

Collaborative Remembering:

Are There Age-Related Differences in Working with a
Stranger or with a Spouse?

by


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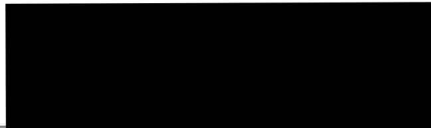

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ABSTRACT

The influence of age and collaborative experience on individual and dyad performed memory-related tasks, including immediate and delayed story recall, working memory, memory self-efficacy, and memory monitoring, was investigated. It was expected that typical age-related differences in these tasks would be moderated by collaborative experience. Participants included younger married couples ($M = 30.19$ years old), younger mixed-gender stranger dyads ($M = 29.78$ years old), older married couples ($M = 70.32$ years old), and older mixed-gender stranger dyads ($M = 70.37$ years old). Participants performed most of the tasks twice, once when working alone and once when working with a partner. It was found that older couples did perform slightly better, although not significantly, than older stranger dyads on memory tasks. In contrast, younger couples and younger stranger dyads performed similarly. In general, both younger and older adults seemed to overestimate the benefits of working with a spouse.

Examiners:



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COLLABORATIVE REMEMBERING:
ARE THERE AGE-RELATED DIFFERENCES IN WORKING WITH A
STRANGER OR WITH A SPOUSE?

Chapter 1

Introduction

People work together to remember information. Whether working with a stranger to remember the location of a forgotten restaurant or working with a spouse to remember a funny event, individuals work with others to remember. Collaborative remembering, or remembering in cooperation with two or more people, has recently become a topic of research interest in the field of cognitive aging (e.g., Gould, Kurzman, & Dixon, 1994; Gould, Trevithick, & Dixon, 1991).

There are two theoretical reasons why collaborative remembering research may prove useful to the field of cognitive aging. First, much everyday remembering occurs in collaborative situations (Dixon, in press; Greeno & Moore, 1993; Meudell, Hitch, & Boyle, 1995). Working with others to solve cognitive problems is a common occurrence for adults of all ages. Individuals may consult others for everything from the mundane (e.g., remembering birthdays) to the profound (e.g., reminding one's spouse to take medication). Research on collaborative remembering will further our understanding of the everyday cognitive functioning of adults and how that functioning may change

with age. With research we can learn more about the influence of environments, partners, and tasks on the effectiveness of collaborative remembering. We can also learn whether the effectiveness of each of these factors changes with age.

The second way collaborative remembering research may prove useful, is that age-related changes in cognitive performance may differ between individual and collaborative situations. For example, typical age-associated deficits found with individual episodic memory tasks (Craik & Jennings, 1992; Hultsch & Dixon, 1990), or tasks in which subjects are instructed to remember, may be attenuated when subjects work together. In other words, older individuals may overcome their individual age-related decline by remembering collaboratively. This is of theoretical importance, as older adults would be adapting to age-related decline by working with others.

The intent of this study is to examine the roles of age (younger vs. older adults), recall condition (individual vs. dyad recall), and collaborative experience (stranger dyads vs. married couples) in performance on several memory tasks, principally recall of stories. Regarding story recall there are three main research questions. First, will typical age-related differences in story recall (Hultsch & Dixon, 1984), be found when comparing the performance of younger and older individuals? Second, will typical age-associated deficits

in story recall also be found in collaborative recall? Specifically, will older dyads recall significantly less story information than younger dyads? Finally, is collaborative story recall performance influenced by interactive experience working with task partner? Is working with a partner with whom one has had extensive collaborative experience, such as a spouse, more beneficial to dyadic remembering than working with a partner with whom one has had no experience collaborating (e.g., a stranger)? The performance of younger and older married couples and younger and older stranger dyads, working alone and working together on story recall and other memory-related tasks, will be compared.

In the following literature review chapter, research pertinent to collaborative remembering and collaborative experience, as well as the major research questions, will be presented. Although this research primarily involves younger adults, recent research involving older adults (e.g., Dixon, in press) is highlighted. Scholarship related to the influence of collaborative experience on recall, such as Wegner's transactive memory system (1986), is discussed. Finally, all hypotheses are presented in detail. Although there are three principal questions, as stated above, several ancillary issues will also be addressed, including the hypothesized age-related and collaboration-related effects on delayed or second recall, memory self-efficacy,

working memory, memory monitoring, and beliefs about collaboration.

Chapter 2

Literature Review

Collaborative Remembering Research

As a predecessor of collaborative remembering research, Ringelman (as cited in Latané, Williams, & Harkins, 1979), nearly 70 years ago, examined the effects of collaboration on rope-pulling. Participants worked alone, with a partner, or with seven partners to pull a rope. Ringelman measured individuals' and groups' productivity with a strain gauge, which measures the amount of pressure exerted. He found that with increasing group size, individuals exerted less pressure. In fact, in the group of eight, the average amount of pressure exerted per individual was half what was exerted by individuals working alone (as cited in Latané et al., 1979).

This early study of collaborative rope-pulling is an effective tool for discussing Steiner's (1966) influential approach to evaluating the effects of collaboration on productivity. Steiner (1966) proposed that collaboration research should examine the potential productivity in groups, as compared with the actual productivity. To date, research had focused on the accomplishments of group work rather than on the potential of group work. Steiner (1966) developed many mathematical models of estimating group productivity, each of which depends on the task demands.

Steiner (1966) suggested that actual productivity is

the difference between potential productivity and loss due to faulty or suboptimal collaborative processes. Process loss could be linked to either problems of motivation or coordination (Steiner, 1966). Motivation-related process loss, as in the rope-pulling case, would occur when individuals working with others exert less effort than when they are working alone. Coordination-related process losses may occur when members of a group fail to pull at the same moment or at the same angle. For both reasons the collaborative performance of a group may be less than optimal.

Others have argued (e.g., Hill, 1982) that collaboration can also lead to process gain. Process gain occurs when performance is facilitated as a function of collaboration. Hill suggested 2 ways in which process gains could occur: (a) cognitive stimulation or emergent features from the group (e.g., ideas that would not been thought of or items that would not have been remembered by any one member of the group alone) and (b) members' capacity to model or learn from one another. In a review of collaborative research, Hill (1982) found evidence for capacity to learn leading to process gain, but little evidence for cognitive stimulation. Furthermore, across a variety of tasks, group performance was routinely quantitatively better than the average individual, but still poorer than the optimal or potential productivity (Hill,

1982).

Because of this difference between optimal productivity and actual performance, some argue that remembering alone is more effective than remembering with others. For example, Andersson and Rönnerberg (1995) compared the delayed or second word and story recall performance of individuals and dyads to their initial individual performance. They found that the recall performance of dyads was less than their potential productivity, as measured by a pooled score of each individual's "alone" performance, called a nominal group. Thus, two individuals working in pairs remembered fewer words and story information than would have resulted had they worked separately and simply summed their individual performances. It should be noted, though, that the average performance of dyads was better than that of individuals. Dyads recalled a higher number of words, as well as more story information, than did individuals.

As a measure of the cognitive stimulation or emergent processes, Andersson and Rönnerberg (1995) examined newly generated items. Specifically they summed the number of recalled items from the delayed recall which were not recalled in the immediate first recall condition. Items recalled only at a delay condition have been referred to as reminiscence (Payne, 1987). Therefore, if groups are able to reminisce more items than individuals, it would be some preliminary evidence that groups show emergent properties.

In fact, Andersson and Rönnerberg (1995) found that individuals had a higher number of reminisced items than groups. Other researchers have also found that groups reminisced fewer items than individuals (Meudell et al., 1995; Meudell, Hitch, & Kirby, 1992).

Andersson and Rönnerberg (1995) also summed the number of forgotten items from the first to the delayed recall. They found that groups forgot more items than individuals in delayed recall. To examine the effects of social interaction on recall, Andersson and Rönnerberg (1995) calculated the difference between the number of reminisced items (RI) to forgotten items (FI). Social interaction would affect recall in a positive way if groups, compared with individuals, reminisce many items while forgetting few. Andersson and Rönnerberg found that individuals had a significantly higher difference than groups, indicating that individuals, in comparison to groups, generated more reminisced items when taking into account the number of forgotten items. Andersson and Rönnerberg (1995) suggested that the deficits of group performance can be minimized when group members are friends (or even a couple) rather than strangers and when the task is complex rather than simple.

In contrast, other collaborative remembering research supports a more optimistic evaluation of group productivity. This research focuses on absolute performance rather than optimal productivity. Research involving younger adults has

shown that groups outperform individuals on recognition memory tasks (Hinsz, 1990), on the completeness and correctness of testimony (Clark, Stephenson, & Kniveton, 1990; Stephenson, Abrams, Wagner, & Wade, 1986; Stephenson, Brandstatter, & Wagner, 1983), and on the total amount of information recalled (Meudell et al., 1995; Meudell et al. 1992). Hinsz (1990) suggested that collaborative remembering is more successful than individual remembering for three reasons. Firstly, groups have a larger information pool than individuals. This is valuable because groups have more individual memories to draw from and, thus, a more complete representation of the presented material can be created. Secondly, groups are able to discuss inconsistencies found in remembering and are able to correct errors. Finally, when compared with individuals, groups have more effective decision-making strategies, some of which are unavailable to individuals. For example, groups may choose a "majority-wins" strategy, in which the majority of the group (in a group of at least 3 members) must agree on the correctness of the information. Alternatively, groups may choose a "truth-wins" strategy, in which a response must be identified as correct. Hinsz (1990) showed that the most adequate decision schemes used in group recognition performance are "majority-wins" strategies rather than "truth-wins" strategies.

What are the effects of collaboration with older

adults? Do older adults benefit, like younger adults, from collaborations? Dixon (in press) found benefits to group recall when using a story recall task with younger and older adults. When comparing the performance of individuals, stranger dyads, and stranger tetrads, Dixon found that both younger and older groups benefit from additional members. Thus, dyads recalled more total story information than individuals, and tetrads recalled more story information than dyads. He also found age-associated differences in recall performance for all group levels. Older individuals recalled less story information than younger individuals, older stranger dyads recalled less than younger stranger dyads, and older stranger tetrads recalled less than younger stranger tetrads (Dixon, in press).

Collaborative Experience Research

Engeström (1992) argued that experience at interactive cognitive problem solving may be a crucial factor in determining the productivity of group performance. Experienced collaborative groups may coordinate their efforts more effectively, resulting in better productivity, than unacquainted groups. For similar reasons, Wegner and his colleagues argued that intimate couples may be particularly efficient at collaborative remembering (Wegner, 1986; Wegner, Erber, & Raymond, 1991; Wegner, Giuliano, & Hertel, 1985). Through their experience at collaborating on a variety of everyday cognitive problems, couples develop a

shared or a transactive memory system (Wegner, 1986). Wegner et al. (1985) suggested that intimate couples create a transactive memory system by learning and differentiating areas of expertise, so that the responsibility of remembering is delegated to the most expert member of the couple. Individuals in a couple will retain information central to their expertise and pass on information to their spouse central to their spouse's expertise. This enables intimate couples to share information storage and to ensure that a broad spectrum of information is retained. While a transactive memory system is more complex than an individual system, more information is remembered (Wegner, 1986; Wegner et al., 1985).

In support, Wegner et al. (1991) compared the performance of dating couples and unacquainted dyads. One-half of the couples and unacquainted dyads were given a remembering structure (e.g., they assigned one member to remember all items from a certain category) and one-half were not given a structure. They found that younger couples remembered more than younger stranger dyads when the remembering structure was lacking. When the remembering structure was imposed the unacquainted dyads performed better than the couples. Wegner et al. (1991) argued that couples performed poorly with an imposed remembering structure because their transactive memory system was disrupted. Members of a couple were assigned to some

categories in which they were not, and their partner was, an expert.

Ross and Holmberg (1990) examined several factors related to (younger) married couples' collaborative recall of their first date, their last vacation, and a recent argument. One factor that was assessed was the vividness of memories. Participants rated the vividness of their own memories and, using transcripts of actual recall conversations, experimenters independently rated the vividness of the participants' memories. Ross and Holmberg (1990) found that women rated their memories of these events as more vivid than did men. The experimenters' ratings supported this gender difference. The participants were also asked to report memory failures. Whereas in the collaborative recall men reported more memory failures than women, when recalling alone men and women reported equivalent rates of memory failures. Finally, both spouses were asked to rate which of the two of them had the "superior" memory. It was found that women were rated by both spouses as having superior memory for such autobiographical events. Notably, whether the women actually remembered more than the men was not assessed in this study. Ross and Holmberg's (1990) explanation for these findings are in partial support of Wegner (1986). As women often assume the role of "relationship expert" in many couples, they are believed to be able to recall more of

about highly interpersonal events, such as a first date (Ross & Holmberg, 1990). Similarly, according to Wegner (1986) and Ross and Holmberg (1990), men may perform better than women on recall tasks for which they have an expertise advantage (e.g., sports).

How might Wegner's (1986) model apply to older couples? Older couples, like younger couples, seem to benefit from their transactive memory systems. Dixon (in press) found age-associated differences in collaborative story recall when same-gender stranger dyads worked together, but older couples remembered as much story information as younger couples. Although the stranger dyads and the couples were not directly compared in this experiment (and the strangers were same gender), it suggests that older couples would recall more story information than older stranger dyads.

In another study, the conversational processes through which younger and older stranger dyads and couples actually collaborated in a story memory task were compared (Gould et al., 1994). Gould et al. (1994) divided the statements made by these dyads and couples into story-related, including individual and collaborative story-based recall, and conversation-related, including task and sociability or support discussions. Younger and older couples and younger and older stranger dyads began with a high proportion of the conversation relating to individual story-based recall. Supporting the notion that efficiency may be associated with

collaborative experience, older couples were especially likely to engage in strategic actions late in the recall conversations. Younger couples engaged in late strategic actions discussions to a lesser extent, and younger and older stranger dyads not at all. Indeed, older stranger dyads engaged in arguably less efficient discussions concerning mutual support and friendliness. Therefore, this research demonstrates a possible mechanism, specifically late task-related discussions, in which older couples could improve recall over that of older stranger dyads.

This study, as well as Dixon's (in press), has important implications for this thesis. Both of these studies support the notion that collaborative remembering may vary with age and collaborative experience, mainly to the benefit of older couples. Both younger and older dyads engaged in little late task-related discussions (Gould et al., 1994) and age differences in recall performances between stranger dyads were still observed (Dixon, in press). Older couples engaged in more late task-related discussions than younger couples (Gould et al., 1994) and yet, these age groups recalled a similar amount of story information (Dixon, in press). It seems that collaborative experience may mediate the influence of age on story recall. Whether this generalizes to other memory-related tasks and is replicable is determined here.

Research Plan and Issues

Overview of Design

The performance of younger and older married couples and younger and older mixed-gender stranger dyads, working alone and working together on story recall and other memory-related tasks, will be compared. The major feature of this design is that one-half of the individuals were tested first with the dyads tested second and one-half of the individuals were tested second with the dyads tested first. Therefore, for most of the memory-related tasks participants were tested twice, once individually and once dyadically. One unique feature of the design is that the story presented and recalled in the first phase of the experiment is recalled again in the second phase, after a brief delay. The delayed recall performance of dyads (after being tested initially as individuals) and individuals (after being tested as dyads) can be compared across age and collaborative experience. In this section, the major research issues and hypotheses are presented. Details on measurement, design, and scoring are presented in the next chapter.

Tasks and Hypotheses

Story recall. One of the principal tasks is to remember information from personal narratives. Age-related deficits are typically found with discourse recall tasks (e.g., Cohen, 1988; Hultsch & Dixon, 1984; Zelinski & Gilewski, 1988). These findings should be replicated, such that younger individuals should recall more story

information than older individuals. Dixon (in press) also found age-associated differences in collaborative story recall when comparing younger and older same-gender stranger dyads. Hence, older stranger dyads should recall less story information than younger stranger dyads.

What about the collaborative recall performance of married couples? Dixon (in press) found older couples remembered as much story information as younger couples. Perhaps older couples recall well because they have interactive expertise. In other words, they are experts at interacting with one another and are able to maintain high collaborative performance through this expertise. Hypothetically, another possible reason that older couples may remember story information as well as younger couples is that the individuals making up older couples have preserved high individual-level memory ability (Dixon, in press). Perhaps long-term marriage somehow leads to maintained memory abilities in older individuals. This (unlikely) possibility will be examined by comparing the performance of individual story recall of older adults who work with strangers (in the collaborative portion of the experiment) and older adults who work with spouses. It is unlikely that there will be any differences between older individuals' recall performance related to collaborative condition. Therefore, age-related differences should be seen between younger and older individuals from the spouse and the

stranger (in the collaboration portion of the experiment) conditions. In other words, individual story recall performance should not vary as a function of collaborative condition for younger or older adults.

