' score, observed in the resource interdependence condition, occurred only for those participants who perceived a more positive relationship (respectively,  $M = 1.40$  and  $M = 2.50$ ; Scheffe test,  $p < 0.05$ ). When the quality of relationship was perceived as less positive, listeners' quality of information recall was just as good ( $M = 2.33$ ) as that of the summarizers ( $M = 2.55$ ;  $p < 0.10$ ). In the resource independence condition, there were no significant differences (all  $p_s > 0.10$ ).

### 5.2.2. Degree of Generality of Recalled Information

Each recalled piece of information was coded on a generality scale from 1 (key word) to 5 (inference and integration). A  $2$  (resource in(ter)dependence)  $\times 2$  (quality of relationship)  $\times 2$  (roles) ANOVA on the generality score showed a significant main effect of role ( $F(1, 38) = 5.71$ ,  $p < 0.05$ ). Degree of generality was higher for summarizers ( $M = 2.51$ ) than for listeners ( $M = 2.21$ ). Moreover, a resource in(ter)dependence  $\times$  role interaction effect ( $F(1, 38) = 8.79$ ,  $p < 0.01$ ) showed that, in the resource interdependence condition, listeners recalled less general pieces of information ( $M = 2.07$ ) than summarizers ( $M = 2.74$ ; Scheffe test,  $p < 0.05$ ), whereas no significant difference was found in degree of generality between listeners and summarizers in the resource independence condition (respectively  $M = 2.36$  and  $M = 2.29$ , n.s.).

Again, the two-way interaction ( $F(1, 38) = 3.41$ ,  $p < 0.08$ ), presented in Figure 4, indicated that the listeners' lower generality of recalled information, as compared to the summarizers' score, observed in the resource interdependence condition, occurred only for those participants who perceived a more positive relationship (respectively,  $M = 1.58$  and  $M = 2.64$ ; Scheffe test,  $p < 0.01$ ). When the quality of relationship was perceived as less positive, listeners' generality of recalled information was just as good ( $M = 2.60$ ) as that of the summar-

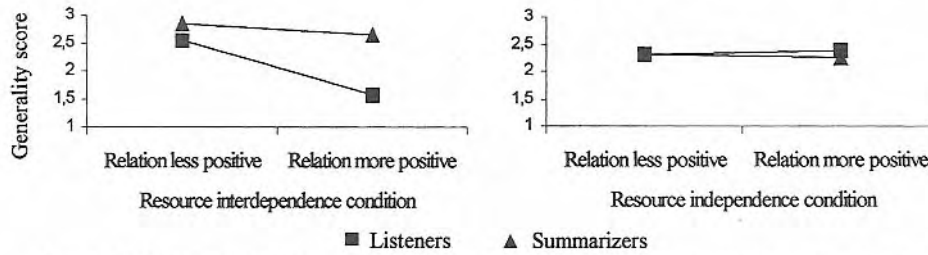


Figure 4. Generality of information recall as a function of resource in(ter)dependence, roles, and perceived relation with the partner. Note: Generality score ranges from 1 (key word) to 5 (inference and integration with prior knowledge).

izers ( $M = 2.86$ ;  $p < 0.10$ ). In the resource independence condition, there were no significant differences (all  $ps > 0.10$ ).

## 6. Discussion

### 6.1. INDEPENDENCE VERSUS INTERDEPENDENCE OF RESOURCES

This study was designed to test two alternative hypotheses concerning the role of resource in(ter)dependence in cooperative learning. At first glance, the hypothesised superiority of independence in resources seemed to receive more support. Indeed, results showed that test performance was better when students discussed identical information than when they shared complementary information. These results apparently contradicted those reported by Lambiotte and her colleagues, although the methodology of the present study was based on their study. Lambiotte et al. (1987) had found that it is more beneficial to share complementary information rather than to discuss identical information. Nevertheless, in their experiment, summarizing took place at the end of each text for the resource interdependence condition, while it took place after each extract for the resource independence condition. This difference in procedure, that is quantity of information and transmission delay, may explain the superiority of the resource interdependence condition. Indeed, less frequent summarizing with more information contained in each summary has been found to be very effective at enhancing quality of recall (Spurlin, Dansereau, O'Donnell, & Brooks, 1986).

However, although in the present study discussing identical information seemed to be more beneficial for direct performance than sharing complementary information, two other results suggest that the superiority of independence may not be so straightforward.

Firstly, superiority of resource independence was not found during recall. Quality and generality of recalled information 1–4 months later were similar in both the independence and interdependence conditions. Whether students discussed identical or complementary information during the cooperative dyadic work, their recall



did not differ. The superiority of discussing identical information did not persist over time.

