

THE EFFECTS OF COLLABORATION AND COMPETITION ON PRO-SOCIAL PROSPECTIVE MEMORY

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The social underpinnings of remembering to perform an action in the future (i.e., prospective memory, PM) have been recently shown to be an important feature of prospective memory functioning (Brandimonte, Ferrante, Bianco, & Villani, 2010). One emergent, though neglected, issue refers to the way people remember to do things *with others* and *for others*. In two experiments, participants were requested to collaborate or compete during an event-based PM task. In Experiment 1, they could also gain money for donation, while in Experiment 2 they could get personal earnings. Participants completed a parity judgment ongoing task and a PM task. Results revealed that a decrease in PM performance occurred with collaboration, as a result of responsibility sharing. In contrast, the pro-social nature of the PM task improved participants' performance. Interestingly, pro-sociality prevented the detrimental effect of collaboration (experiments 1 and 2), while a personal gain did not contrast responsibility sharing (experiment 2). Surprisingly, competition did not significantly affect PM performance. Finally, an increase of the monitoring costs during the ongoing task was associated with pro-social goals. This pattern of result suggests that PM is influenced by social drives and points to a pivotal role of motivation in regulating conscious mechanisms underlying memory for intentions.

It is a common experience relying on others in order to perform an intention in the future, as when we ask someone else: "Please, remind me to drop by the library". Indeed, human beings are social creatures and a great part of their daily activities are realised in a social context (Thompson, 2002). Prospective memory (PM) is not an exception. Prospective memory is the ability to realise delayed intentions (Brandimonte, Einstein, & McDaniel, 1996; Kliegel, McDaniel, & Einstein, 2008), such as buying groceries, picking up kids from school or keeping an appointment.

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In a self-report study, Meacham and Kushner (1980) reported that intentions that are to be performed in relation to someone else are more likely to be remembered. They demonstrated that intentions regarding people (e.g., meeting someone) are perceived as more memorable than those regarding objects or events. It was suggested that “an important variable in prospective remembering (...) is the extent to which another person is affected” (Meacham & Kushner, 1980, p. 208). Indeed, people make social inferences about how another person carries out a prospective memory task. In this sense, prospective memory includes a moral component, as preventing negative social upshots represents an incentive to execute an intended action (Guajardo & Best, 2000). In other words, the ability to remember to do something for others is usually considered as an important feature of the reputation of a person.

In order to better understand the role of social and motivational factors that may affect prospective memory performance, research should account for the way people remember to do things *with* others and *for* others (Kliegel, personal communication, 2007). From now on, we will refer to the former as *Collaborative Prospective Memory* (CPM) and to the latter as *Pro-social Prospective Memory* (PPM).

However, just a handful of studies (Altgassen, Kliegel, Brandimonte, & Filippello, 2010; Brandimonte et al., 2010; Johansson, Andersson, & Rönnerberg, 2000; Shaefer & Laing, 2000) have investigated how social factors activate motivation in remembering to do things in the future. Also, none of these studies have considered at the same time two different kinds of motivation (collaboration and pro-sociality) as social determinants. Therefore, the cognitive mechanisms that govern prospective memory related to social dimensions are still largely unknown.

Prospective memory, collaboration, and pro-sociality

Based on the common sense, one would take an advantage by asking a friend to provide a reminder. In that case, two people, rather than one, will be committed on that intention. Nonetheless, in collaborative situations, prospective memory failures occur even if the content of the intention (the retrospective component) is preserved.

For example Marcatto, Ferrante, Pelizzon, and Brandimonte (2007) tested the effect of the responsibility sharing on prospective memory. Participants engaged in a very simple prospective memory task, i.e., remembering to turn the light off when leaving the experimental booth after completing a task. Participants performed the task either individually or with a confederate, hence manipulating the level of responsibility sharing on the intention. These authors reported that, as opposed to the Individual condition, when performance was at ceiling, performance significantly declined as the level of respon-

sibility sharing on the intention increased. Similarly, Johansson et al. (2000), Kobayashi and Maruno (1994), and Shaefer and Laing (2000) reported detrimental effects of the presence of others on prospective memory performance.

Shaefer and Laing (2000) argued that activation toward the intention decreases when a reminder is expected. According to these authors, the chance for success decreases if diffusion of responsibility about the intended action increases. In other words, the strength of an intention is weakened if someone adopts another person as an external memory aid. Typically, the loss of motivation and the related decrease of performance in collaborative situations go under the rubric of *social loafing effects* (Karau & Williams, 1993; Latané, Williams, & Harkins, 1979). Individuals working collectively in the real or imagined presence of others, with whom they merge their contributions in a single group output, are likely to reduce their efforts with respect to individuals working alone.

Brandimonte and Ferrante (2008) suggested that an inhibition of PM performance in collaborative situations may occur as a consequence of social loafing. Thus, collaborating within a PM task may result in drive reduction when remembering intentions.

In order to shed light on the complex dynamics of pro-social prospective memory, one needs to examine the mechanisms underlying the realisation of future actions *for* the benefit of other people. Pro-social behaviour can be considered as a range of deeds aimed to benefit one or more people other than oneself, like donating, helping, supporting, sharing, and cooperating (Batson, 1998). In the realm of prospective memory, pro-sociality implies to carry out an intention that favours someone else.