Delayed story recall. This task involves a "delayed" or "second" recall of story information (the former label will be used here). The purpose of this task is to examine the influence of age, collaborative remembering, and collaborative experience on delayed recall. Typically with delayed recall of text there is some decay or loss of information (e.g., Dixon, Simon, Nowak, & Hulstsch, 1982). Will collaboration produce a different decay pattern than individual remembering? Will the decay be moderated by the collaborative experience working with task partner? Will there be age differences in the decay pattern? These questions will be addressed. Moreover, whether group differences are a product of differences in reminiscence, forgetting, or a combination of the two can be examined by comparing the items recalled from the initial and items recalled from the delayed recall.

It is expected that older couples will disproportionately benefit from collaboration in the delayed recall task. Younger individuals should have less decay of story information than older individuals in delayed recall. Based on Dixon et al. (1982), older individuals, having just remembered with a partner, will lose more of the story

information than younger individuals. Similar age-related differences in decay of delayed story recall are expected for stranger dyads. Older couples, however, should have less decay with delay than older stranger dyads. When going from working alone to working with a partner, older couples should benefit from their interactive experience and lose less story information than do older stranger dyads.

Reminiscence and forgetting. Reminiscence in story recall refers to the number of items recalled in the delayed condition that were not recalled in the initial recall condition. Forgotten items are those items that were remembered in the initial recall but not produced in the delayed recall. There are several ways of measuring the extent of reminiscence and forgetting. Andersson and Rönnerberg (1995) used a difference score, in which the number of forgotten items is subtracted from the number of reminisced items. In this study, this difference score is used, as is a ratio of reminisced items to forgotten items. The rationale for the ratio indicator is that it affords a more direct evaluation of comparisons between reminiscence and forgetting, in which baseline rates of recall are not a factor. The number of reminisced items per forgotten item is to be examined. For story recall, the item is a proposition.

Andersson and Rönnerberg (1995) found that individuals (as compared to groups) had a higher difference between

reminisced items and forgotten items. These deficits of groups were minimized, though, when the group members were friends rather than strangers. That is, collaborating friends had a higher positive difference score than collaborating strangers (Andersson & Rönnerberg, 1995). This indicates that experience working with a task partner may facilitate reminiscence and minimize forgetting. In line with this evidence, it is hypothesized that couples should reminisce more story recall items to forgotten items than stranger dyads. Also, age-related differences in the ratio of reminisced items to forgotten items for stranger dyads, but not couples, are expected. Finally, like Andersson and Rönnerberg's (1995) findings, individuals should generate more new items when taking into account forgotten items than stranger dyads and couples.

Spousal knowledge and agreement of expertise. Dixon (in press) used a spousal knowledge and spousal expertise questionnaire to assess younger and older individuals' knowledge of, and agreement of expertise with, spouse. When comparing the cognitive performances of younger and older couples, age is confounded with collaborative experience; although it is possible to test older couples married for a short time (e.g., five years), it is impossible to test younger couples married a long time (e.g., 40 years). Thus, Dixon (in press) used these two dimensions, spousal knowledge and spousal expertise, to equate younger and older

couples. Specifically, each individual answered a series of questions concerning knowledge of their spouse (e.g., "What is the birthdate of your spouse?", "What high school did your spouse graduate from?") and which spouse actually performs or is best at performing a series of typical tasks (e.g., balancing the cheque book). It should be noted that the spousal expertise dimension is intended to tap the level of expertise spouses show in regards to their relationship (e.g., they are experts in knowing who does what) and not the level of expertise in collaboration as proposed by Wegner (1986).

Dixon (in press) showed that the younger and older couples were similar in performance on both dimensions. A spousal expertise questionnaire, similar to the one used by Dixon (in press), will be used to equate younger and older couples. Differences between younger and older couples on spousal knowledge and spousal agreement of expertise should not be found. Spouses should agree on knowledge and expertise to a high extent and there should be no age-related differences in relation to these agreements.

Memory self-efficacy. Memory self-efficacy are the beliefs of one's own ability to undertake actions required for successful memory performance (Berry, West, & Dennehey, 1989). Memory self-efficacy is thought to be one aspect of metamemory, which is the knowledge, beliefs, and self evaluations, individuals have regarding their memory

processes (Hertzog & Dixon, 1994; Hertzog, Dixon, & Hultsch, 1990). Memory self-efficacy typically accounts for most age-differences found with metamemory questionnaires (Hertzog & Dixon, 1994; Hertzog et al., 1990). Older adults, when compared with younger adults, often report lower efficacy in relation to their memory.

Although age-related differences in memory self-efficacy are important in their own right (Hertzog & Dixon, 1994), they account for very little of the age-related deficits found with memory tasks. The correlations between memory self-efficacy and performance usually vary up to 0.3 (Hertzog & Dixon, 1994). Hertzog et al. (1990) argued that this small relationship between memory self-efficacy and performance may be a function of the fact that metamemory questionnaires are tapping global memory self-efficacy. Memory self-efficacy may vary depending on the task at hand (e.g., recalling names, performing math calculations), as well as the context at hand (e.g., recalling names at conferences, performing math calculations in the supermarket). Hertzog et al. (1990) argued that perhaps a task- and context-specific memory self-efficacy questionnaire would better explain performance differences. Both global, using the General Rating Scale of the Memory Functioning Questionnaire (Gilewski & Zelinski, 1988), and task-specific memory self-efficacy judgments, using the Memory Self-Efficacy Questionnaire (Berry et al., 1989),

were made.

Individuals and dyads (including couples) made global and task-specific memory self-efficacy judgments. Hence, by emphasizing "when working together," memory self-efficacy judgments can be made in regards to working with a partner. It is expected that older couples should have high global and specific self-efficacy in their collaborative efforts with their spouse. Aware of the benefits of working with one another, older couples may feel more self-efficacious when working with their spouse rather than when working with a stranger or working alone. Like previous research (e.g., Hultsch, Hertzog, & Dixon, 1987), younger individuals should report higher memory self-efficacy and memory functioning than older individuals. Similar age-related differences are expected with stranger dyads, whereas older couples and younger couples will report similar levels of memory self-efficacy and memory functioning.

Based on Hertzog et al.'s (1990) arguments, it is expected that task-specific memory self-efficacy ratings should correlate more highly to memory performance than global memory self-efficacy ratings. Therefore, the memory self-efficacy judgments of one's ability to recall story information (the story scale of MSEQ) should be highly related to story recall performance. Similarly, judgments of one's ability to successfully complete working memory tasks (the hardware scale of the MSEQ) should be highly

related to working memory performance. General Ratings of memory functioning (MFQ), though, should only be mildly (if at all) correlated to story recall and working memory performance.

Working memory. Working memory is commonly seen as a limited-capacity storage system, in which information is stored and processed for complex cognitive tasks (Daneman, 1987). Working memory tasks typically involve remembering recently presented information, while processing additional information (Hultsch & Dixon, 1990). Age-related differences in individual working memory performance are typical (e.g., Craik, 1986; Kemper, 1986). Younger individuals tend to perform significantly better than older individuals on working memory tasks. Two working memory tasks, alpha span (Craik, 1986) and sentence repetition (Kemper, 1986), were used in this experiment. Age-associated deficits in working memory performance should be replicated here for both working memory tasks. Moreover, age-associated deficits are expected for stranger dyads. Younger stranger dyads should perform significantly better than older stranger dyads on working memory tasks. In contrast, younger couples and older couples should perform similarly on working memory tasks.

Given the ubiquitous decline in many cognitive tasks with age, researchers have suggested that one or a few general factors existing in limited supply (called

processing resources) may be responsible (Salthouse, 1990). Therefore, age-related deficits in processing resources are theorized as responsible for the age-related declines seen in many cognitive tasks. Working memory has been proposed as a potential processing resource (Salthouse, 1990). In fact, some theorists suggest that age-related decline in individual discourse recall may be a product of working memory deficits (e.g., Tun, Wingfield, & Stine, 1991). Some evidence supports this contention (Norman, Kemper, & Kynette, 1992; Stine & Wingfield, 1987; Tun et al., 1991).

Collaborative working memory performance may, like individual performance, be related to collaborative discourse memory performance. These relationships will be examined here. It is expected that individual working memory performance will be positively related to individual story recall results. Similarly, collaborative working memory performance will be positively related to collaborative working memory performance.

Memory monitoring. Collaborative memory monitoring is also explored: Can younger and older individuals, stranger dyads, and couples effectively monitor their recall performance? Researchers often use predictions and postdictions of performance to examine age-related differences in memory monitoring ability (e.g., Dixon, in press; Hertzog, Saylor, Fleece, & Dixon, 1994). In this procedure, younger and older individuals (or dyads) first

estimate how much of the story they believe they can recall (prediction), perform the recall task, and then, finally, estimate how much information they believe they actually recalled (postdiction). As an index of prediction and postdiction accuracy, prediction and postdiction estimates are subtracted from actual performance.

Devolder, Brigham, and Pressley (1990) found that older individuals predicted less accurately than younger individuals, but found no age-related differences in postdiction accuracy. Devolder et al. (1990) found that older individuals were less accurate than younger individuals because they tended to over-predict their performance. In contrast, Hertzog et al. (1994) found that younger and older adults were equally accurate at predicting and postdicting performance. Further, it has been shown that younger and older individuals (Hertzog et al., 1994) and younger and older couples (Dixon, in press) were effective at updating their estimates based on actual performance. Therefore, individuals and couples are able to monitor their performance and improve their accuracy from predictions to postdictions.

Using predictions and postdictions of story recall performance, it is expected that older individuals and younger individuals will be similarly accurate in both estimates of performance. This hypothesis is based on Hertzog et al.'s (1994) findings. Moreover, younger and

older couples will be more effective at monitoring their performance than younger and older stranger dyads. Couples have had a greater amount of experience working together to remember and, thus, their predictions and postdictions should be more accurate than stranger dyads. Therefore, younger and older individuals' predictions and postdictions should be highly related to performance. Younger and older couples' estimates of performance should also be highly related to performance, while younger and older stranger dyads' estimates should be moderately related to performance.

Beliefs about collaboration. A collaborative effectiveness instrument measures an individual's subjective views as to the effectiveness of working with a spouse, a stranger of the opposite gender, a stranger of the same gender, a friend of the opposite gender, a friend of the same gender, and alone. Participants will be asked to rank order these six conditions of remembering according to effectiveness. Older individuals, aware of their declining remembering abilities (Dixon & Hultsch, 1983), may give working with others (all types) higher effectiveness ranking than working alone, whereas younger individuals may give working alone a higher effectiveness ranking than working with strangers.

Chapter 3

Method

Design

The basic design was a 2 (age: younger vs. older) x 2 (recall condition: individual vs. dyad) x 2 (collaborative condition: spouse vs. stranger). The design enabled several important comparisons. Specifically, individuals were compared to dyads. Moreover, individuals and dyads from the stranger and spouse conditions were compared. Although collaborative condition lacks meaning in the individual recall condition (as they are working without a partner), it was crucial to examine whether individuals from the stranger and the spouse conditions were similar. If the individuals from the stranger and spouse conditions differed, any dyad-level collaborative condition differences could be attributed to individual-level ability rather than interactive experience. Finally, the performance of younger and older individuals and dyads were compared, as was the influence of collaborative condition on any age-related differences.

Several order and list control factors were also tested, including order (individual first vs. dyad first), story ("A Trip Abroad" vs. "Playing Cards"), working memory task order (alpha span first vs. sentence repetition first), and working memory list (A vs. B). Whereas story and working memory list were within subjects factors, memory

task order was a between subjects factor.

Participants

Sixty-four younger and 66 older adults participated in this experiment. The subjects were recruited from a subject pool, newspaper advertisements, campus events, and posters distributed around the University of Victoria. Each adult participated in this experiment with a partner, either their spouse or a randomly assigned opposite-gender stranger. There were 32 pairs of younger subjects, including 16 younger married couples and 16 mixed-gender unacquainted dyads, who were matched to the younger married couples according to age. The average age of the younger married couples and the younger unacquainted dyads was 30.19 ($SD = 3.92$) and 29.78 ($SD = 4.07$) years, respectively. The 66 older individuals included 17 older married couples and 16 mixed-gender unacquainted dyads, who were matched to the older married couples according to age. The older married couples and the older mixed-gender unacquainted dyads had a mean age of 70.32 ($SD = 6.59$) and 70.37 ($SD = 6.37$) years, respectively.

The younger couples included only couples married at least 6 months ($M = 4.53$ years, $SD = 3.07$), whereas the older couples were married at least 15 years ($M = 45.79$ years, $SD = 6.99$). As would be expected, some of the individuals in the unacquainted dyads condition were married to individuals who did not participate in the study. Five

of the individuals in the younger unacquainted dyads were married ($M = 5.50$ years, $SD = 7.18$), whereas 23 of the individuals in the older unacquainted dyads were married ($M = 37.23$ years, $SD = 14.40$).

Participants individually completed a vocabulary survey. The survey involved 54 items taken from the Kit of Factor Reference Cognitive Tests (Ekstrom, French, Harman, & Dermen, 1986). A 2×2 analysis of variance (ANOVA) revealed significant main effects for age, $F(1, 125) = 108.26$, $p < .001$, and for collaborative condition, $F(1, 125) = 10.87$, $p < .001$, but no significant interaction. As is typical, the older adults ($M = 44.03$, $SD = 5.44$) performed significantly better than the younger adults ($M = 33.73$, $SD = 6.34$) on the vocabulary survey. The individuals from the unacquainted dyads ($M = 40.52$, $SD = 6.93$) performed better than the individuals from the married couples ($M = 37.51$, $SD = 8.40$).

A second 2×2 ANOVA was performed with the number of years of education as the dependent variable. Only a main effect of age, $F(1, 125) = 7.63$, $p < .007$, was significant. The younger adults ($M = 15.85$, $SD = 2.25$) had more education than the older adults ($M = 14.55$, $SD = 2.99$).

All of the subjects received a small honorarium for their participation.

Materials

Several questionnaires and memory tasks were used and

each is described in turn.

Personal Information Questionnaire (PIQ). Individuals completed the PIQ. Demographic information, including age, education, first language, and years married was obtained using the PIQ. The married couples also completed an attached spousal knowledge and agreement questionnaire (see Appendix A), which included 30 factual information questions about themselves and their spouses (spousal knowledge), as well as 12 questions regarding domains in which they believe they or their spouse are skilled (spousal expertise). Proportion correct on the spousal knowledge dimension, and proportion agreement on the spousal expertise dimension, were calculated. Scoring of this segment involved assigning a 1 when spouses agreed and a 0 when spouses disagreed. For example, if a wife agreed with her husband that he was born on November 4, 1928, then that response item was given a 1.

Memory Self-Efficacy Questionnaire (MSEQ). A "story" subscale and a "hardware" subscale, based on the MSEQ (Berry et al., 1989), were used to assess individual and dyadic memory self-efficacy of story recall and working memory, respectively (see Appendix B). Participants were instructed to indicate whether they think they could (by circling "yes") or could not (by circling "no") perform a specified memory task. If subjects indicated that they thought they could perform the specified memory task, they were instructed to then give a confidence rating between 0% and

100%. Both the story and hardware subscales included five levels of difficulty, beginning with least difficult and ending with most difficult. Memory self-efficacy is traditionally administered to individuals, but by adding "when working with your partner" to each memory task statement the "story" and "hardware" subscales could be administered to dyads. According to Berry et al. (1989), scoring involves both summing all "yes" responses greater than 20% and plotting change in confidence according to the five levels of difficulty. Moreover, each confidence rating, as well as averaged confidence levels, were entered into analyses to ascertain age and collaborative condition differences in confidence at each level and overall.

Memory Functioning Questionnaire (MFQ). The General Rating Scale of the MFQ (Gilewski & Zelinski, 1988) was administered twice to each participant, once when working alone and once when working with a partner. The General Rating Scale indicates subjects' views of their memory functioning in general.

The dyadic administration of the MFQ differed from the individual administration in that the former condition emphasized memory functioning "when working with a stranger" or "when working with a spouse" (in the stranger or the couples condition, respectively). The MFQ involves a one to seven Likert-like response scale, with seven indicating high memory functioning.

Sentence Repetition. Two equivalent lists of 32 sentences, based on Kemper (1986), constituted this working memory task. Each list was composed of 16 grammatically correct and 16 grammatically incorrect sentences. Eight of the grammatically correct and eight of the grammatically incorrect sentences were compound sentences, whereas the remaining were simple or complex sentences. Grammatically incorrect simple or complex sentences contained one grammatical error, while grammatically incorrect compound sentences contained two grammatical errors, one in each independent clause.