Secondly, the present study allowed us to refine the underlying processes that may explain the differences in performance observed in the two conditions. In fact, analyses separating roles played during dyadic work emphasized that the difference in performance was not due to summarizers discussing identical information (who performed better) but to listeners discussing complementary information (who performed more poorly). Indeed, summarizers and listeners discussing identical information and summarizers teaching complementary information did not differ in performance. Only listeners who had not read the text before discussion showed a significant disadvantage. Their recall of information was also lower in quality and degree of generality than that of summarizers. Thus, the poorer performance of listeners sharing complementary information generalized from direct performance to recall.

To sum up, the present study has demonstrated that what appears to be important in dyadic cooperative work is direct access to information. Students who learn information via their partners perform less well than those who can access this information directly. Thus, what seems to be at stake is the degree of partners' dependence on access to information. Dependence, then, appears to be a crucial dimension in cooperative learning.

## 6.2. THE ROLE OF THE QUALITY OF RELATIONSHIP

The hypothesis that dependence upon the partner is a crucial matter is supported by results concerning the effect of the perceived quality of the relationship. Results indicated that this relationship can influence the detrimental effect of not reading information directly. Indeed, both the effect of role played (poorer performance for listeners than for summarizers) and of resource in(ter)dependence (poorer performance for students sharing complementary information than for students discussing identical information) on direct performance can be explained by the fact that listeners who did not read the texts directly performed more poorly than subjects in other conditions. However, as far as direct performance is concerned, listeners who perceived a more positive relationship with their partner performed as well as summarizers. It is only when the relationship was perceived as less positive that listeners' performance decreased. One conclusion that can be derived from these results is that when students depend on their partners for access to information, the quality of the relationship becomes a crucial dimension for performance.

## 6.3. PERCEIVED QUALITY OF RELATIONSHIP AND LEVELS OF PERFORMANCE

It was mentioned above that the perceived quality of relationship had an impact on listeners' direct performance. However, results also indicated that the quality of relationship yielded different effects depending on the level of performance. On the

one hand, as it is mentioned, a more positively perceived relationship was associated with listeners performing as well as the summarizers, as far as direct performance (as indicated by the multiple choice test) was concerned; listeners perceiving a less positive relationship performed more poorly than summarizers. Therefore, perceiving a less positive relationship may be detrimental to direct performance. On the other hand, when it comes to recall under resource interdependence, it may be a less positive relationship that prevents dependent listeners from being at a significant disadvantage when compared to summarizers. In fact, dependent listeners perceiving a more positive relationship recalled information with lower quality and generality than that of summarizers. Under resource independence, perceived quality of relationship did not affect recall performance.

The effects of quality of relationship on direct performance and on quality and generality of recall suggest some considerations concerning the potential impact of conflict, namely, that it is possible to interpret the above results in terms of cognitive benefits generated by conflicts. In accordance with the socio-cognitive conflict tradition (cf. Doise & Mugny, 1984), a positive relationship may elicit effects similar to those of compliance. Compliance consists of taking the partner's information as it is without question for relational reasons. Compliance would thus lead to better direct performance. Nevertheless, an over-positive (consensual) relationship would not raise doubts or genuine information integration. The poor performance on the recall task of listeners who depended on the partner for access to information and who perceived the relationship as being very positive could be a reflection of this lack of real information integration.

As for students who perceive the relationship as less positive, sharing complementary information could be a way of being released from relational and evaluation concerns and therefore of managing conflict in a constructive manner. This socio-cognitive conflict would not generate immediate benefits; nevertheless it could enhance information integration through decentration (cf. Butera & Mugny, in press). This would explain why listeners in the interdependence condition who perceived the relationship as being less positive performed poorly in their direct, immediate test scores but overcame this disadvantage when recall was assessed.

However, a caveat is needed with regard to such interpretations. Interpreting the perception of a less positive relationship in terms of conflict is rather delicate. The dichotomization based on the quality of the relationship was based on a median split, but the median was quite high ( $Me = 5.86$  on a scale from 1 to 7). This suggests that the perceived relationship in the 'less positive' group may not have been really conflictual. Nevertheless, two results enhance confidence in the quality of relationship measure. On the one hand, even though the overall median was high, the difference in perception of the two dichotomized groups was highly significant ( $F(1, 55) = 136.24, p < 0.001$ ). On the other hand, a further finding allowed us to rule out the possibility that the quality of relationship score was not about the relationship but really about mood; If this was the case in more successful groups, everything should be more positive (including relationships). Three ques-

tions assessed anticipated performance on a 7-point scale ('I feel I can manage the materials presented,' 'I think my answers on the multiple choice test were good,' and 'I'm confident about my answers'). The alphas for each session ( $\alpha = 0.72, 0.74, 0.82$ ) were sufficiently high to compute an 'anticipated success' score. Participants were then dichotomized on the basis of a median split ( $Me = 3.88$ ). A one-way ANOVA on perceived quality of relationship showed that participants whose feeling of success was weak did not perceive the quality of relationship in a different way ( $M = 5.75$ ) from participants whose feeling of success was higher ( $M = 5.97$ , n.s.). Perception of the quality of the relationship was therefore not affected by feelings of success.