Recently, Brandimonte et al. (2010) investigated the relationship between pro-social intentions and motivation. They found that the likelihood that the intention will be realised increased if the to be performed action provided a benefit or avoided a damage to someone else, with respect to a control task. However, they also found that the expectation of a small reward for a pro-social action reduced memory for that action (motivation crowding-out effects). Brandimonte and Ferrante (2008) argued that intentions can be considered as motivational states, just like needs and goals. Motivational states hold a top place in our cognitive system (e.g., Anderson, 1983; Bruner, 1957; Förster, Liberman, & Higgins, 2005). According to this view, pro-sociality can be considered as a source of activation in realising an intention, and therefore as a mechanism that might mitigate the effects, if any, of social loafing. In short, pro-sociality may prevent the diffusion of responsibility in some collaborative situations.

Collaboration vs. competition

Collaboration represents one pole of the interaction between individuals. Usually, people collaborate if they fully share a common interest. Working jointly with others is a way to maximise individuals' well-being (Grzelak, 1988). In many other situations, the interest of an individual is in opposition to the interest of others, such as in a speed race, a poker game or to outbid someone at an auction. In these situations, one wins if others lose. In most cases, people make decisions about whether it is more fruitful to collaborate or to compete. This topic was often investigated by means of experiments simulating a natural conflict scenario (e.g., Deutsch & Krauss, 1960) or by experimental games, like the "prisoner's dilemma" (e.g., Dreber, Rand, Fudenberg, & Nowak, 2008). To date, no studies have investigated the effect of competition on prospective memory. The manipulation of a competitive interaction in the realm of prospective memory may represent a stimulating topic of interest for several reasons. First, collaboration and competition are crucial to understand any form of social interaction (Archer, 2001). Indeed, individuals can cooperate or compete to achieve the highest benefit from a situation. Second, it may be interesting to create a social interaction in opposition to collaboration; in a collaborative interaction there is a group output, and therefore an interdependence of the individuals' efforts. In contrast, in a competitive interaction, efforts are in reciprocal antagonism. In this sense, collaboration and completion can be considered as drives in opposition. Third, competition in remembering intentions mirrors some real life situations, such as remembering sales before other persons, or remembering to enter a competition before other people, so as to gain an advantage.

The aim of this study was, therefore, to investigate some novel social aspects of prospective memory. In particular, we were interested in exploring (a) the effect of different types of social interaction. In fact, although the effects of collaboration were addressed in previous studies (e.g., Johansson et al., 2000; Shaefer & Laing, 2000), it was never considered the impact of competition on remembering intentions. In addition, we evaluated (b) whether social interaction and pro-sociality interact. The kind of social interaction and the chance to provide or receive a benefit for the execution of an intention reflect different sources of motivation. Competition, pro-social and personal benefit are expected to increase individuals' motivation. On the other hand, collaboration has been associated with a loss of motivation and, consequently, with a decrease of PM performance (Brandimonte & Ferrante, 2008). To date, this is the first study exploring if different social drives compete or rather produce additive effects. Finally, we explored (c) whether pro-social motivation leads socially interacting participants to adopt attention-based strategies to be more effective in the execution of an event based PM task. In fact, some researchers reported that task importance improves the likelihood

to remember to do something in the future (Andrzejewski, Moore, Corvette, & Hereman, 1991; Brandimonte et al., 2010; Cicogna & Nigro, 1998; Kliegel, Martin, McDaniel, & Einstein, 2004; Meacham & Singer, 1977). According to the Multi-process theory (Einstein, McDaniel, Thomas, Mayfield, Shank, Morrisette et al., 2005; McDaniel & Einstein, 2000), people can rely on a relatively automatic and associative process to carry out an intention. In that case, there would be an association between the target-event and the intention, so that people will simply wait for the cueing event to execute the planned action. This process is rather automatic and requires few cognitive resources. On the other hand, it is reasonable that people recruit more attentional resources to ensure realising a relevant intention (Brandimonte, Ferrante, Feresin, & Delbello, 2001; Einstein et al., 2005, Kliegel et al., 2004; Smith, 2003; Smith & Bayen, 2004). This latter process is based on higher levels of monitoring and it can be highly taxing in terms of cognitive effort. As a consequence, individuals will be slower in the execution of an ongoing task, since cognitive resources are partially allocated in rehearsing the intention. At the same time, they should be more accurate in the execution of the prospective memory task.

Experiment 1

A key feature of event-based PM task is engaging participants in an ongoing task and providing at the same time instructions to perform an intended action on the occurrence of a target event at some point of the ongoing task (Einstein et al., 2005). This experimental procedure reproduces an aspect of daily activities, when people have to carry out a planned action on the occurrence of a stimulus, during an ongoing task (e.g., delivering a message to a colleague when we meet him, while engaged in our job).

Participants were tested in an event-based prospective memory task: they engaged in a computer based even/odd digit verification task. At the same time, they had to perform the prospective memory task of pressing the space bar upon the appearance of four target numbers. Social interaction was manipulated by engaging participants in individual, collaborative or competitive task. In the individual task, participants were tested alone. In the collaborative and competitive task, couples of participants performed the task at the same time, adopting an interface, which simulated a connection between-participants' computers. Previous research (e.g., Hoyt, Blascovich, & Swinth, 2003) reported the typical social influence effects in immersive virtual environments. Therefore, we simulated a computer-based interaction that could prompt a feeling of collaboration/competition among participants. Pro-sociality was also manipulated by informing participants that they would gain a reward of 50 Eurocents for a donation each time they remembered to press the

space bar on the appearance of a target number. Importantly, in the competitive task, only the winner would get the reward or would be mentioned as donor.