There were four possible types of clauses in each of the sentences, including: gerund, that, what, and relative clauses. These four types of clauses occurred initially in the sentence (left branched) or occurred finally in the sentence (right branched) (Kemper, 1986). The type of clauses and their placement in the sentence were counter-balanced in each of the lists of 32 sentences. It should be noted that compound sentences had the same type and placement of type in each independent clause, such that one compound sentence could contain two initially placed gerund clauses or one compound sentence could contain two finally placed gerund clauses. Moreover, the embedded clauses were long (six to nine words), according to Kemper (1986).

Participants were presented the sentences by an auditory recording of a professional radio announcer. The

sentences were read at slightly slower than normal speaking rate. Subjects were asked to repeat each sentence word for word, unless the sentence contained one or two grammatical errors. If a sentence contained one or two grammatical errors, subjects were asked to correct the errors, but to repeat the rest of the sentence word for word. As much time as needed to respond was given.

As discussed in Kemper (1986), scoring of sentence repetition involved assigning a numerical value between one and five to each sentence reproduced by the participant. A score of five represents the best possible performance, namely, verbatim recall with grammatical errors corrected. A score of four represents semantic (but not syntactic) equivalence to the original with grammatical errors corrected. A score of three represents some semantic meaning of the original sentence is maintained and some is missing and all grammatical errors are corrected. A score of two represents departure from syntactic and semantic content of the original sentence, or that the response is grammatically incorrect. Finally, a score of one represents inability to recall any of the sentence. The interrater reliability for sentence repetition is presented in the following scoring section.

Alpha Span. This working memory task was based on Craik (1986). Participants were asked to recall an orally presented (by experimenter) word series in alphabetical

order. All word series were presented in non-alphabetical order. The words were presented at a slow rate, with approximately 2 seconds between each word. The words were chosen from a children's dictionary (Morris, 1988) and each word in a series began with a different letter.

The trial began with a two-word series. Each subsequent series involved one additional word, up to a 10-word series. If subjects correctly recalled a series they immediately proceeded to the subsequent level of series. When subjects incorrectly recalled a series they were presented a second series of the same level. If subjects correctly recalled the second series, they progressed to the next series level, but if subjects incorrectly recalled the second series, testing stopped. The alpha span score is the total number of words in a single series in which the highest number of correctly recalled words was achieved.

Story Recall. Two near-equivalent stories created by Dixon, Hulstsch, and Hertzog (1989), regarding elderly couples, were presented to participants at a normal speaking rate by an auditory recording of a professional radio announcer. Whereas the first story, "A Trip Abroad," contains 165 words and 92 propositions, the second story, "Playing Cards," contains 162 words and 90 propositions (Dixon et al., 1989). Subjects were asked to listen carefully to the story so they could remember it later. Scoring of free recall of the text was based on the number

of propositions correctly recalled using a lenient or gist criterion (Dixon et al., 1989). Information on scoring reliability is presented later.

Parts of the recall protocols could not be classified as gist recall. These parts were scored in terms of a select set of other recall characteristics, including elaborations, macrostatements, metastatements, repetitions, intrusive errors, and constructive errors.

Elaborations are statements consistent with the story, but not actually contained in it. Therefore, if a participant stated that the O'Sheas travelled by airplane to Ireland in "A Trip Abroad," parts of this response (e.g., by airplane) would be scored as a elaboration because no mention was made in the original story of how the O'Sheas reached Ireland. Macrostatements are summary statements of two or more propositions in the story. If a participant stated that Barbara served food in "Playing Cards," this was scored as a macrostatement because several different food types were listed. Metastatements are comments about one's own memory processes, such as "my memory is not what it used to be." Repetitions are simply statements that repeat an already scored proposition. Constructive errors are errors that are consistent with the story, but are recalled incorrectly. Therefore, if a participant recalled that Dick has three brothers, when in fact he has four ("A Trip Abroad"), the proposition specifying the number of brothers

would be considered a constructive error. Intrusive errors are errors that are inconsistent with the story. For example, a participant recalling that couples were playing against each other in "Playing Cards," would be scored as an intrusive error as they were playing men against the women.

Delayed Story Recall. Subjects were asked to recall the story they had been presented and had recalled in the first part of the experiment (without hearing it again). Therefore, those subjects presented the story first individually recalled the story again dyadically, whereas those subjects presented the story first dyadically recalled the story again individually. Approximately 45 to 60 minutes elapsed between initial and delayed recall (all participants).

Like the story recall, the delayed recall was scored according to a propositional analysis of the gist recall. Any components of the recall not scored as a proposition was scored as an elaboration, macrostatement, metastatement, repetition, constructive error or intrusive error.

In addition, following Andersson and Rönnerberg (1995), the number of reminisced items (RI) and the number of forgotten items (FI), when comparing the first recall with delayed recall, were calculated. Thus, the story items (propositions) recalled in the first phase of the experiment were compared with those recalled in the second. Each item that was not recalled in the first phase, but was recalled

in the second phase was given a score of 1 and was summed (RI). Similarly, each "forgotten" item was given a score of 1 and was summed. A difference of reminisced items to forgotten items, which involved subtracting forgotten items from reminisced items, was calculated (Andersson & Rönnerberg, 1995). Also, as a more direct measure of the relationship between the number of reminisced items and the number of forgotten items, a reminisced items and forgotten items ratio was calculated (RI/FI).

Memory Monitoring. After listening to each story, but before recalling it subjects estimated, on a scale of 0% to 100%, how much information in the story they believed they could remember (prediction). After recalling a story, subjects estimated, again on a scale of 0% to 100%, the proportion of the information in the story they believed they had actually recalled (postdiction). The actual instructions for predictions were: "I would like you to give me an estimate of how much of the information in the story you believe you can recall. Every story contains numerous ideas a bits of information and I would like you to tell me what proportion of the ideas and bits of information you think that you can recall." The instructions for postdictions were a shorten version of the prediction instructions. Participants were then given a scale from 0 to 100, with increments of 10, and told that this could be used to help them estimate.

Several variables were developed from these tasks. Actual values of predictions and postdictions were evaluated. In addition, three ways of evaluating the accuracy of the predictions and postdictions were used. First, the difference between the proportion of actual performance and prediction (or postdiction) estimates were calculated. If the result of the subtraction is negative, participants have overestimated their upcoming (or just past) performance, whereas if the result of the subtraction is positive participants have underestimated their performance. Second, Devolder et al. (1990) argued that the absolute difference between performance and estimates of performance should be used because with simple difference scores (above), direction differences within an age group can cancel one another out (making the inaccuracy appear less). Therefore, absolute differences were evaluated. Finally, accuracy was also evaluated with correlations computed between prediction or postdiction (in proportion) and proportion of actual performance.

Collaboration Effectiveness Questionnaire (CEQ).

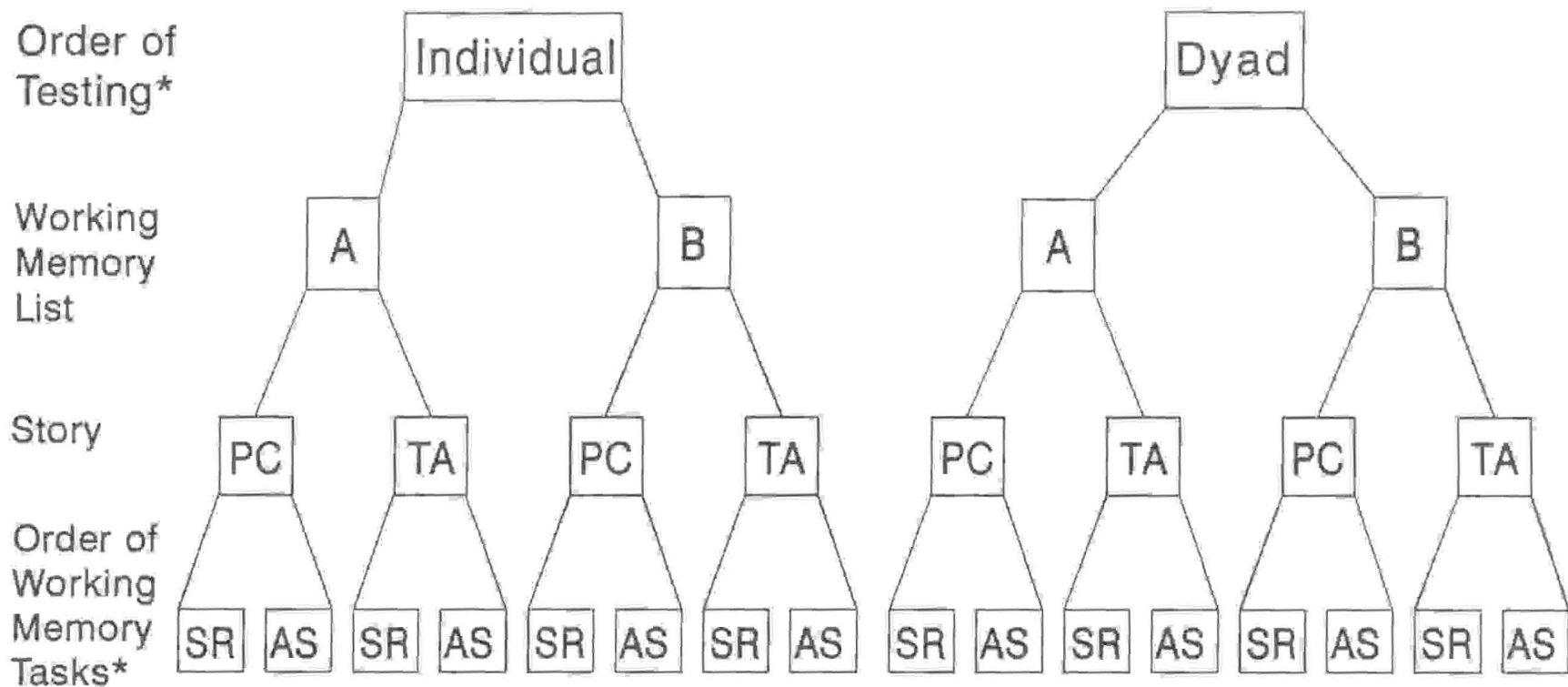
Participants rank-ordered working with a spouse, working with a stranger of the opposite gender, working with a stranger of the same gender, working with a friend of the opposite gender, working with a friend of the same gender, and working alone according to effectiveness in terms of remembering. The most effective method of remembering was

assigned a one, the second most effective method of remembering was assigned a two, and so on such that the least effective method of remembering was assigned a six. Scoring constituted calculating the mean rank ordering for each item according to age.

Procedure

Sixteen testing protocols were used. As seen in Figure 1, the protocols were first counterbalanced according to whether the individual or the dyad testing occurred first. Whereas half of the subjects were tested alone first and tested with their partner second, the other half of the subjects were tested with their partner first and tested alone second.

The protocols also differed according to whether list A or list B of the alpha span and sentence repetition tasks were given to individuals and to dyads. The working memory list not given in the first part of the experiment was given in the second part. For example, for a given dyad, if in the individual testing condition each participant was given list A, in the dyad testing condition the dyad would be given list B. Also shown in Figure 1, the stories were counterbalanced, such that one-fourth of the subjects was presented "Playing Cards" alone, one-fourth was presented "A Trip Abroad" alone, one-fourth was presented "Playing Cards" when working with a partner, and one-fourth was presented "A Trip Abroad" when working with a partner. The story not



PC = Playing Cards, TA = A Trip Abroad, SR = Sentence Repetition, AS = Alpha Span

* The first condition (individual or dyad) or the first working memory task is presented here.

Figure 1. The sixteen testing protocols used.

presented in the first part of the experiment was presented in the second part of the experiment. The final protocol condition was the order of the working memory tasks. Half of the subjects got sentence repetition first and half got alpha span first. The order of working memory tasks was maintained from individual to dyadic testing.

The Personal Information Questionnaire, Vocabulary Survey, and Collaboration Effectiveness Questionnaire were administered to subjects when working alone. The order of all tasks is presented in Table 1. The Personal Information Questionnaire was the first task for individuals, with the Vocabulary Survey second. The Collaboration Effectiveness Questionnaire was the concluding task of the experiment (whether tested as individuals or dyads first). The Memory Self-Efficacy Questionnaire, Memory Functioning Questionnaire, Alpha Span, Sentence Repetition, and Story Recall tasks were administered twice to each subject, once in the individual condition and once in the dyadic condition. The Memory Self-Efficacy Questionnaire was always followed by the Memory Functioning Questionnaire. The working memory tasks (the order of the working memory tasks being counter-balanced) followed both of the memory self-efficacy questionnaires, but preceded the Story Recall task. Delayed Recall always occurred in the second phase of testing (whether individual or dyad) after the working memory tasks, but before the Story Recall task.

Table 1

Order of Tasks

| Individuals First | Dyads First |
|--------------------------|--------------------------|
| <u>Individual</u> | <u>Dyad</u> |
| 1. PIQ | 1. MSEQ |
| 2. Vocabulary Survey | 2. MFQ |
| 3. MSEQ | 3. Working Memory Tasks |
| 4. MFQ | 4. Story Recall |
| 5. Working Memory Tasks | <u>Individual</u> |
| 6. Story Recall | 5. PIQ |
| <u>Dyad</u> | 6. Vocabulary Survey |
| 7. MSEQ | 7. MSEQ |
| 8. MFQ | 8. MFQ |
| 9. Working Memory Tasks | 9. Working Memory Tasks |
| 10. Delayed Story Recall | 10. Delayed Story Recall |
| 11. Story Recall | 11. Story Recall |
| <u>Individual</u> | 12. CEQ |
| 12. CEQ | |

Note. PIQ = Personal Information Questionnaire, MSEQ = Memory Self-Efficacy Questionnaire, MFQ = Memory Functioning Questionnaire, and CEQ = Collaborative Effectiveness Questionnaire.

The dyad phase of the experiment was recorded on video tape, while Alpha Span, Sentence Repetition, Story Recall, and Collaborative Effectiveness tasks were recorded on audio tape in the individual phase of the experiment. The session took approximately two hours, with a short break between individual and dyadic testing.

Scoring

Two of the materials used, specifically sentence repetition and story recall, require elaboration (as follows) on the scoring procedures.

Sentence Repetition. The interrater reliability of three scorers was calculated on approximately 15% of the total number of sentence repetition tasks, including both individual and collaborative performances. Interrater reliability ranged from $r = .89$ to $r = .92$ (both $p < .001$) for total sentence repetition performance. Moreover, the average interrater agreement was between $r = .83$ and $r = .84$ ($p < .001$) for the sentence by sentence scoring.

Story Recall. In accordance with Dixon et al. (1989), the components of the story recall were scored as propositional or gist recall, elaborations, macrostatements, metastatements, repetitions, constructive errors, and intrusive errors. Two raters scored all of the story recall. The interrater reliability was based on approximately 14% of the total story recall tasks (both individuals and dyads). The interrater propositional

analyses reliability based on the total number of propositions scored was $\underline{r} = .97$ ($\underline{p} < .001$). The interrater reliability for elaborations, macrostatements, metastatements, repetitions, and errors, based on the total number, was $\underline{r} = .61$ ($\underline{p} < .001$), $\underline{r} = .36$ ($\underline{p} < .07$), $\underline{r} = .96$ ($\underline{p} < .001$), $\underline{r} = .76$ ($\underline{p} < .001$), and $\underline{r} = .64$ ($\underline{p} < .004$) respectively. It should be noted that the interrater correlations for macrostatements and errors is rather low due to the few number of each of these. Moreover, the average interrater agreement was $\underline{r} = .80$ ($\underline{p} < .001$) on the proposition by proposition scoring.

Chapter 4

Results

Spousal Knowledge and Agreement of Expertise

The percentage of agreement between spouses on the spousal knowledge (e.g., what high school did your spouse attend) and spousal expertise (e.g., who is more likely to complete the income tax return) dimensions of the personal information questionnaire were calculated. A multivariate analysis of variance (MANOVA) was performed on these percentages, with age as the independent variable. A multivariate main effect was significant, Wilks' $F(2, 63) = 4.74, p < .012$. A follow-up ANOVA showed that older couples agreed to a lesser extent than younger couples on the spousal knowledge questionnaire ($M = 57.35, SD = 11.46; M = 66.02, SD = 11.33$, respectively), $F(1, 64) = 9.52, p < .003$. The follow-up ANOVA on spousal expertise was nonsignificant, $F(1, 64) = .03, p > .85$. Older ($M = 81.86, SD = 14.57$) and younger ($M = 81.25, SD = 12.52$) couples demonstrated equivalent agreement. Although the age difference for knowledge was unexpected it may not imperil the goal of equating younger married couples to long-term married couples. That is, although married much longer, the older couples did not have an expertise advantage over the younger couples. Perhaps this result may be a function of the fact that some of the questions require a more long-term remembering for older (e.g., where their spouse went to high

school) than for younger adults.