## 7. Conclusions

This study was designed to test the effects of resource in(ter)dependence on learning. The aim was to compare two cooperative learning methods, that is, to investigate whether it is more beneficial to ask students to share complementary information (resource interdependence) or identical information (resource independence) in cooperative dyads. In this study, results regarding direct performance indicated that, on the one hand, summarizers performed better than listeners and that, on the other hand, direct performance was better when students discussed identical information than when they shared complementary information. Thus, at first glance, discussing identical information would appear to be more beneficial than sharing complementary information. However, two other results appeared to qualify the superiority of resource independence.

First, the effects of role and of resource in(ter)dependence can both be explained by the fact that listeners sharing complementary information performed more poorly. Indeed, summarizers and listeners discussing identical information and summarizers teaching complementary information did not differ in direct performance. Therefore, as for direct performance, the superiority of resource independence was not due to students who performed better when discussing identical information, but rather to the fact that listeners who had not read the text before discussion (complementary information) performed more poorly.

Second, when it came to information recall, the superiority of resource independence seems not to persist. As far as performance on recall is concerned, students sharing complementary information performed as well as students discussing identical information, whether as measured by quality or on the generality measure. Thus, the superiority of discussing identical information did not persist over time.

Thus, to understand the above results completely, the perceived quality of the relationship must be taken into account. Quality of relationship modulated performance at every level (direct performance as well as information recall), but the effects of quality of relationship were quite different depending on the level of performance. As for direct performance as measured by the multiple choice test,

listeners perceiving a more positive relationship performed as well as summarizers, whereas listeners perceiving the relationship as less positive performed less well than summarizers. Thus, for direct performance, a more positive relationship prevented listeners from being disadvantaged by not having read a part of the materials.

The perceived quality of relationship also had an impact on information recall but in a reverse direction as compared to direct performance. When it came to recall, it was a less positive relationship that prevented dependent listeners (complementary information) from being at a significant disadvantage when compared to summarizers. Indeed, dependent listeners perceiving a more positive relation performed more poorly in the delayed recall task than summarizers, whereas dependent listeners perceiving a less positive performed as well in this task as summarizers. Under conditions of resource independence, perceived quality of relationship did not affect performance.

Although the sample in this study was relatively small and its results need to be replicated, some implications for education stem from these results. In the present study, discussing identical information seemed to favour learning for immediate performance, but this advantage did not persist for recall performance 1–4 months later. It is important to note that effects of learning methods can differ with time. Therefore, this study illustrates the need to assess long-term, qualitative effects when evaluating learning methods. Learning is not a simple matter of immediate performance; it is also important to assess long-term information mastery and retention.

The present study also emphasises the importance of students' relationships in cooperational caring. It should be recalled that for immediate performance, a more positive relationship prevented listeners from being disadvantaged, whereas listeners perceiving a less positive relationship performed more poorly than summarizers. At first glance, it could be concluded that a positive relationship is needed to induce benefits in cooperative learning. But when it comes to delayed performance, a more positive relationship did not allow dependent listeners to perform well. When recalling information, it was a less-positive relationship that prevented dependent listeners from being disadvantaged. Therefore, this study has shown the importance of the quality of relationship with partners when students share information cooperatively and indicate that a positive relationship is not beneficial at all times. This point is important because teachers implementing cooperative learning methods must be tempted to intervene to promote mindless, friendly relationships among students. The present study suggests that an unduly positive relationship can deny students delayed benefits, whereas not experiencing a highly positive relationship during cooperative work may sometimes favour subsequent information mastery and retention.

Regarding resource interdependence (complementary information), the present study demonstrated that, in situations where resources are limited, it is possible to learn in an effective way, but efforts need to be concentrated on the relationship

between partners. An interpretation of this result has been offered in terms of the potential benefits created by socio-cognitive conflict. More studies are needed to sort out the role of conflict in determining at what level a beneficial effect will occur. In particular, a study is now in progress in which we are attempting to manipulate the nature of conflict (socio-cognitive vs. relational) directly in cooperative learning.

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### Endnotes

<sup>1</sup>The procedure is similar to that used by Lambiotte and her colleagues (1987) but see the caveat made in the discussion section.

<sup>2</sup>In the traditional session there was no further dyadic work but small group discussions such as are usually practiced in French universities – the teacher explains concepts and studies facilitating students' participation.

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