A baseline condition (ongoing task only) was created to test the monitoring hypothesis. In this condition, participants were tested individually and were requested to execute only the even/odd task. This procedure was intended to analyse the ongoing reaction times in order to assess the costs of performing only the ongoing task, as compared to the ongoing task with the embedded prospective memory task. It was also predicted that in the ongoing task, collaboration would lead to a drop in accuracy. Because pro-sociality was manipulated only for the prospective memory task, it should not affect the ongoing task. However, it is plausible that a demanding pro-social intention may activate overall participants' motivation. In this case, the pro-social goal might improve accuracy in the ongoing task, hence mitigating the effect of collaboration.

It was also expected that collaboration would induce social loafing, so that participants' performance would drop in a collaborative prospective memory task and, conversely, pro-sociality would improve prospective memory performance. Consequently, pro-sociality would reduce the detrimental effect of collaboration. Moreover, we explored whether a pro-social intention would lead participants to adopt a higher level of monitoring with respect to a task with no pro-social implication. If so, as an effect of the presence of a pro-social goal, a significant improvement of accuracy in the prospective memory task should be accompanied by a slowdown in the ongoing RTs. This pattern of results would emerge by comparing the highly demanding task (i.e., pro-social task) with the baseline, control task. Finally, competition, as compared to the individual task, should improve prospective memory performance, by increasing the individual's motivation.

It should be noticed that previous research on this issue (Brandimonte et al., 2010) showed that the mechanisms that modulate pro-social intentions can be triggered and then operate in the absence of conscious guidance (Bargh & Morsella, 2008). However, this is not always the case. For instance, most recent research (Brandimonte, Ferrante, Bianco, & Villani, submitted) has shown that in the presence of non-material social rewards (publicity of giving behaviour), ongoing task costs emerge, as compared to the pro-social condition, plausibly because concerns about social reputation activate conscious monitoring of the intention. Collaborative situations may have a substantial impact on social reputation and may, therefore, prompt conscious rather than unconscious monitoring mechanisms.

Method

Participants

100 participants recruited from the University of Bari took part in this experiment. All participants were randomly assigned to the experimental or to the baseline conditions. 8 participants were excluded from the whole design because they forgot the instructions at the end of the experiment, asked to interrupt the experiment or for technical problems during the registration of their output files. Consequently, 12 people performed the baseline task, while 80 participated in the experimental sessions.

Design

The design included 6 between-participant conditions, obtained by crossing the variables Type of Social Interaction (Collaboration, Individual and Competition) and Benefit (No Benefit, Pro-social Benefit). A baseline condition (ongoing task only) was included in order to address the monitoring hypothesis.

Materials and procedure

Stimuli were presented at the centre of a 19-inch computer screen by means of Superlab 2.0. Stimuli were 352 *two-digit* numbers, balanced between even and odd. 42 stimuli were used for training; none of them appeared during the experimental session. 42 stimuli, presented seven times each, were used for the ongoing task, within the experimental session. 4 blocks, each composed of four stimuli, were presented as target events. Thus, 310 stimuli appeared during the experimental session: 294 ongoing events and 16 target events. The proportion of target-events within the ongoing task was about 5%, given that previous studies reported a shifting from prospective memory to vigilance processes over that threshold (Brandimonte et al., 2001). Each stimulus remained in view until the pressure of any of two designated keys, and was preceded by a fixation point lasting 750 milliseconds. Stimuli were pseudo-randomized within the experiment, so that participants could not predict when a target-event would appear. In addition, the order of appearance of each target-event was pseudo-randomized within each block of target-events. The ongoing task was to judge if the number was even or odd. As a prospective memory task, participants had to press the space-bar upon appearance of any two-digit numbers containing "7" or "8". Categorical rather than specific instructions were given for the prospective memory task in order to prevent ceiling effects (e.g., Van den Berg, Aarts, Midden, & Verplanken, 2004). Participants provided their responses through a standard keyboard. As an ongoing task, they had to press the "P" labelled key for even numbers (*Pari*

in Italian) or the "D" labelled key for odd numbers (*Dispari* in Italian). The position of the labels "P" and "D" was counterbalanced across participants.

In the Individual condition, participants performed the whole task individually. In the conditions of collaboration and competition, participants were tested in couples. A research assistant introduced each participant to one another, first ensuring that the participants of each couple were not mates in everyday life before assigning each one to his or her seat.

In the Collaboration and Competition conditions, the couples were tested simultaneously. Importantly, they received no further instructions on the PM task, in order to avoid to emphasise the intention. Each couple used two different computers. The two participants were told that their computers were linked by Ethernet. To this aim, a series of windows simulated the connection between the two computers.

Participants were seated facing the computer screen one in front of the other, so that each participant could see the other working, but was unable to look at the other's computer screen and keyboard. This procedure was adopted to make participants reciprocally aware of the presence of the other, while restricting the opportunity to check reciprocally their responses.

The instructions were adjusted for each experimental condition. Participants assigned to the Competition condition were requested to compete during the experimental task, and were told that the winner would be the participant providing the highest number of correct responses during the whole task. They were also informed that at the end of the experiment, they would receive the result of their performance, so that the winner could be stated.

Participants assigned to Collaboration condition were requested to collaborate during the entire experimental task. They were also informed that their responses would be collected as a single database that considered only correct responses, independently of who of the participants actually gave the answer. In doing so, we ensured that each member of the couple was informed that any of them could benefit of the correct responses of the other participant. Importantly, in this way, the individual contributions in the experimental task would have been undetectable. These caveats reproduced the basic condition for the social loafing effect to emerge.