Working Memory

Due to technical difficulties, half of the results of one older individuals' (from the stranger condition) sentence repetition performance was lost. Moreover, a single data point (out of 32) was lost for three participants, including one younger individual from the stranger condition, one older individual from the spouse condition, and one older individual from the stranger condition. Finally, two data points were missing for a younger individual from the spouse condition. These data points were replaced via a linear trend. According to Norušis (1993, p. 125), the existing series of data points is regressed on an index variable scaled 1 to n , in which $n = 194$. In Norušis' procedure, the predicted values are used to replace missing values. The results with the replaced data are nearly identical to the results in which the participant with missing data was removed. Hence, the full sample with five participants having partially replaced data for one working memory task will be used.

Correlations between memory tasks. Table 2 contains the correlations between all memory tasks. Hence, the performance of younger and older individuals, as well as younger and older stranger dyads and couples, on sentence repetition is correlated with alpha span, initial story recall, and delayed story recall. Moreover, performances on

Table 2

The Correlations between Performances on the Memory Tasks

| | Individuals | | Couples | | Strangers | |
|--------|-------------|-------|---------|-------|-----------|-------|
| | Younger | Older | Younger | Older | Younger | Older |
| AS/SR | .43* | .58* | .24 | .51* | .38 | .35 |
| STR/AS | .36* | .32* | .04 | .52* | -.14 | .22 |
| STR/SR | .17 | .41* | .29 | .26 | -.08 | -.17 |
| DR/AS | .23 | .18 | .41 | .33 | -.69 | .40 |
| DR/SR | .30 | .32 | .01 | .09 | -.46 | .32 |

Note. AS/SR = correlations between alpha span and sentence repetition, STR/AS = correlations between initial story recall and alpha span, STR/SR = correlations between initial story recall and sentence repetition, DR/AS = correlations between delayed recall and alpha span, and DR/SR = correlations between delayed recall and sentence repetition.

alpha span is correlated with story recall and delayed recall. The purpose of these correlations is twofold. First, the similarity between the two working memory tasks - sentence repetition and alpha span -- can be assessed. Second, the hypothesis that working memory is a processing resource for discourse recall can be evaluated. As seen in Table 2, three of the six correlations between alpha span and sentence repetition were significant in the expected direction ($r = .43$ to $.58$). The remaining correlations were moderate ($r = .24$ to $.38$) and in the same direction. Therefore, individuals or dyads that performed well on alpha span performed well on sentence repetition.

Table 2 also shows that alpha span performance in younger and older individuals ($r = .36$ and $r = .32$, respectively), as well as older couples ($r = .52$), was significantly related to initial story recall performance. The corresponding correlations for younger couples ($r = .04$), and younger ($r = -.14$) and older ($r = .22$) stranger dyads were nonsignificant. Sentence repetition performance was significantly related to initial story recall performance in older individuals ($r = .41$). It seems that these correlations lend modest support to the processing resources theory. To some extent, those participants with higher working memory performance (at least in younger and older individuals and older couples) tend to have higher initial story recall performance.

Counter-balance results. In order to test the influence of list and working memory task order on alpha span and sentence repetition performance a 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (recall condition: individual, dyad) x 2 (list: A, B) x 2 (order: individual first, dyad first) x 2 (working memory task order: A first, B first) MANOVA was performed. It is important to note that list was not used as a repeated measures factor. List could be considered a within-subjects factor because all participants performed both working memory tasks twice, once when working alone and once when working with a partner. The list not presented in the first recall condition was presented in the second recall condition. List deviated from a typical within-subjects factor, though, in that the condition of recall changes for time one to time two. Either participants went from working alone to working with a partner or from working with a partner to working alone. Moreover, if list were used as a repeated measures factor, an interesting aspect of most of the results -- comparing individual and dyad performance -- would be eliminated. Many of the tasks, including story recall, memory self-efficacy questionnaires, and working memory performance, were given twice, with the purpose being that individual- and dyad-level performance could be compared. At risk of increasing the error rate, then, list was treated as a between-subjects factor.

The multivariate test of a five-way interaction between collaborative condition, recall condition, list, order, and working memory task order was found significant, Wilks' $F(2, 130) = 4.20, p < .017$, as was the four-way interaction between age, collaborative condition, recall condition, and list, Wilks' $F(2, 130) = 4.85, p < .009$. All the follow-up univariate tests, in relation to these two interactions, were nonsignificant. A collaborative condition, recall condition, by list interaction was found significant, Wilks' $F(2, 130) = 4.39, p < .014$. The follow-up ANOVA showed a significant effect for alpha span, with $F(1, 131) = 8.84, p < .004$. A three-way interaction involving age, collaborative condition, and working memory list order was significant, Wilks' $F(2, 130) = 3.12, p < .047$. The follow-up ANOVA was only significant for alpha span, $F(1, 131) = 6.26, p < .014$. Finally, an order by working memory task order interaction was observed significant, Wilks' $F(2, 130) = 4.10, p < .019$. The follow-up ANOVA for alpha span was significant, $F(1, 131) = 6.26, p < .014$. As the multivariate main effects of list and working memory task order were nonsignificant and as neither of these two factors directly interacted with the main factors, age and collaborative condition, they were dropped from subsequent analyses.

Sentence repetition and alpha span performance results.

A 2 (age: young, old) x 2 (recall condition: individual,

dyad) x 2 (collaborative condition: spouse, stranger) x 2 (order: individual first, dyad first) multivariate analysis of variance was performed on individuals' and dyads' alpha span and sentence repetition performance. The purpose being to examine any age-, recall condition-, collaborative condition-, and order-related differences in working memory performance. Order was considered a substantive issue in the working memory tasks. For example, the issue of how practice may differentially influence performance when going from individuals to dyads or from dyads to individuals could be addressed. The MANOVA revealed a significant two-way interaction between age and collaborative condition, Wilks' $F(2, 178) = 3.15, p < .045$. Follow-up ANOVAs showed that the interaction was significant for both alpha span, $F(1, 179) = 4.85, p < .029$, and sentence repetition, $F(1, 179) = 4.15, p < .043$. As depicted in Figure 2, the younger individuals and dyads from the stranger condition ($M = 5.73, SD = 1.63$) performed better on alpha span than younger individuals and couples from spouse condition ($M = 5.29, SD = 1.29$), but the difference was less for spouses than for strangers. Older individuals and couples from the spouse condition ($M = 4.69, SD = 1.01$) performed slightly better on alpha span than older individuals and dyads from the stranger condition ($M = 4.35, SD = .96$).

Figure 3 shows that for sentence repetition younger persons participating as strangers ($M = 140.47, SD = 6.05$)

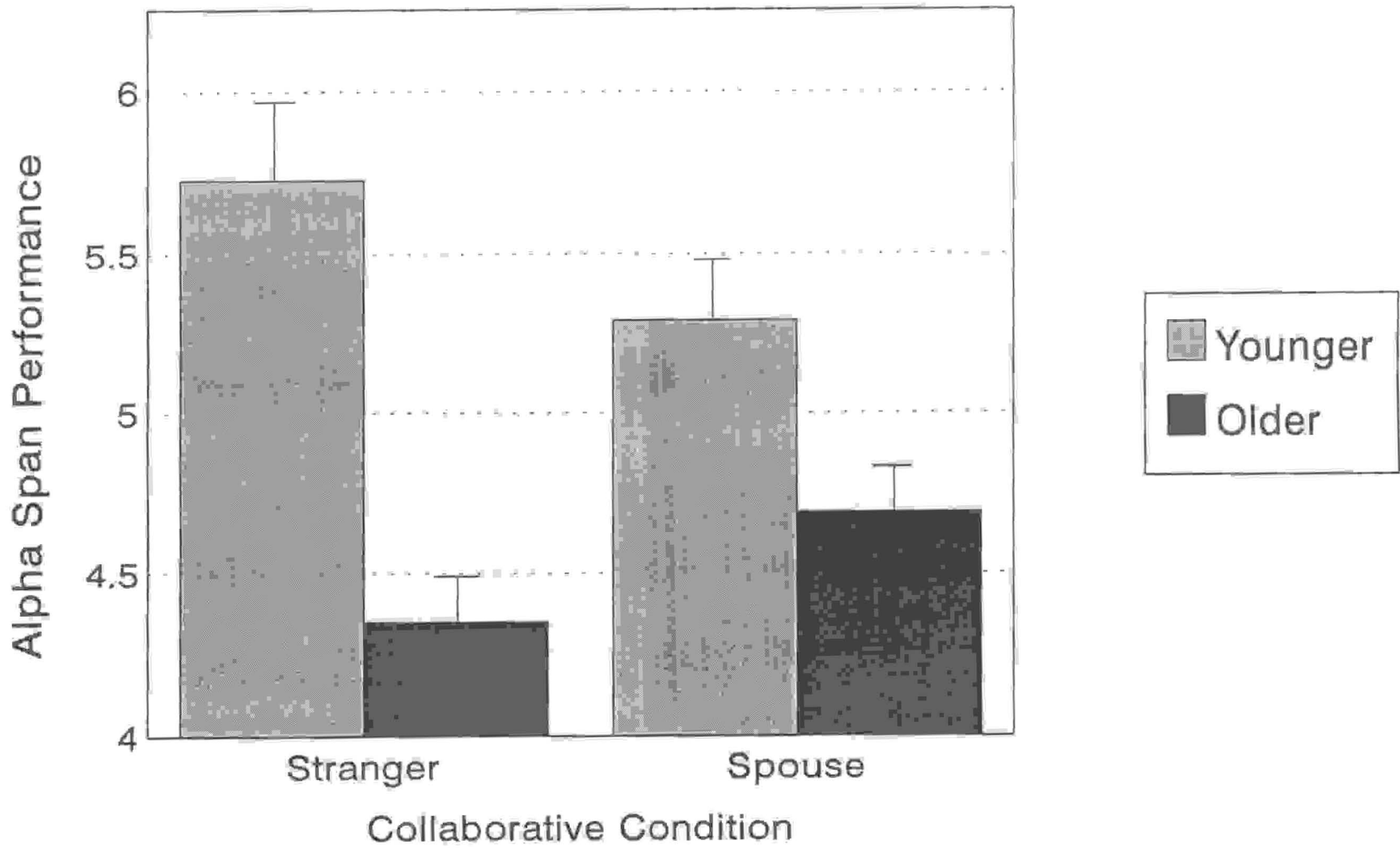


Figure 2. Alpha span performance as a function of age and collaborative condition.

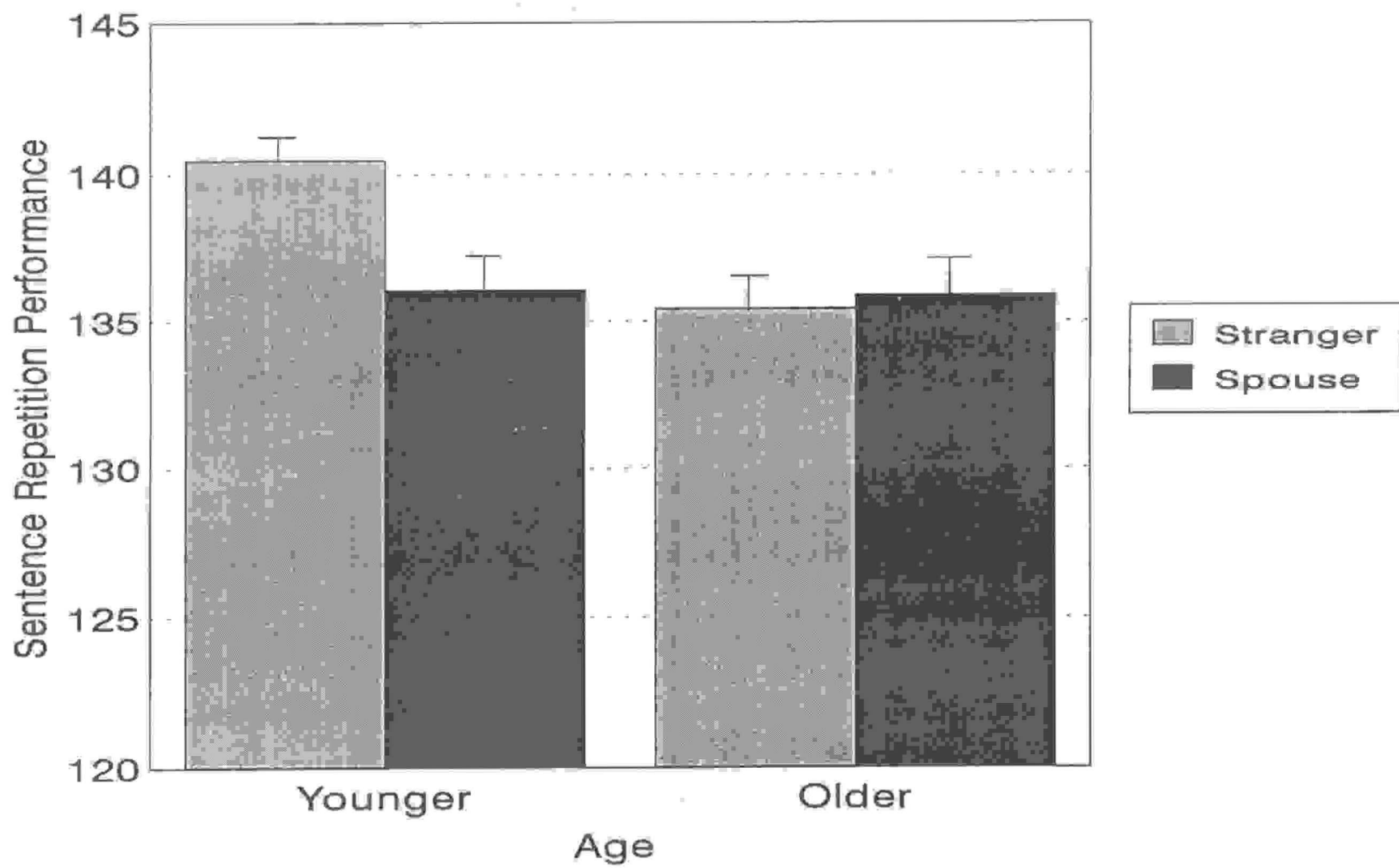


Figure 3. Sentence repetition performance as a function of age and collaborative condition.

performed better than younger persons participating as spouses ($\underline{M} = 136.08$, $\underline{SD} = 8.74$). In contrast, older persons participating as strangers ($\underline{M} = 135.42$, $\underline{SD} = 7.82$) performed similarly to older persons participating as spouses ($\underline{M} = 135.89$, $\underline{SD} = 9.53$).

The multivariate test of recall condition was significant, Wilks' $\underline{F} (2, 178) = 17.34$, $\underline{p} < .001$, with both follow-up univariate tests -- alpha span, $\underline{F} (1, 179) = 34.43$, $\underline{p} < .001$, and sentence repetition, $\underline{F} (1, 179) = 9.54$, $\underline{p} < .002$ -- being significant. Working with a partner ($\underline{M} = 5.68$, $\underline{SD} = 1.48$; $\underline{M} = 139.46$, $\underline{SD} = 6.33$; alpha span and sentence repetition respectively) resulted in higher working memory performance than working alone ($\underline{M} = 4.66$, $\underline{SD} = 1.14$; $\underline{M} = 135.69$, $\underline{SD} = 9.00$; alpha span and sentence repetition respectively). Finally, age was also found to be significant, Wilks' $\underline{F} (2, 178) = 19.23$, $\underline{p} < .001$. The follow-up ANOVA for alpha span, $\underline{F} (1, 179) = 37.95$, $\underline{p} < .000$, revealed that younger adults ($\underline{M} = 5.51$, $\underline{SD} = 1.48$) performed better than older adults ($\underline{M} = 4.53$, $\underline{SD} = .99$) on alpha span. The follow-up ANOVA for sentence repetition approached significance, $\underline{F} (1, 179) = 3.34$, $\underline{p} < .069$. Younger adults ($\underline{M} = 138.27$, $\underline{SD} = 7.80$) performed better than older adults ($\underline{M} = 135.66$, $\underline{SD} = 8.70$) on sentence repetition.