The presence of a pro-social benefit was manipulated only for the prospective memory task. Indeed, the participants assigned to the Pro-social condition were informed that they would earn 50 Eurocents for each correct prospective memory response. The whole stored amount would be donated to a well-known homeless caring organisation. In order to strengthen the pro-social upshot of the task, at the beginning of the experiment participants signed a form to give their consent for the donation. In the Collaboration condition, participants were told that the couple would store the amount for the donation and be mentioned as donor, even if only a member of the collabora-

tive couple performed correctly. The participants assigned to the Competition condition were told that only the winner would be mentioned as donor of the amount that he/she actually earned.

In the No-Benefit condition, participants received instructions on the standard prospective memory task.

All participants read the instructions and were required to recall them. Participants were also requested to be as accurate and fast as possible, because the computer would not register the slowest responses. They then engaged in a training phase and, after a 20-minutes retention interval, were tested in the experimental session.

During the retention interval, participants were requested to collaborate/compete or to work alone on a set of problem solving and lateral thinking questions. This procedure was adopted to increase the effect of social interaction.

At the end of the experiment, all participants were requested to verbalise the procedure, in order to ensure that prospective memory failures were caused by the prospective memory component (i.e., performing the intention at the appropriate moment) rather than by the retrospective component (i.e., remembering the content of the intention). Finally, each participant was debriefed.

Results

Ongoing task

Reaction times

Six conditions were obtained by crossing the levels of the two independent, between-participants variables. Namely, Type of Social Interaction (Collaboration, Individual, and Competition) and Benefit (No-Benefit, Pro-social Benefit) were manipulated.

We computed an ANOVA on the mean response times of correctly answered trials.

There were no significant main or interaction effects noted (Table 1, a, p. 214).

Accuracy

Having specific predictions about the direction of the effects, we did not conduct the omnibus F test at all, but rather conducted the appropriate multiple comparisons, as they were the main purpose for doing the study. Planned Comparisons revealed that, in absence of a pro-social benefit, Collaboration significantly reduced accuracy, with respect to the Individual condition, $F(1,$

Table 1

Mean proportion and standard errors of correct responses and reaction times in preliminary analysis. Ongoing and Prospective memory tasks of Experiment I

(a)	Preliminary analysis (on ongoing performance)							
	Ongoing only				Ongoing + Prospective memory			
	Accuracy		Reaction times		Accuracy		Reaction times	
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
	0.970	0.015	686	41	0.950	0.006	768	36
(b)	Ongoing task							
	No-Benefit				Prosocial Benefit			
	Accuracy		Reaction times		Accuracy		Reaction times	
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
	0.953	0.019	798	35	0.950	0.018	805	47
Competition	0.953	0.019	798	35	0.950	0.018	805	47
Individual	0.958	0.007	768	36	0.959	0.014	920	67
Collaboration	0.895	0.026	905	87	0.959	0.015	840	42
(c)	Prospective memory task							
	No-Benefit				Prosocial Benefit			
	Accuracy		Reaction times		Accuracy		Reaction times	
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
	0.647	0.057	1025	74	0.583	0.097	869	40
Competition	0.647	0.057	1025	74	0.583	0.097	869	40
Individual	0.613	0.056	961	69	0.693	0.065	1006	79
Collaboration	0.424	0.064	948	69	0.734	0.048	988	58

74) = 7.34, $p < .01$, partial $\eta^2 = 0.09$ (Table 1, b). However, when a pro-social benefit was added in the Collaboration condition, it significantly improved participants' accuracy, with respect to the No-Benefit condition, $F(1, 74) = 6.66, p < .01$, partial $\eta^2 = 0.08$.

Prospective memory task

Reaction times

A 3×2 ANOVA was computed on the mean reaction times of prospective memory responses. The design included two between-participants variables, Type of Social Interaction (Collaboration, Individual, and Competition) and Benefit (No-Benefit, Pro-social Benefit). No main or interaction effects emerged.

Accuracy

A 3×2 ANOVA on the proportion of correct prospective memory responses was performed. The pro-social task was completed with higher accuracy than the No-Benefit task, $F(1, 74) = 4.12, p < .05$, partial $\eta^2 = 0.05$ (Table 1, c). The interaction between Type of Social Interaction and Benefit was also significant, $F(2, 74) = 4.08, p < .05$, partial $\eta^2 = 0.10$. As it can be seen in Figure 1, the interaction accounted for the differences among patterns that emerged for the three levels of social interaction. A series of planned comparisons was performed in order to evaluate parts of the whole design. That is, the difference between Collaboration and Individual conditions, when no benefit was associated to the prospective memory responses, was significant, $F(1, 74) = 4.73, p < .05$, partial $\eta^2 = 0.06$. In addition, in the Collaboration condition, pro-sociality improved accuracy $F(1, 74) = 11.01, p < .01$, partial $\eta^2 = 0.13$. On the other hand, no difference emerged between Pro-social and No-Benefit conditions during either competitive or individual testing.

Evaluation of the monitoring costs

If pro-sociality leads participants to rehearse the intention, then in the ongoing task they should be slower than participants who are involved in the standard PM condition (Individual/No Benefit). At the same time, they should be more accurate in the execution of the prospective memory task, when compared to the standard PM task.