Individuals separately. Some of the preceding working memory analyses were also done on the individual data (solely) and the dyad data (solely), which are summarized in

the following section. The purpose of these additional analyses is twofold. First, as all research in this area has concentrated on individual- or dyad-level data, issues concerning replication will be addressed. Second, issues surrounding the equivalence of the individuals from the spousal and the stranger conditions (in the dyad portion of the experiment) can be discussed. It should be noted that the equivalence of the individuals from the different dyad conditions was shown with the combined, dyad and individual data, but by separating the data this assumption can be tested more directly. For example, if there was a collaborative condition difference in individual-level data and couples and stranger dyads perform similarly, this would be revealed with a two-way interaction between recall condition and collaborative condition.

A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (order: individual first, dyad first) MANOVA was used to analyze individual level working memory performance. The multivariate test of order was found significant, Wilks' $F(2, 121) = 3.23, p < .043$. Follow-up univariate analysis of alpha span was significant, $F(1, 122) = 6.30, p < .013$. Thus, those individuals tested as dyads first and as individuals second ($M = 4.89, SD = 1.22$) performed significantly better than those individuals that were tested as individuals first and as dyads second ($M = 4.45, SD = 1.02$) in the alpha span task. This suggests that

there may be a small benefit of experience with the task. The multivariate main effect of collaborative condition was also significant, Wilks' $F(2, 121) = 3.16, p < .046$. A follow-up ANOVA revealed that for sentence repetition, $F(1, 122) = 4.26, p < .041$, individuals from the spouse condition ($M = 134.17, SD = 9.47$) performed significantly worse than individuals from the stranger condition ($M = 137.26, SD = 8.17$). The multivariate test of age, Wilks' $F(2, 121) = 11.64, p < .001$, was significant. Follow-up univariate analyses showed that the age effect was significant for both alpha span, $F(1, 122) = 23.46, p < .001$, and sentence repetition, $F(1, 122) = 5.44, p < .021$. Younger individuals ($M = 5.11, SD = 1.14; M = 137.46, SD = 8.09$; alpha span and sentence repetition respectively) outperformed older individuals ($M = 4.26, SD = .98; M = 133.98, SD = 9.47$; alpha span and sentence repetition respectively) on both working memory tasks. No interactions were significant.

Dyads separately. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (order: individuals first, dyads first) MANOVA was performed on dyads' working memory performance. Although the multivariate test of the age and collaborative condition interaction was nonsignificant, the univariate analyses were examined as this interaction was expected to be significant. The univariate test of sentence repetition approached

significance, with $F(1, 57) = 2.90, p < .094$. Younger stranger dyads ($M = 141.12, SD = 5.19$) performed better than younger couples ($M = 138.69, SD = 8.48$) and yet older couples ($M = 140.47, SD = 5.82$) performed better than older stranger dyads ($M = 137.50, SD = 5.20$). Although not significant, the means are in the direction predicted. A main effect of age effect was also significant with a multivariate Wilks' $F(2, 56) = 7.13, p < .002$. The follow-up univariate test of alpha span was significant, $F(1, 57) = 14.14, p < .001$. Younger dyads ($M = 6.31, SD = 1.75$) performed better than older dyads ($M = 5.06, SD = .79$). The univariate ANOVA on sentence repetition was not significant. No other interactions or main effects were significant.

Story Recall

One older individual's story recall data, from the spouse condition, was removed from the analyses as it was more than two standard deviations below the mean. The central unit of analyses used here was the mean and, as the mean is highly influenced by extreme scores, this outlier would lower the mean substantially.

Story recall products. Table 3 contains all the average story recall characteristics according to age, collaborative condition, and recall condition. Specifically, Table 3 shows the average proportion of propositions recalled, as well as the average number of nonrecall statements, including macrostatements,

Table 3

The Means and Standard Deviations for Story Recall Characteristics

| | Couples | | | | Strangers | | | |
|----|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | Younger | | Older | | Younger | | Older | |
| | I | D | I | D | I | D | I | D |
| Pp | 39.79 (11.75) | 47.76 (12.78) | 30.66 (10.41) | 42.87 (12.96) | 40.23 (13.71) | 48.24 (11.38) | 28.74 (11.87) | 35.32 (11.25) |
| Ma | 1.19 (1.03) | 2.19 (1.11) | 1.38 (1.13) | 2.00 (1.62) | .87 (1.01) | 1.44 (1.03) | .69 (.74) | .81 (1.05) |
| E1 | 17.72 (10.33) | 32.44 (11.92) | 16.88 (7.94) | 27.59 (9.89) | 19.75 (10.22) | 21.75 (9.51) | 16.16 (7.46) | 22.69 (7.52) |
| Me | 2.53 (2.03) | 1.69 (3.32) | 4.03 (3.78) | .71 (1.21) | 4.91 (3.84) | 1.38 (1.82) | 4.28 (4.93) | 3.00 (2.61) |
| Re | 3.44 (3.84) | 4.50 (2.76) | 2.12 (2.24) | 5.59 (5.91) | 2.69 (4.30) | 6.63 (6.20) | 1.69 (3.15) | 5.75 (4.34) |
| Er | 1.88 (1.58) | 1.44 (1.21) | 1.59 (1.69) | 1.88 (1.69) | 2.16 (2.27) | 3.12 (2.33) | 1.78 (1.41) | 2.63 (1.75) |

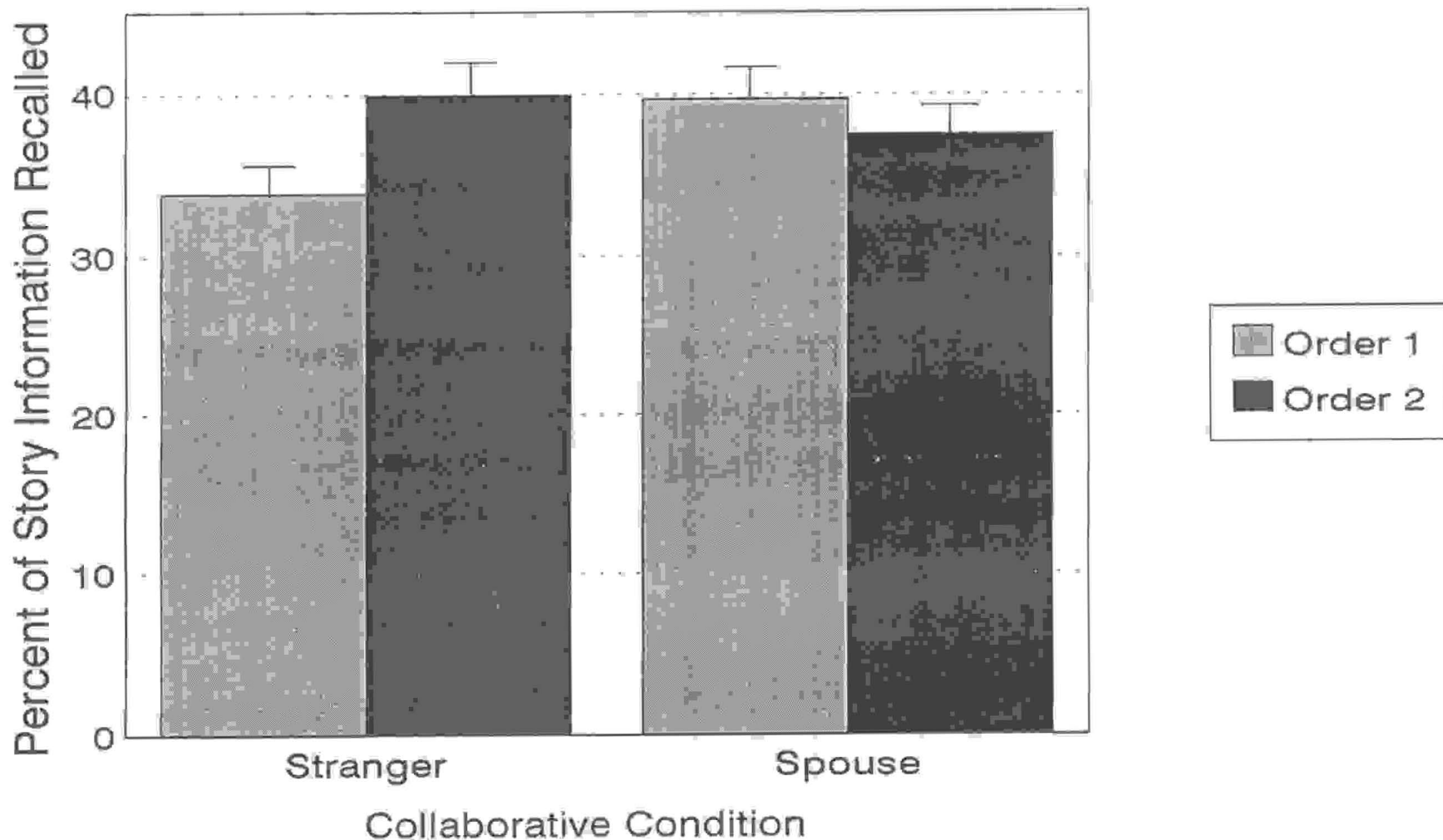
Note. I = Individuals, D = Dyads, Pp = Percentage of propositions, Me = Metastatements, Ma = Macrostatements, Re = Repetitions, E1 = Elaborations, and Er = Total number of errors.

elaborations, metastatements, repetitions, and errors, produced by younger and older individuals, couples and dyads.

Counter-balance results. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (order: individual first, dyad first) x 2 (story: "Playing Cards," "A Trip Abroad") x 2 (recall condition: individual, dyad) ANOVA was used to analyze the effect of story on the percentage of story information individuals and dyads recalled in the immediate recall condition only. It is important to note, that the story factor, like the list factor in the working memory section, was not used as a repeated measures factor. A main effect of story, $F(1, 186) = 5.46$, $p < .021$, revealed that more story information was recalled from Playing Cards ($M = 39.87\%$, $SD = 14.93$) than from A Trip Abroad ($M = 35.61\%$, $SD = 11.70$). This suggests that the former story may have been slightly easier to remember than the latter. A two-way interaction between story and recall condition was observed, $F(1, 162) = 18.10$, $p < .001$. An examination of the means revealed that individuals recalled a similar amount of story information whether A Trip Abroad or Playing Cards. Dyads recalled more story information from Playing Cards than from A Trip Abroad. These two stories were developed to have structural equivalence and to contain similar narrative context characteristics (Dixon et al., 1989). For example, A Trip

Abroad contains 92 propositions (165 words) and Playing Cards contains 90 propositions (162 words). Perhaps, the difference in the recall of these two stories may be a function of the "readability" of the stories. According to a Flesch-Kincaid grade level reading score, Playing Cards (6.67) is slightly easier to read than A Trip Abroad (7.03). It should be noted, though, that the readability level is also quite similar, and that the participants listened to the stories. These differences found in the recall levels for the two stories did not significantly influence the age or the collaborative condition variables and, thus, story was dropped from subsequent analyses.

Gist recall results. A 2 (age) x 2 (collaborative condition) x 2 (order) x 2 (recall condition) ANOVA was used to examine the effects of the aforementioned factors on the percentage of propositions recalled. A significant two-way interaction between collaborative condition and order was observed, $F(1, 178) = 5.47, p < .020$. As shown in Figure 4, this interaction revealed that whereas recall performance in the spouse condition was similar for both orders ($M = 39.68, SD = 13.52; M = 37.51, SD = 12.76$, individuals first and dyads first, respectively), performance in the stranger condition was better for the dyad-first-and-individual-second order ($M = 39.93, SD = 14.00$) than for the individual-first-and-dyad-second order ($M = 33.90, SD = 13.48$).



Note. Order 1 = individuals first and order 2 = dyads first.

Figure 4. Immediate story recall performance as a function of order and collaborative condition.

A main effect of age, $F(1, 178) = 27.56, p < .001$, was also observed. Younger participants ($M = 42.68\%$, $SD = 12.92$) recalled a higher percentage of propositions than older participants ($M = 32.91\%$, $SD = 12.41$). Moreover, a main effect of recall condition, $F(1, 178) = 22.66, p < .001$, revealed that significantly more propositions were recalled, on average, when working with a partner ($M = 43.54\%$, $SD = 12.93$) than when working alone ($M = 34.82\%$, $SD = 12.94$). All remaining results were nonsignificant.

Elaborations. A series of ANOVAs was performed on the non-propositional characteristics of the story recall. Firstly, a 2 (age: young, old) \times 2 (collaborative condition: spouse, stranger) \times 2 (recall condition: individual, dyad) ANOVA was performed on the number of elaborations produced when a story was recalled. A main effect of collaboration condition, $F(1, 187) = 6.35, p < .013$, and a main effect of recall condition, $F(1, 187) = 35.91, p < .001$, were significant. Thus, those participants in the spouse condition ($M = 21.51$, $SD = 11.43$) made significantly more elaboration statements than those participants in the stranger condition ($M = 19.38$, $SD = 9.04$). Moreover, significantly more elaborations were made when participants worked with a partner ($M = 26.14$, $SD = 10.51$) than when participants worked alone ($M = 17.62$, $SD = 9.06$). A two-way interaction was also observed between collaborative condition and recall condition, $F(1, 187) = 8.89, p < .003$.

Shown in Figure 5, there was little difference between the number of elaborations made by strangers working alone ($M = 17.95$, $SD = 9.06$) or spouses working alone ($M = 17.29$, $SD = 9.11$), but spouses working together ($M = 29.94$, $SD = 11.02$) made many more elaborative statements than strangers working together ($M = 22.22$, $SD = 8.45$).

Macrostatements. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the number of macrostatements made by individuals and dyads. A main effect of collaborative condition, $F(1, 187) = 20.31$, $p < .001$, and a main effect of recall condition, $F(1, 187) = 12.45$, $p < .001$, were significant. Those individuals and dyads from the spouse condition ($M = 1.56$, $SD = 1.24$) made significantly more macrostatements than those individuals and dyads from the stranger condition ($M = .90$, $SD = .96$). Moreover, subjects made significantly more macrostatements when working with a partner ($M = 1.62$, $SD = 1.32$) than when working alone ($M = 1.04$, $SD = 1.01$). No interactions or other main effects were significant.

Metastatements. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the number of metastatements made by individuals and dyads. A main effect of collaborative condition, $F(1, 187) = 5.00$, $p < .027$, and a main effect of recall condition, $F(1, 187) = 18.97$, $p < .001$, were significant. When working alone ($M = 3.94$, $SD = 3.85$) participants made more metastatements than

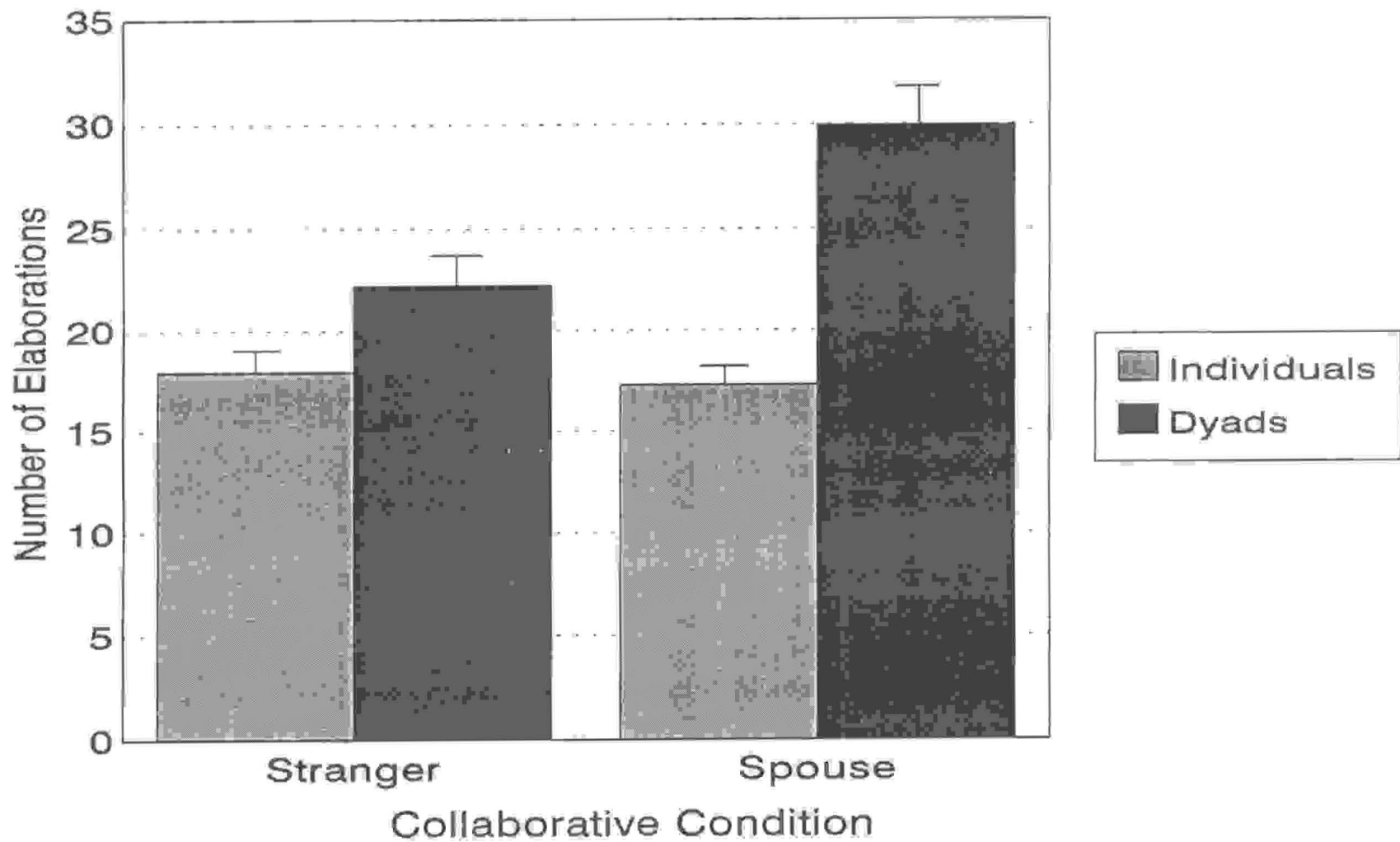


Figure 5. The number of elaborations made in immediate story recall as a function of recall condition and collaborative condition.

when working with a partner ($\underline{M} = 1.68$, $\underline{SD} = 2.46$).

Moreover, adults in the spousal condition ($\underline{M} = 2.60$, $\underline{SD} = 3.08$) made significantly fewer metastatements than adults in the stranger condition ($\underline{M} = 3.79$, $\underline{SD} = 3.99$). The three-way interaction between age, collaborative condition and recall condition was also significant, $F(1, 187) = 60.55$, $p < .023$. As shown in Figure 6, the patterns were different for the individual and dyad recall condition. Younger individuals from the stranger condition made more metastatements than younger individuals from the spouse condition ($\underline{M} = 4.91$, $\underline{SD} = 3.84$; $\underline{M} = 2.53$, $\underline{SD} = 2.03$, respectively). Older individuals from the stranger condition and older individuals from the spouse condition ($\underline{M} = 4.28$, $\underline{SD} = 4.93$; $\underline{M} = 4.03$, $\underline{SD} = 3.78$, respectively), made a similar number of metastatements and more than did younger individuals from the spouse condition. In contrast, older stranger dyads ($\underline{M} = 3.00$, $\underline{SD} = 2.61$) made more such statements than younger stranger dyads ($\underline{M} = 1.38$, $\underline{SD} = 1.82$), younger married couples ($\underline{M} = 1.69$, $\underline{SD} = 3.32$), and older married couples ($\underline{M} = .71$, $\underline{SD} = 1.21$), who made the fewest number of metastatements. Performing as individuals and as stranger dyads, older adults produced relatively frequent metastatements. However, performing as couples they produced the fewest.

Repetitions. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the number of

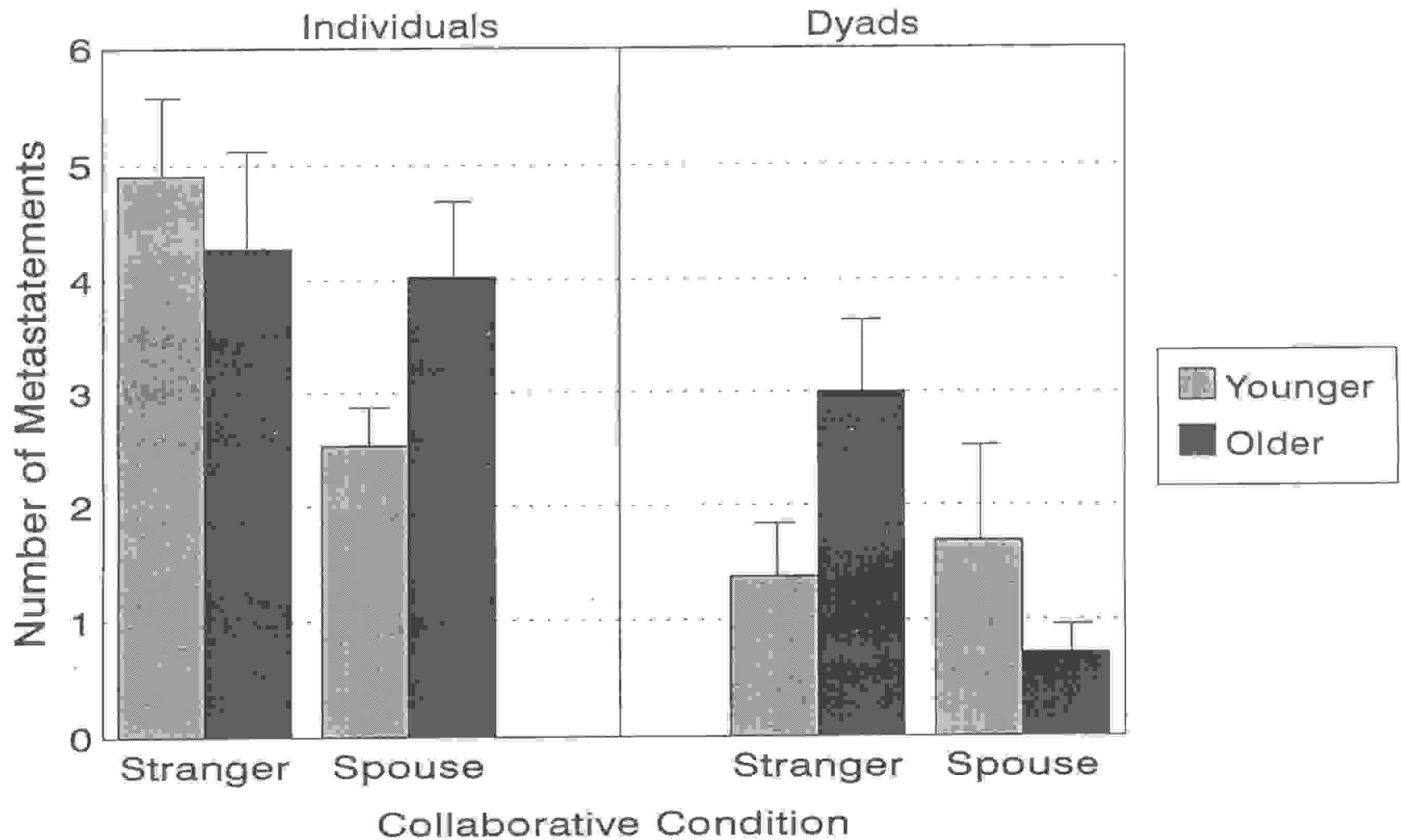


Figure 6. The number of metastatements made in immediate story recall as a function of age, recall condition, and collaborative condition.

repetitions made when recalling a story. Only a main effect of recall condition was significant, $F(1, 187) = 26.20$, $p < .001$. When working alone ($M = 2.48$, $SD = 3.48$) participants made fewer repetitions than when working with a partner ($M = 5.62$, $SD = 4.95$).

Errors. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the total number of errors made when a story was recalled. The main effect of collaborative condition was significant, $F(1, 187) = 7.25$, $p < .008$. Individuals and dyads from the stranger condition ($M = 2.27$, $SD = 1.98$) made significantly more errors than individuals and dyads from the spousal condition ($M = 1.71$, $SD = 1.57$). The remaining main effects and all interactions were not statistically significant.

Individuals separately. The analysis on the percentage of propositions recalled was repeated here with the individual data and in the next section with the dyad data. The reason for these analyses is to show replication of previous research and to show equivalence between the individuals from the different collaborative conditions. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (order: individuals first, dyads first) ANOVA was used to analyze individual level propositional recall. There was only a main effect of age, $F(1, 121) = 23.82$, $p < .000$. Older individuals ($M = 29.71\%$, $SD = 11.11$) recalled less story information than younger individuals ($M = 40.01\%$,

$SD = 12.67$). The other main effects and all interactions were not statistically significant. Therefore, individuals assigned to the order condition and selected for the collaborative condition did not vary on story recall performance.

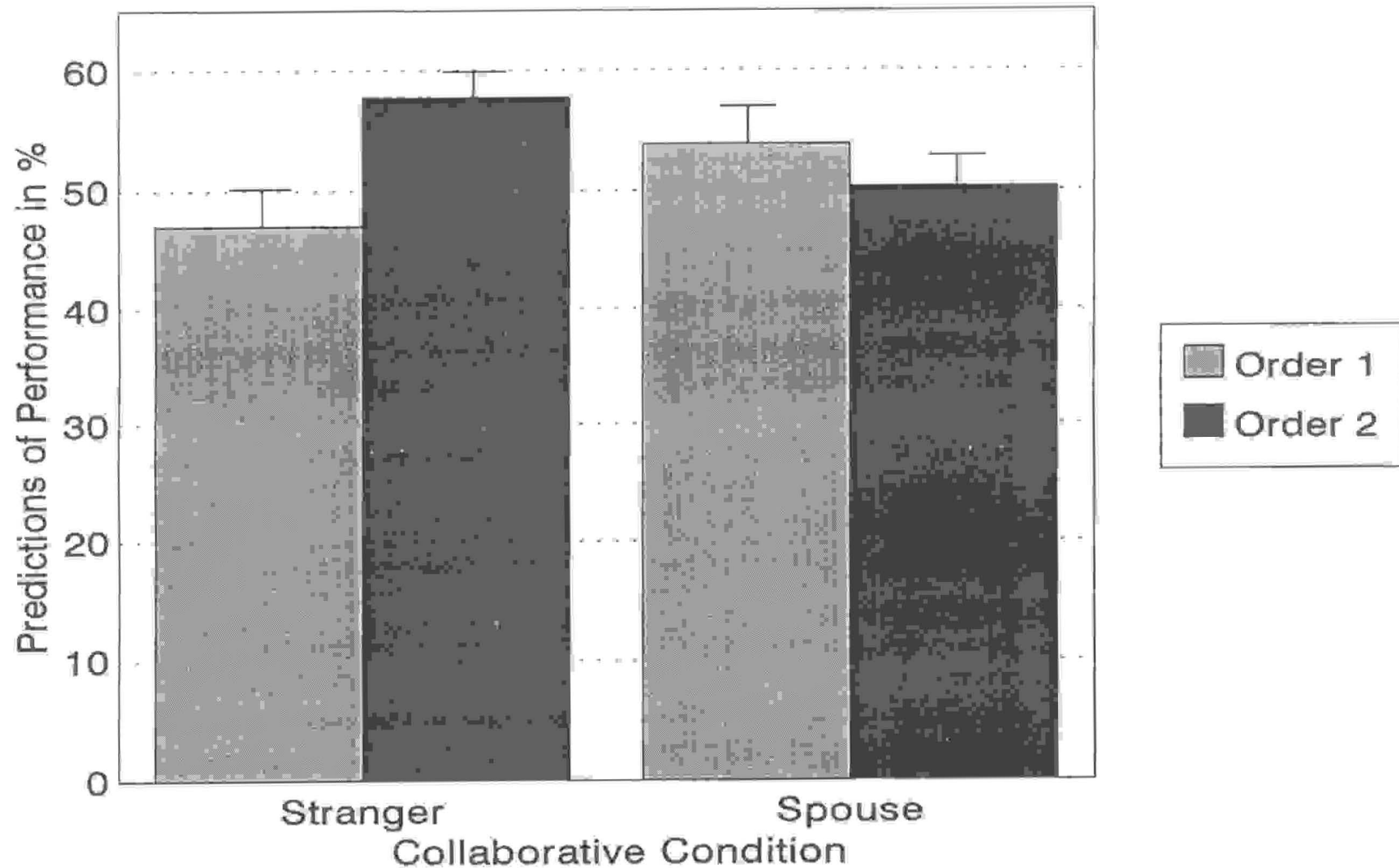
Dyads separately. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (order: individuals first, dyads first) ANOVA was performed on the percentage of propositions recalled by dyads. A main effect of age was significant, $F(1, 57) = 8.77$, $p < .004$. Younger dyads ($M = 48.00\%$, $SD = 11.91$) recalled significantly more story information than older dyads ($M = 39.21\%$, $SD = 12.57$). Moreover, the two-way interaction between collaborative condition and age approached significance, $F(1, 49) = 3.25$, $p < .077$. This expected near significant result showed that younger stranger dyads ($M = 48.24$, $SD = 11.38$) performed similarly to younger couples ($M = 47.76$, $SD = 12.78$). In contrast, older couples ($M = 42.87$, $SD = 12.96$) recalled more story information than older stranger dyads ($M = 35.32$, $SD = 11.25$). The remaining results were nonsignificant.

Monitoring of Story Recall

Counter-balance results. A 2 (age: young, old) x 2 (recall condition: individual, dyad) x 2 (collaborative condition: spouse, stranger) x 2 (order: individuals first, dyads first) x 2 (story: "Playing Cards," "A Trip Abroad") MANOVA was used to examine the influence of story on the

magnitude (in percent) of predicted and postdicted story recall performance. A five-way interaction involving all the independent variables was significant, Wilks' $F(2, 162) = 5.13$, $p < .007$. This interaction was significant for both the follow-up ANOVAs of prediction and postdiction, $F(1, 163) = 4.97$, $p < .027$ and $F(2, 163) = 10.14$, $p < .002$, respectively. Moreover, the multivariate test of a two-way interaction involving recall condition and story was significant, Wilks' $F(2, 162) = 3.13$, $p < .046$. Both the follow-up ANOVAs were significant, with $F(1, 163) = 4.44$, $p < .037$ for predictions and $F(1, 163) = 6.25$, $p < .013$ for postdictions. As the main effect of story and the interactions between story and age and story and collaborative condition were nonsignificant, story was dropped from subsequent analyses.

Actual estimates. A 2 (age: young, old) \times 2 (collaborative condition: spouse, stranger) \times 2 (order: individuals first, dyads first) \times 2 (recall condition: individual, dyad) MANOVA was performed with prediction and postdiction of performance in percent as dependent variables. The multivariate two-way interaction involving collaborative condition and order was significant, Wilks' $F(2, 178) = 3.89$, $p < .022$. Both of the follow-up ANOVAs for predictions and postdictions were significant, $F(1, 179) = 7.73$, $p < .006$ and $F(1, 179) = 5.75$, $p < .018$, respectively. As shown in Figure 7, individuals and dyads



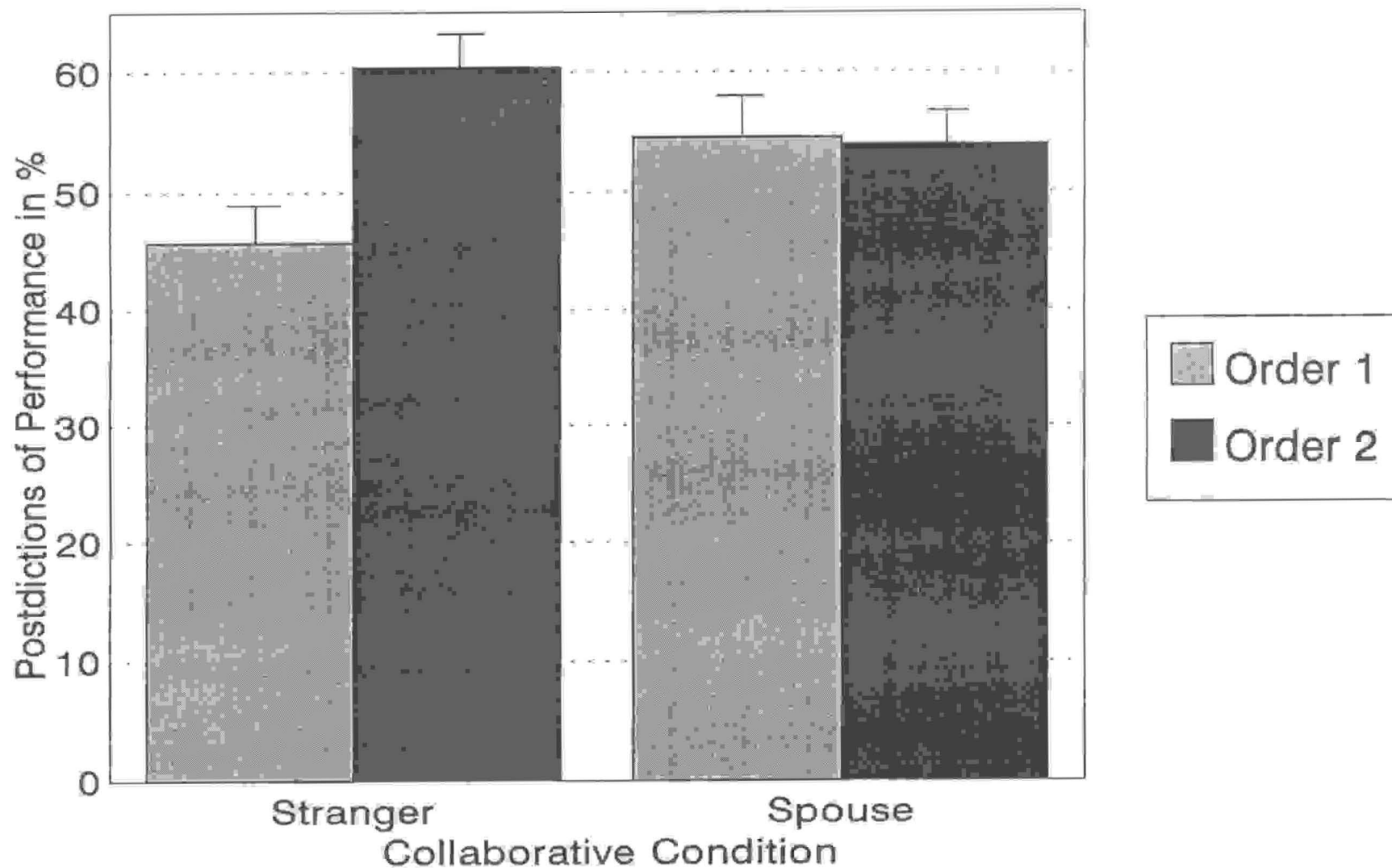
Note. Order 1 = individuals first and order 2 = dyads first.