To evaluate this, a One-way ANOVA on the reaction times of the Baseline condition, standard PM task (Individual, No-Benefit) and Individual Pro-social task was computed. A significant effect emerged, $F(2, 41) = 7.61, p < .001$, partial $\eta^2 = 0.27$. Planned comparisons showed that participants' performance did not significantly differ in the baseline and the standard PM task. Importantly, participants in the Individual Pro-social task were significantly slower than participants in the Individual, No-Benefit condition, $F(1, 41) = 5.99, p < .05$, partial $\eta^2 = 0.13$ (see Figure 1, p. 216).

Discussion

The ongoing task and the prospective memory task showed a similar pattern of results. In both tasks a social loafing effect emerged when participants had to collaborate, with respect to the Individual condition. More interestingly, prosociality not only improved participants' accuracy *per se*, but even reduced the effect of social loafing. Indeed, in the collaborative groups the pro-social benefit, as opposed to the No-Benefit condition, enhanced the likelihood of realising the intention.

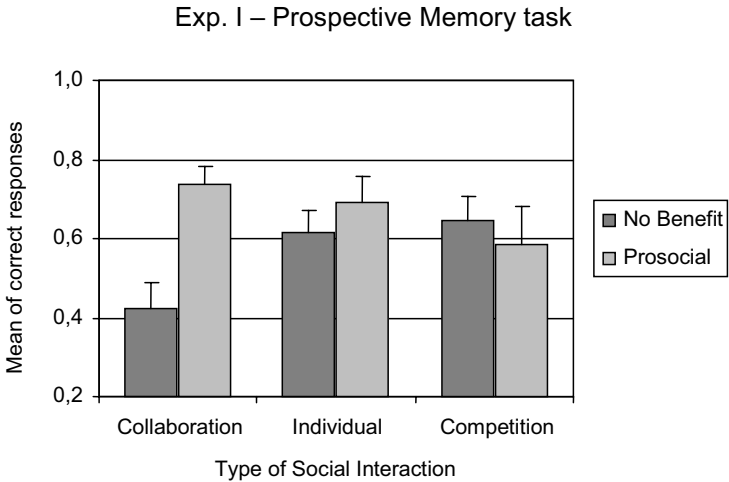


Figure 1

Mean proportion of correct responses (bars are standard errors) for the prospective memory task, as function of Type of Social Interaction and Benefit

Therefore, pro-sociality seemed to act like a source of activation. This hypothesis is confirmed by the evaluation of monitoring request. Both analyses took into account, from different perspectives, the reaction times of the ongoing task. No differences were observed between baseline and control prospective memory task (i.e., the Individual/No-Benefit condition). At the same time, the reaction times of the Individual/Pro-social-Benefit condition were significantly slower than those of the Individual/No-Benefit condition. This pattern of results suggests that the standard prospective memory task can be considered as a relative effortless and automatic task (e.g., Einstein et al., 2005; McDaniel & Einstein, 2000). On the other hand, participants aiming to perform the task successfully, seemed to recruit attentional resources to rehearse the pro-social intention. The increase of monitoring in the Pro-social condition, with respect to the No-Benefit condition, made participants slower in the execution of the ongoing task (Brandimonte et al., 2001). The critical result of the present experiment is that competition affects neither ongoing, nor PM performance. This result emerged even when the task had a pro-social implication. However, the sense of competition is usually connected with the concept of personal prize. One may therefore wonder if providing a personal benefit for the winner is a factor that could magnify the effects of competition.

Experiment 2

The previous experiment has shown that social loafing effects do not emerge when participants have to *remember to do things for others*, and that competition does not improve prospective memory. What about collaborating or competing for a personal benefit? In order to address this issue, we introduced a personal reward for the execution of the PM task, as opposed to the Pro-social condition. The procedure was the same as that of Experiment 1, except for the *personal benefit condition*.

It is expected that our previous results on the diffusion of responsibility (i.e., social loafing effect) and prosociality would be replicated. In Experiment 2, we therefore explored if getting a personal benefit can increase *per se* remembering intentions. We also explored if a small personal benefit can reduce social loafing effects during collaboration, acting similarly to the pro-social benefit. Finally, it is predicted that competition will enhance prospective memory accuracy only when a personal benefit is available, as opposed to the Pro-social and No-Benefit competitive conditions.

Method

Participants

162 participants from Suor Orsola Benincasa University of Naples took part in the experiment. The data of two participants were eliminated as, at the end of the experiment, they did not recall instructions as required.

Design

The design included 9 between-participant conditions, obtained by crossing the variables Type of Social Interaction (Collaboration, Individual, and Competition) and Benefit (No-Benefit, Pro-social Benefit, Personal Benefit).

As in experiment 1, a baseline condition (ongoing task only) was included to investigate the monitoring hypothesis.

Materials and procedure

Materials and procedure were the same as in Experiment 1. The only difference was related to the Personal Benefit condition. During instructions, participants learned that they would earn 50 Eurocents for every correct prospective memory response and that they would later get the whole amount. In the Collaboration condition, participants were informed that, if even just one of the members of the collaborative couple performed correctly, that couple would still be able to store the amount. In the Competition condition, participants were told that only the winner would earn his/her total store. By cross-

ing the two independent variables, that is, Type of Social interaction (Collaboration, Individual, Competition) and Direction of the Benefit (No-Benefit, Pro-social, Personal), 9 experimental conditions were obtained.

Results

Ongoing task

Reaction times

A 3×3 ANOVA was computed on the mean response time of the correct ongoing responses. The analysis contained the between-participants' variables Social Interaction (Individual, Competition) and Benefit (No-Benefit, Pro-social Benefit, Personal Benefit). The main effect of the Benefit was significant, indicating that participants in the Pro-social condition were slower than those in the No-Benefit and in the Personal Benefit condition, $F(2, 133) = 6.15, p < .01$, partial $\eta^2 = 0.08$ (Table 2, a, p. 219).

Accuracy

A 3×3 ANOVA was computed on the proportion of correct ongoing responses, which showed an interaction between Social Interaction and Benefit, $F(4, 133) = 3.08, p < .05$, partial $\eta^2 = 0.08$. Planned comparisons revealed that, in the No-Benefit condition, collaborative participants scored significantly lower than Individual participants, $F(1, 133) = 10.97, p < .01$, partial $\eta^2 = 0.07$. However, in the Collaboration condition the pro-social benefit significantly improved performance with respect to the No-Benefit condition, $F(1, 133) = 13.89, p < .001$, partial $\eta^2 = 0.09$. On the other hand, in the Collaboration condition, the effect of personal benefit was only marginally significant, $F(1, 133) = 3.47, p < .064$, partial $\eta^2 = 0.02$. No other theoretically relevant comparisons resulted significant. (see Figure 2, p. 220).

Prospective memory task

Reaction times

A 3×3 ANOVA that contained the between-participants' variables Social Interaction (Individual, Competition) and Benefit (No-Benefit, Pro-social Benefit, Personal Benefit) was performed on the mean response times of the correct prospective memory responses. There were no significant effects.

Table 2
Mean proportion and standard errors of correct responses and reaction times in the Ongoing and Prospective memory tasks of Experiment II

(a) Ongoing task													
	No-Benefit			Prosocial Benefit			Personal Benefit			Reaction times			Std. Error
	Accuracy			Accuracy			Accuracy			Mean			
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	
Competition	0,935	0,012	730	25	0,952	0,017	914	54	0,925	0,018	705	37	
Individual	0,953	0,013	853	49	0,922	0,032	934	100	0,934	0,021	831	49	
Collaboration	0,861	0,023	759	32	0,963	0,005	870	77	0,917	0,023	770	39	
(b) Prospective memory task													
	No-Benefit			Prosocial Benefit			Personal Benefit			Reaction times			Std. Error
	Accuracy			Accuracy			Accuracy			Mean			
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	
Competition	0,559	0,066	900	49	0,638	0,086	1049	100	0,430	0,068	899	60	
Individual	0,520	0,069	990	92	0,727	0,045	959	70	0,492	0,069	969	75	
Collaboration	0,336	0,051	903	47	0,629	0,069	1063	114	0,485	0,068	861	64	

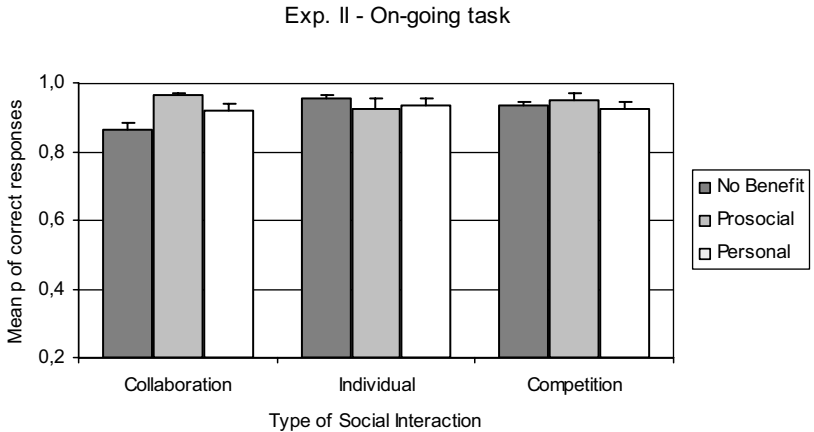


Figure 2

Mean proportion of correct responses (bars are standard errors) for the ongoing task, as function of Type of Social Interaction and Direction of Benefit

Accuracy

A 3×3 ANOVA was computed on the proportion of correct prospective memory responses. The main effect of Benefit was significant, $F(2, 133) = 9.46, p < .001$, partial $\eta^2 = 0.12$. Planned comparisons performed on accuracy data revealed that the pro-social benefit produced an increase in accuracy with respect to both No-Benefit and Personal benefit experimental conditions, respectively $F(1, 133) = 13.56, p < .001$, partial $\eta^2 = 0.09$; $F(1, 133) = 15.02, p < .001$, partial $\eta^2 = 0.10$.

In addition, planned comparisons revealed that, in the No-Benefit condition, collaboration reduced participants' accuracy, when compared to the Individual condition, $F(1, 133) = 3.96, p < .05$, partial $\eta^2 = 0.02$. Finally, in under Collaboration conditions, participants in the Pro-social condition outperformed participants in the No-Benefit condition, $F(1, 133) = 11.18, p < .01$, partial $\eta^2 = 0.09$. However, the personal benefit did not significantly reduce the detrimental effect of collaboration (Table 1, b).

Evaluation of monitoring costs

As, in Experiment 1, the hypothesis that pro-social intentions may induce an increase in the cost of the execution of the ongoing task was tested. A one-way ANOVA was performed on the reaction times of the Baseline condition, standard PM task (Individual, No-Benefit) and Individual Pro-social condition. A significant effect emerged, $F(2, 45) = 3.42, p < .05$, partial $\eta^2 = 0.13$.