Figure 7. Predictions of immediate story recall performance as a function of order and collaborative condition.

from the spouse condition tested as individuals first ($\bar{M} = 53.85$, $SD = 21.93$) gave higher prediction estimates than individuals and dyads from the spouse condition tested as dyads first ($\bar{M} = 50.29$, $SD = 19.25$). In contrast, individuals and dyads from the stranger condition tested as dyads first ($\bar{M} = 57.71$, $SD = 15.30$) made higher prediction estimates than individuals and dyads from the stranger condition tested as individuals first ($\bar{M} = 47.02$, $SD = 22.19$).

Figure 8 shows that individuals and dyads from the spouse condition tested as individuals first ($\bar{M} = 54.60$, $SD = 24.89$) and individuals and dyads from the stranger condition tested as dyads first ($\bar{M} = 54.02$, $SD = 22.45$) made similar postdiction estimates. This is again in contrast to the stranger condition. For postdicting, however, individuals and dyads from the stranger condition ($\bar{M} = 60.42$, $SD = 20.44$) made higher postdiction estimates than individuals and dyads from the spouse condition ($\bar{M} = 45.73$, $SD = 22.71$).

The MANOVA also showed a significant effect of recall condition, Wilks' $F(2, 178) = 24.54$, $p < .001$. The follow-up ANOVAs revealed a significant effect of recall condition for predictions, $F(1, 179) = 23.18$, $p < .001$, and for postdictions, $F(1, 179) = 47.96$, $p < .001$. Therefore, when working with a partner ($\bar{M} = 61.49$, $SD = 17.68$; $\bar{M} = 67.85$, $SD = 17.81$, prediction and postdiction respectively)



Note. Order 1 = individuals first and order 2 = dyads first.

Figure 8. Postdictions of immediate story recall performance as a function of order and collaborative condition.

participants made significantly higher estimates of performance than when working alone ($M = 47.54$, $SD = 19.67$; $M = 46.62$, $SD = 22.21$, respectively). The main effect of order was significant, Wilks' $F(2, 178) = 3.59$, $p < .029$. Only the follow-up ANOVA for postdiction was found significant, with $F(1, 179) = 6.27$, $p < .013$. Persons tested as individuals first and as dyads second ($M = 50.17$, $SD = 24.12$) gave significantly lower postdiction estimates than persons tested as dyads first and as individuals second ($M = 57.12$, $SD = 21.63$). Finally, there was a multivariate effect of age, Wilks' $F(2, 178) = 5.98$, $p < .007$. The follow-up ANOVA for postdiction was significant, $F(1, 179) = 8.65$, $p < .004$. Younger individuals and dyads ($M = 58.61\%$, $SD = 20.24$) made significantly higher postdiction estimates than older individuals and dyads ($M = 48.93\%$, $SD = 24.73$). No other multivariate or univariate effects were significant.

Accuracy of estimation. The accuracy of the predictions and postdictions were measured by taking the difference between actual performance and predictions (or postdictions). A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (recall condition: individual, dyad) MANOVA was performed on individuals' and dyads' prediction and postdiction accuracies. The multivariate main effects of recall condition and age were significant, Wilks' $F(2, 186) = 13.64$, $p < .001$ and $F(2,$

186) = 3.49, $p < .032$, respectively. For postdiction accuracy, $F(1, 187) = 22.97$, $p < .001$, participants were more accurate when working alone ($M = -12.06$, $SD = 16.87$) than when working with a partner ($M = -24.31$, $SD = 15.88$). For prediction accuracy, older individuals and dyads ($M = -17.13$, $SD = 16.24$) were less accurate than younger individuals and dyads ($M = -12.06$). No other multivariate or univariate effects were significant.

Devolder et al. (1990) argued that the absolute difference between performance and estimates of performance should be used because with simple difference scores, direction differences within an age group can cancel one another out (making the inaccuracy appear less). A 2 (age) x 2 (collaborative condition) x 2 (recall condition) MANOVA was used to examine the absolute prediction and postdiction accuracies. Only a main effect of recall condition, Wilks' $F(2, 185) = 9.60$, $p < .001$, was significant. Like simple accuracies, the follow-up recall condition effect was significant for postdiction accuracies, $F(1, 186) = 18.07$, $p < .001$. Working alone ($M = 16.56$, $SD = 12.57$) resulted in better accuracy of performance than working with a partner ($M = 25.18$, $SD = 14.44$). No other multivariate or univariate effects were significant.

Table 4 shows the correlations between performance and predictions of performance according to collaborative condition and age. These correlations show the accuracy

Table 4

Correlations Between Immediate Story Recall Performance and Estimates of Performance

| | Couples | | Strangers | |
|-------------------|---------|-------|-----------|-------|
| | Younger | Older | Younger | Older |
| <u>Individual</u> | | | | |
| Prediction | .55* | .42* | .54* | .55* |
| Postdiction | .75* | .49* | .64* | .58* |
| <u>Dyad</u> | | | | |
| Prediction | .27 | .60* | .07 | .74* |
| Postdiction | .49 | .61* | .23 | .50* |

Note. * = $p < .05$.

with which younger and older individuals, as well as younger and older stranger dyads and couples, make estimates of performance. The correlations, with the exception of the younger individuals from the stranger condition ($r = .07$), are moderately to extremely high ($r = .23$ to $.75$). One interesting pattern that emerged in Table 4 is that younger and older individuals from both collaborative conditions improved their estimates of performance from predictions to postdictions and, yet this improvement was not the case for every couple or dyad. Older stranger dyads, for example, predictions ($r = .74$) were more accurate than their postdictions ($r = .50$).

Individuals separately. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (order: individuals first, dyads first) MANOVA was performed on individuals' predictions and postdictions of performance. The multivariate tests revealed a significant age effect, Wilks' $F(2, 121) = 5.17, p < .007$. The follow-up ANOVA for postdictions was significant, $F(1, 122) = 8.81, p < .004$. Younger individuals ($M = 52.30\%$, $SD = 20.63$) made significantly higher postdiction estimates than older individuals ($M = 41.12\%$, $SD = 22.45$). The remaining results were nonsignificant.

A 2 (age) x 2 (collaborative condition) MANOVA was performed on the individuals' prediction and postdiction accuracies. The multivariate test of age was significant,

Wilks' $F(2, 125) = 3.14, p < .047$, but the follow-up univariate tests were nonsignificant. No other multivariate or univariate tests were significant.

Dyads separately. A 2 (age: young, old) \times 2 (collaborative condition: spouse, stranger) \times 2 (order: individuals first, dyads first) MANOVA was used to examine dyads' estimate of performance. The multivariate two-way interaction between collaborative condition and order was significant, Wilks' $F(2, 56) = 3.27, p < .045$. Follow-up analyses showed that for predictions, $F(1, 57) = 6.47, p < .014$, married couples gave a similar estimate of performance if tested alone first ($M = 65.94, SD = 13.57$) or if tested as a dyads first ($M = 60.59, SD = 17.84$). Whereas stranger dyads gave a higher estimate of performance if tested as a dyad first ($M = 67.81, SD = 10.48$) than if tested as a individual first ($M = 51.69, SD = 23.07$). The remaining interactions and main effects were nonsignificant.

A 2 (age) \times 2 (collaborative condition) MANOVA was performed on dyads' prediction and postdiction accuracy. There were no statistically significant results.

Delayed Story Recall

Delay story recall products. Table 5 shows the performance characteristics of the delayed story recall of younger and older individuals from the spouse and stranger conditions, as well as younger and older married couples and stranger dyads. Shown in Table 5 is the average number of

Table 5

The Means and Standard Deviations for Delayed Story Recall Characteristics

| | Couples | | | | Strangers | | | |
|----|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| | Younger | | Older | | Younger | | Older | |
| | I | D | I | D | I | D | I | D |
| Pp | 36.58 (16.19) | 47.33 (12.57) | 29.48 (13.25) | 36.37 (6.74) | 42.88 (11.28) | 44.29 (10.03) | 29.92 (11.70) | 33.41 (7.06) |
| Ma | 1.81 (1.38) | 2.50 (1.60) | 1.89 (1.71) | 2.75 (1.75) | .88 (.89) | 1.25 (.71) | .56 (.63) | .50 (.76) |
| El | 21.00 (13.76) | 39.25 (7.13) | 16.94 (7.56) | 34.00 (17.94) | 23.25 (9.04) | 30.63 (11.34) | 19.13 (7.91) | 22.88 (6.38) |
| Me | 3.06 (2.14) | 1.38 (1.19) | 3.89 (3.92) | .75 (1.04) | 5.56 (5.16) | 1.50 (1.85) | 4.50 (2.85) | 3.25 (2.76) |
| Re | 4.37 (5.98) | 8.75 (13.84) | 2.56 (2.77) | 3.88 (3.52) | 1.56 (2.71) | 2.75 (3.45) | 1.19 (2.26) | 2.50 (2.93) |
| Er | 1.69 (1.92) | 1.63 (1.51) | 1.89 (1.13) | 3.00 (1.51) | 3.00 (1.59) | 1.38 (1.19) | 2.38 (1.50) | 3.25 (1.67) |

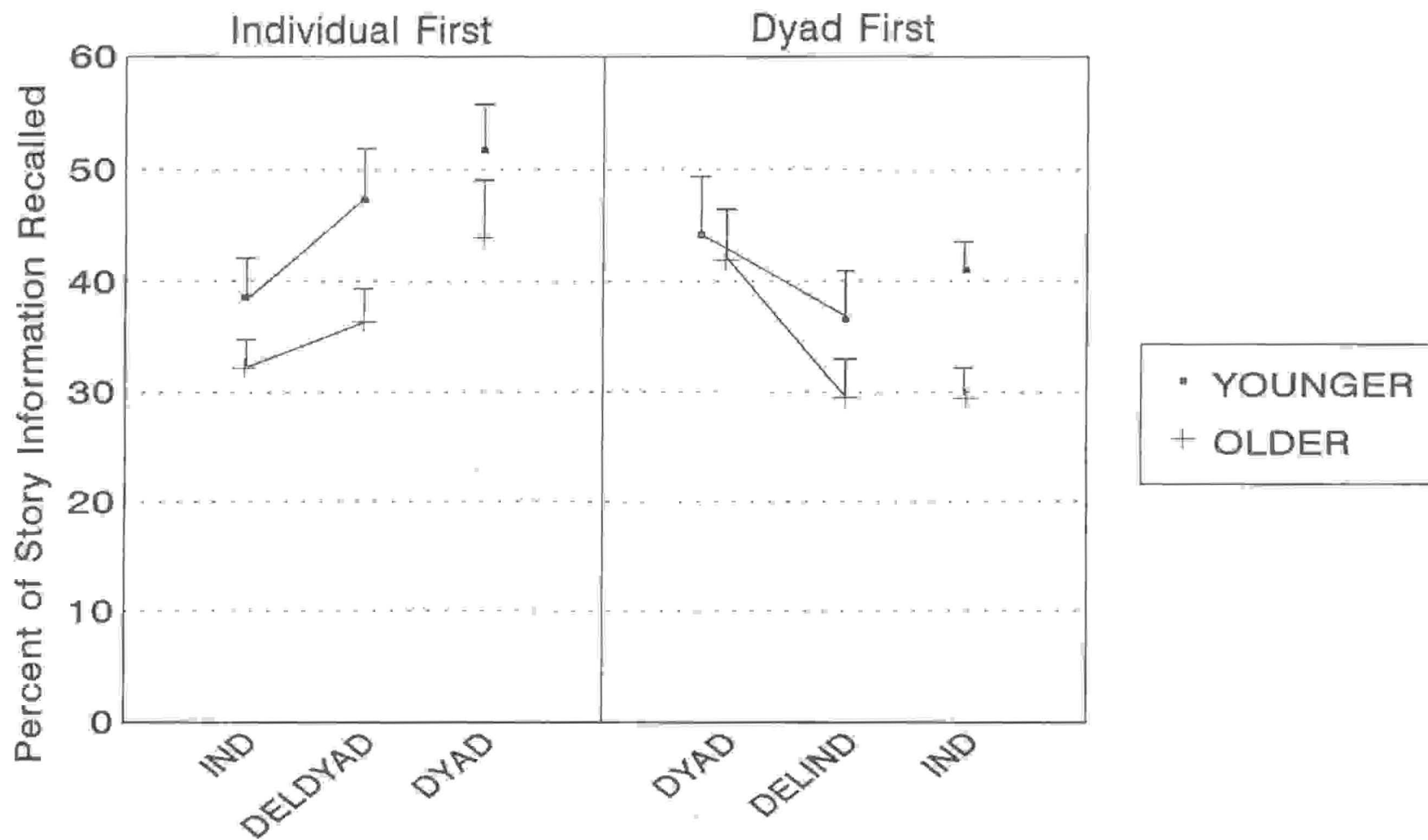
Note. I = Individuals, D = Dyads, Pp = Percentage of propositions, Me = Metastatements, Ma = Macrostatements, Re = Repetitions, El = Elaborations, and Er = Total number of errors.

propositions, macrostatements, elaborations, metastatements, repetitions, and errors made by each group of participants.

Counter-balance results. A 2 (age: young, old) x 2 (recall condition: individual, dyad) x 2 (collaborative condition: spouse, stranger) x 2 (story: "Playing Cards," "A Trip Abroad") ANOVA was used to test the effects of story on the delayed recall performance, in percent, of individuals and dyads. A two-way interaction involving age and story was found significant, $F(1, 82) = 4.62, p < .034$, such that younger and older persons recalled a similar amount from A Trip Abroad while older persons recalled much less from Playing Cards than younger persons. In addition, a two-way interaction involving recall condition and story was also found significant, $F(1, 82) = 4.04, p < .048$. This interaction seems a function of similar performance for dyads on both stories, but more story information recalled for Playing Cards than A Trip Abroad with individuals. A main effect of story was observed, $F(1, 82) = 23.59, p < .001$. More story information was recalled from Playing Cards ($M = 42.80, SD = 12.06$) than from A Trip Abroad ($M = 30.35, SD = 11.48$). As noted in the story recall section, these stories were created as structurally equivalent (Dixon et al., 1989) and no immediate explanation for the apparent delayed story recall performance differences is available. Despite these unexpected differences, the story factor was dropped from subsequent analyses.