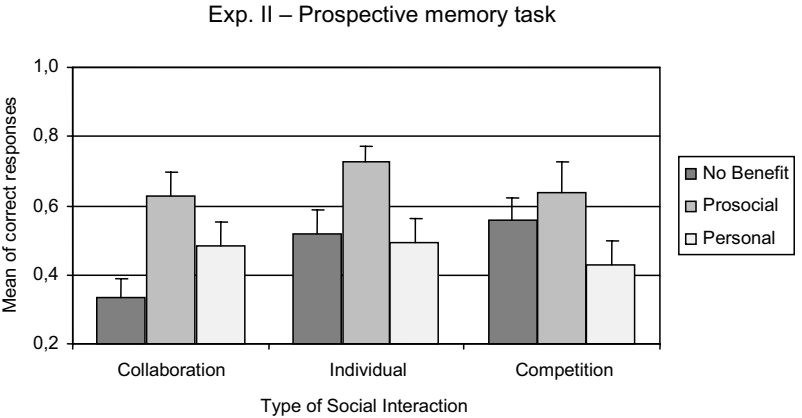


Figure 3

Mean proportion of correct responses (bars are standard errors) for the prospective memory task, as function of Type of Social Interaction and Direction of Benefit

Planned comparisons revealed that there was no significant difference between baseline and standard PM task performance, as well as between Individual, No-Benefit and Individual/Pro-social-Benefit condition. However, participants in the Individual, Pro-social condition were significantly slower than participants in the Baseline condition, $F(1, 41) = 15.14, p < .01$, partial $\eta^2 = 0.13$. Finally, we looked at the relationship between PM accuracy in the Individual/No-Benefit condition and the reaction times of the individual/Pro-social-Benefit condition. As in the previous experiment, this contrast did not reach the significance.

Discussion

The results of this experiment revealed a pattern much similar to that of Experiment 1. In the No-Benefit condition, social loafing occurred both in the ongoing and in the prospective memory tasks. So, again, collaboration seems to have a detrimental effect on cognitive tasks. In addition, prosociality enhanced *per se* accuracy both in the ongoing and in the prospective memory tasks. As in Experiment 1, prosociality prevented social loafing effects in collaborative couples. Interestingly, the increase in accuracy under Pro-social conditions was associated with slower reaction time in the execution of the ongoing task, as compared to the baseline ongoing task. This suggests that participants relied on an attentional strategy to perform a socially relevant intention.

A personal benefit did not reduce the social loafing effect with the same strength of a pro-social incentive. As stated above, sometimes the profit of an individual is clearly at odds with that of another. Several studies in the realm of the game theory simulated a conflict scenario (e.g., Deutsch & Krauss, 1960; Dreber et al., 2008). However, most of them focused on how people decide to behave collaboratively or competitively. To our knowledge, the present study is the first addressing the issue of the ability to remember to do something in the future in a competitive context. Unexpectedly, also in Experiment 2, competition did not affect prospective memory performance. This result was reliable although a personal reward was set as a prize for the winner. A possible explanation of this result relies on what is at stake for the winner. Probably, in order to elicit a sufficient feeling of challenge, the reward needs to be really appealing for the contenders. This may not have been the case in our experiment.

General discussion

In two experiments, participants were tested using an event-based prospective memory task. In both experiments, participants collaborated, competed or executed the assigned task individually. Moreover, they had the chance to carry out a pro-social intention by donating (Experiments 1 and 2) or gaining personally (Experiment 2) a small monetary reward for the execution of the prospective memory task. These two experimental conditions were compared to a standard PM task, in which the intention was not associated to any reward for anyone.

Social interaction showed a similar effect on the ongoing as well as on the prospective memory task. Participants performed both tasks with a lower level of accuracy in the collaborative condition as compared to the Individual condition. No differences were observed between the Competition and the Individual conditions. Collaboration had a detrimental effect, not only on prospective memory performance, but also on the ongoing activity.

Evoking prosociality for each prospective event prevented some of the detrimental effects of collaboration on prospective memory performance and also on the ongoing task. Indeed, collaborative participants who engaged in remembering a pro-social intention, executed the ongoing task more accurately than collaborative participants who performed the standard prospective memory task (Experiments 1 and 2). Neither competition nor personal benefit had any effect on performance in the ongoing task.

In both experiments, a decrease in performance occurred during the prospective memory task if participants had to collaborate, with respect to the Individual condition. As predicted, a social loafing effect arose by means of the diffusion of responsibility. This finding confirms previous empirical

results. For instance, Brandimonte and Ferrante (2008) reported a quite robust social loafing effect when participants actually had the chance to interact during the experimental task. In our study, participants collaborated by means of a computer interface. Their interaction was *technologically mediated* (e.g., Swinth & Blascovich, 2002). Even though they were not physically interacting, the awareness about the presence of the other and toward the treatment of their single outcomes was enough to guarantee the diffusion of responsibility. This particular form of social interaction is called *copresence* (Zhao, 2003), which indicates the sense of *togetherness* with others in a mediated (either remote or virtual) environment (Durlach & Slater, 2000). Therefore, not only the actual, but even the imagined or implied presence of others can influence motivation, thoughts and behaviours (Allport, 1985). In the present research, not only the social presence of others who actually interact, but even the simple *copresence* of others can affect individual cognitive processes. To our knowledge, the present study is the first extending the effect of social interaction on prospective memory to the issue of *copresence*.

This study is also the first devoted to compare the effects of collaboration and competition on prospective memory performance. If the effect of collaboration on prospective memory seems to be quite clear, on the contrary, competition does not seem to influence prospective memory performance. Indeed, in both experiments competitive participants' results are largely comparable to those of individual participants. There may be two explanations for the absence of the effect of competition. The first one is that participants did not feel that the even/odd ongoing task and the prospective memory task were actually challenging, possibly because there is no challenge if there is not an appealing reward to get or a punishment to avoid. However, competition did not affect participants' outcomes even when a small reward for oneself or for another person was offered as a prize for the winner. The second explanation is that competition does not effectively influence prospective memory performance unless participants are in a real critical situation, like remembering to sign up for a competition early to be sure to get into it. Further investigations are certainly required, for instance by manipulating the level of reward and what is at stake, in order to systematically evaluate the effects of competition.

In contrast, prosociality has shown a clear-cut effect on prospective memory. Indeed, in Experiment 1 participants scored higher when the intention had a pro-social implication, in comparison to the No-Benefit condition. In Experiment 2, participants assigned to the pro-social benefit condition executed the prospective memory task more accurately than those assigned to the Personal Benefit and No-Benefit conditions.

More intriguingly, both experiments indicated that a pro-social intention may trigger monitoring processes. Indeed, people can rely on executive proc-

esses to ensure success in retrieving intentions, if the task is important enough to justify the effort (Brandimonte et al., 2001; Einstein et al., 2005; Kliegel et al., 2004; McDaniel & Einstein, 2000; Smith, 2003; Smith & Bayen, 2004), or if the action has a direct impact on social reputation (e.g., Brandimonte et al., 2010). According to one view, people monitor the intention for important task and rely on relatively automatic and associative processes for less important intentions. However, monitoring is a costly activity. Consequently, highly monitoring participants, in opposition to the lowly monitoring ones, are slower in the execution of the ongoing task. At the same time, participants adopting a continuous monitoring strategy will be more accurate in the prospective memory task. In Experiment 1, no differences were found in the reaction times of the ongoing task between baseline (ongoing only) and standard conditions (i.e., Individual/No-Benefit task). Conversely, a significant difference emerged between No-Benefit and pro-social performance latency in the Individual condition. In addition, participants in the Pro-social condition outperformed participants in the standard PM condition in terms of correct responses. This pattern of result was confirmed in both experiments, hence supporting the hypothesis of an increase of monitoring for the pro-social task.

Another important issue emerges from the findings of the Pro-social condition. Remind that collaboration decreased the performance of a standard (No-Benefit) prospective memory task. However, in both experiments, collaboration was no longer harmful if the task had a pro-social implication. In the No-Benefit condition, collaborative participants performed poorer than individual participants. Nonetheless, the former scored significantly higher in the pro-social benefit condition than in the No-Benefit condition. In other words, a demanding pro-social intention may mitigate or neutralise some of the detrimental effects of collaboration. Coherently with Brandimonte et al. (2010), a small personal benefit (as in our Experiment 2) slightly affected prospective memory performance. Previous studies reported that incentives enhance prospective memory (e.g., Guajardo & Best, 2000; Meacham & Singer, 1977). The findings of our study highlight the importance of considering the nature of the incentive. On the one hand, remembering to do something for someone else really needing can be a strong incentive to remember the intention. On the other hand, the same money reward does not produce the same effects if the recipient of the benefit is the participant him/herself. In this view, the evaluation of quantitative (the amount of money, not accounted for in the present study) and qualitative (the direction of the benefit) dimensions of the reward seem to modulate the perceived importance of the task.

To sum up, the expectation to collaborate appears to generate responsibility sharing and, hence, social loafing. This finding supports the hypothesis of a detrimental effect of other persons on prospective memory, if the individual

outcomes are not clearly detectable within the outcomes of the group (Marcatto et al., 2007). It is well known that social loafing is based on a motivational mechanism, that makes individuals working in group less effective than individuals working alone. Thus, collaboration may act as a source of de-activation in a prospective memory task. Moreover, we demonstrated that simply engaging a couple of participants in *copresence* in a kind of technologically-mediated social interaction, can induce social loafing during a prospective memory task.

In spite of this, competition, as well as a small personal reward, had not a large effect on memory for intentions. A further remarkable finding is that, in accordance with previous results (Brandimonte et al., 2010), pro-sociality may improve retrieval of the intention and, as our results showed, may reduce collaborative inhibition effects on prospective memory. The pro-social upshots of the task emphasised the perceived importance of the intention. As a consequence, participants recruited more attentional resources to ensure to realise successfully the pro-social prospective memory task. In this view, collaboration and pro-sociality may be considered as two antagonist sources of activation, respectively inhibiting or enhancing the likelihood to perform an intended action. The key finding of this study is that social variables may play an important role in the individual's motivational system, which in turn may activate or diminish attentional strategies implied in retrieving an intention.

The dynamics between social, motivational and attentional mechanisms at the root of PM performance is certainly a complex one. Social motivations may interact by regulating the level of activation towards the execution of an intention. In turn, the level of activation, which will produce success or failure in remembering the future, may be more or less attention-based. While there is consensus on the idea that motivation works by shaping the cognitive processes recruited to carry out a prospective memory task, further research is needed to disentangle the relative contribution of social, motivational and attentional factors in memory for intentions. The present results represent a step towards this goal.

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