Delayed gist recall results. A 2 (age: young, old) x 2 (recall condition: individual, dyad) x 2 (collaborative condition: spouse, stranger) analysis of variance was performed on the percentage of story information recalled with delay. A main effect of age, $F(1, 90) = 15.92$, $p < .001$, and a main effect of recall condition, $F(1, 90) = 4.61$, $p < .034$, was significant. Younger individuals and dyads ($M = 41.76$, $SD = 13.37$) remembered more story information than older individuals and dyads ($M = 31.35$, $SD = 11.10$). Individuals ($M = 35.56$, $SD = 14.07$) recalled less story information with delay than dyads ($M = 40.35$, $SD = 10.63$). The remaining results were nonsignificant.

Figure 9 depicts the average percentage of story information recalled by spouses according to order, recall condition, and age. Therefore, as shown in the left-hand side of Figure 9, when tested as individuals first and as dyads second, the amount of story information recalled was actually higher in the delayed recall condition for both younger and older adults. Thus, both younger and older married couples improved their story recall (8.75% and 4.21% more respectively) when collaborating with their spouse, although recall was delayed, than when they recalled as individuals. Shown in the right-hand panel of Figure 9, younger and older married couples, when tested with their spouse first and alone second, performed much more poorly with delayed recall. Younger and older individuals recalled



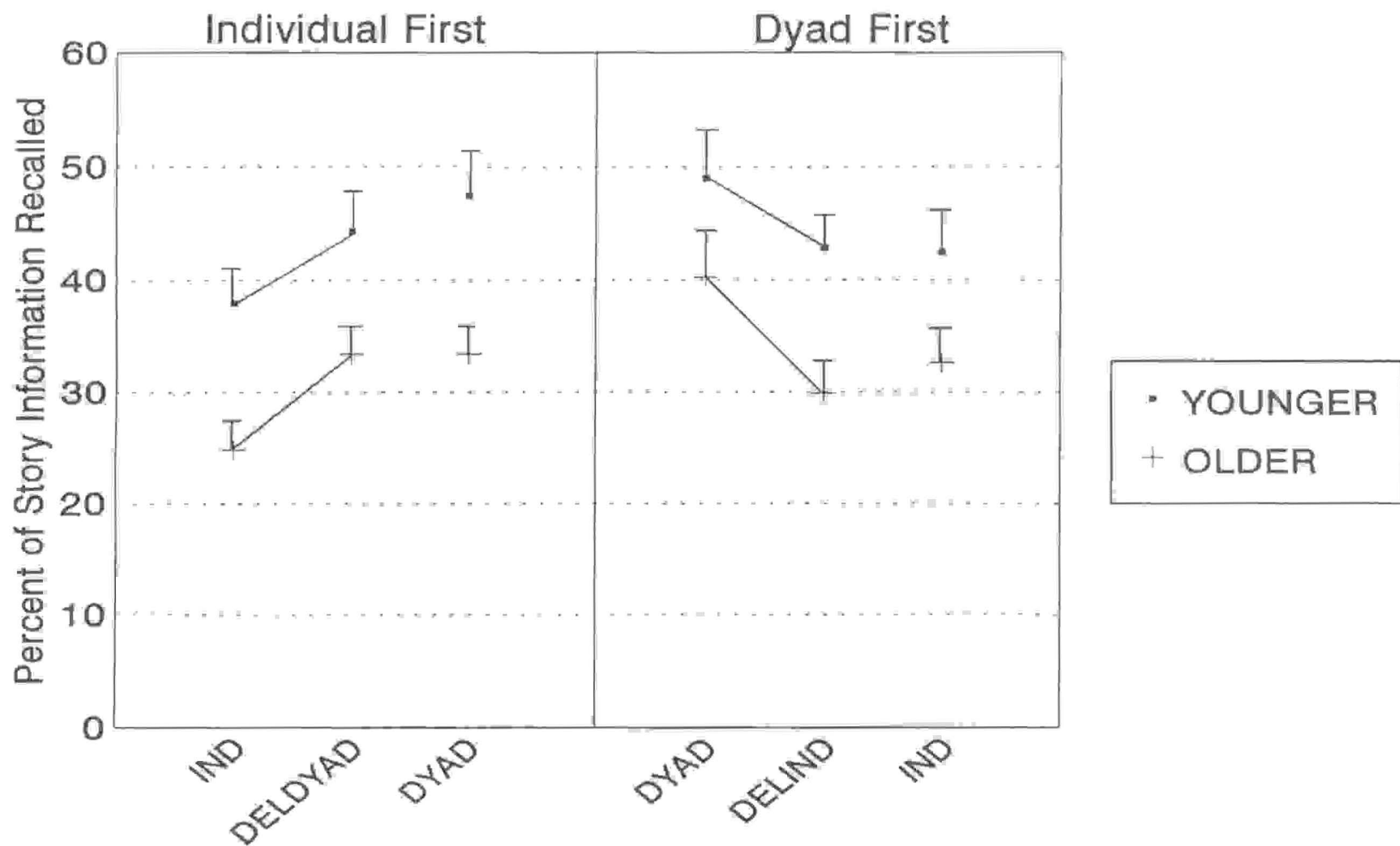
Note. IND = individual immediate recall, DELDYAD = dyad delayed recall, DYAD = dyad immediate recall, and DELIND = individual delayed recall.

Figure 9. Spouses' immediate and delayed story recall performance.

much less story information (7.21% and 12.43% less respectively) when they went from recalling with their spouse to recalling alone.

Figure 10 depicts the percent of story information recalled by strangers according to age, order, and recall condition. The pattern of results are similar to those depicted in Figure 9. As shown in the left-hand side of Figure 10, younger and older adults performed much better (6.33% and 8.58% more respectively) with delayed recall when delay involves working with a partner (compared to initial recall alone) and, yet, going from working with a partner to working alone younger and older adults performed much poorer (6.13% and 10.34% less respectively).

Elaborations. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (recall condition: individual, dyad) ANOVA was performed on the number of elaborations produced by individuals and dyads when recall was delayed. A two-way interaction involving collaborative condition and recall condition was found significant, $F(1, 90) = 7.25, p < .008$. As shown in Figure 11, individuals from the spouse condition ($M = 18.85, SD = 10.94$) made fewer elaborative statements than married couples ($M = 36.63, SD = 13.46$). Whereas individuals from the stranger condition ($M = 21.19, SD = 8.61$) and unacquainted dyads ($M = 26.75, SD = 9.75$), as shown in Figure 11, made a similar number of elaborative statements.



Note. IND = individual immediate recall, DELDYAD = dyad delayed recall, DYAD = dyad immediate recall, and DELIND = individual delayed recall.

Figure 10. Strangers' immediate and delayed story recall performance.

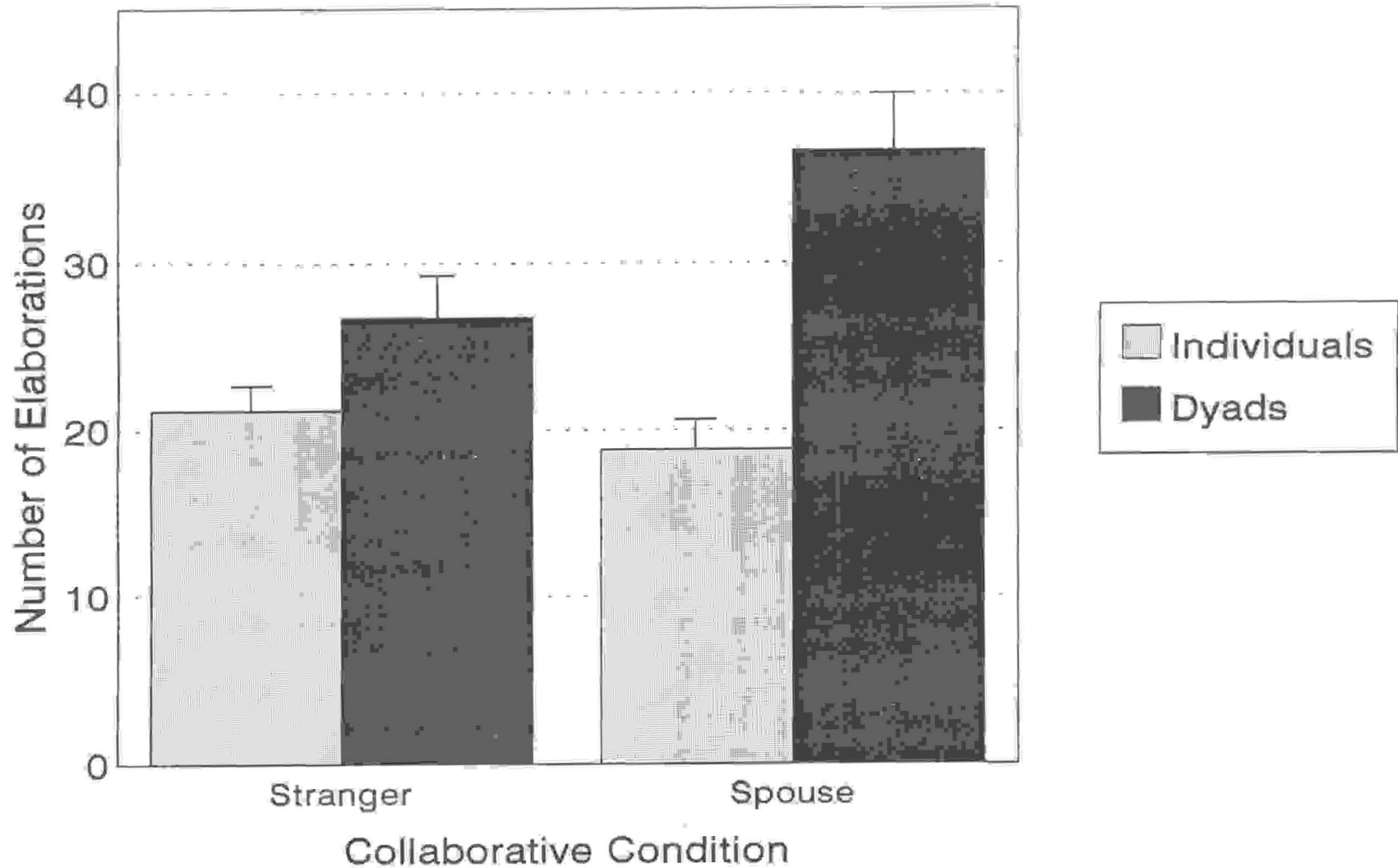


Figure 11. The number of elaborations made in delayed recall as a function of recall condition and collaborative condition.

A main effect of age and a main effect of recall condition was also significant, $F(1, 90) = 5.56, p < .020$ and $F(1, 90) = 19.98, p < .001$, respectively. The age effect revealed that younger individuals and dyads ($M = 26.40, SD = 12.56$) made significantly more elaborative statements than older individuals and dyads ($M = 21.32, SD = 11.22$). Moreover, the recall condition effect shows that dyads ($M = 31.69, SD = 12.60$) made more elaborations than individuals ($M = 19.98, SD = 9.88$). The remaining results were nonsignificant.

Macrostatements. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the number of summary or macrostatements made by individuals and dyads with delayed recall. Only the main effect of collaborative condition was significant, $F(1, 90) = 28.16, p < .001$. The participants from the married couples ($M = 2.10, SD = 1.59$) made significantly more macrostatements than participants from the unacquainted dyads ($M = .77, SD = .78$).

Metastatements. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the number of metastatements made with delayed recall. Significant main effects of collaborative condition and recall condition were found, $F(1, 90) = 4.21, p < .043$ and $F(1, 90) = 13.14, p < .001$, respectively. Those participants from the unacquainted dyads condition ($M =$

4.15, $SD = 3.85$) made significantly more metastatements than those participants from the married couples condition ($M = 2.72$, $SD = 2.93$). Furthermore, individuals ($M = 4.24$, $SD = 3.73$) made significantly more metastatements than dyads ($M = 1.72$, $SD = 1.99$). The remaining main effect and all interactions were nonsignificant.

Repetitions. A 2 (age) \times 2 (collaborative condition) \times 2 (recall condition) ANOVA was performed on the number of repetitions made when a story was recalled for a second time. A main effect of collaborative condition, $F(1, 90) = 6.67$, $p < .001$, was the only effect to reach statistical significance. Individuals and dyads from the married couples condition repeated themselves significantly more often than individuals and dyads from the stranger dyads condition ($M = 4.34$, $SD = 6.86$; $M = 1.79$, $SD = 2.72$, respectively).

Errors. A 2 (age) \times 2 (collaborative condition) \times 2 (recall condition) ANOVA was used to test the effects of age and collaborative experience on the number of errors made by individuals and dyads. There was a significant main effect of age, $F(1, 90) = 4.60$, $p < .035$. Older individuals and dyads ($M = 2.44$, $SD = 1.46$) made significantly more errors than younger individuals and dyads ($M = 2.06$, $SD = 1.73$). A two-way interaction between age and recall condition was also found significant, $F(1, 90) = 7.78$, $p < .035$. As shown in Figure 12, younger and older individuals made a

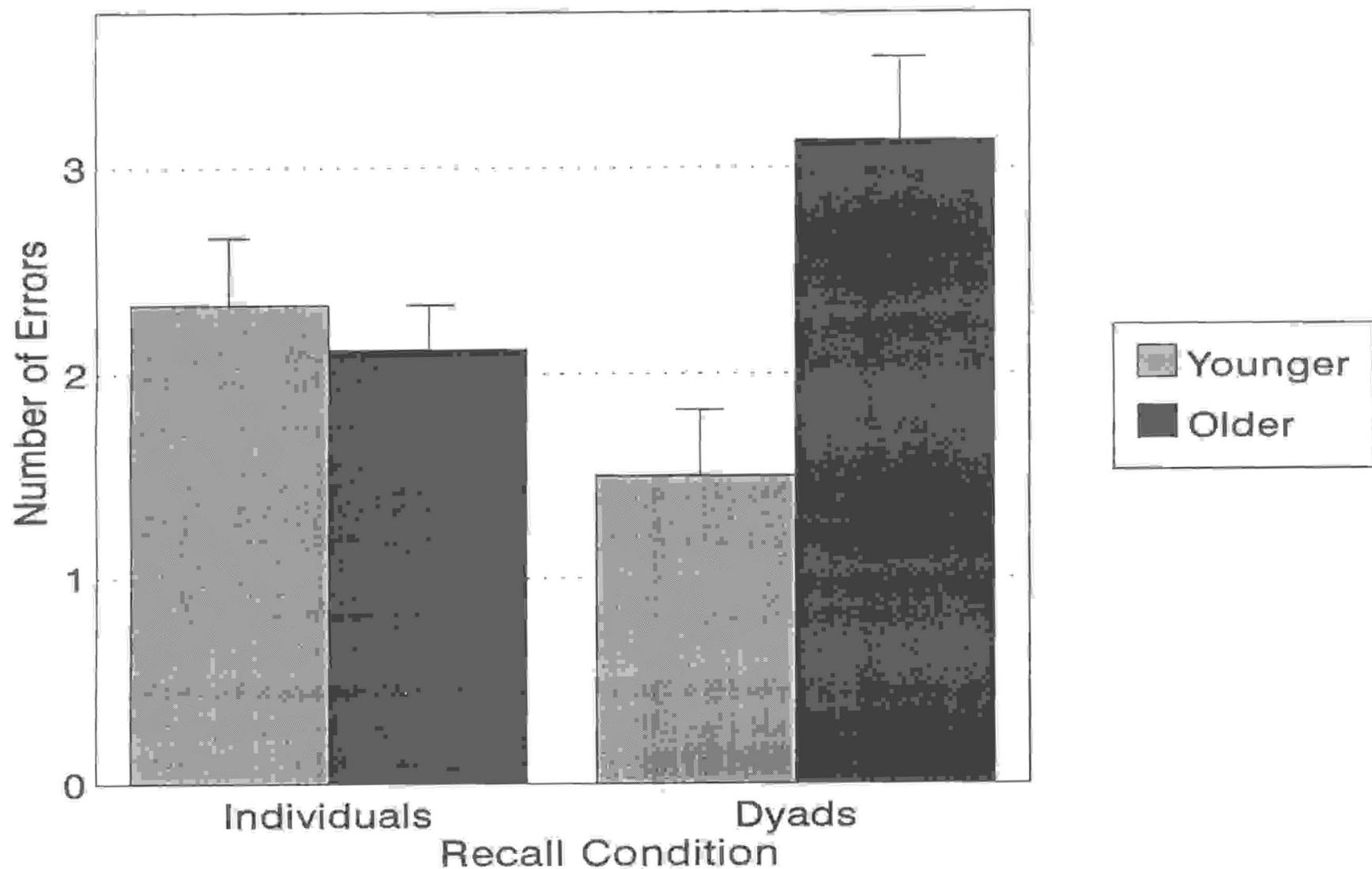


Figure 12. The number of errors made in delayed recall as a function of age and recall condition.

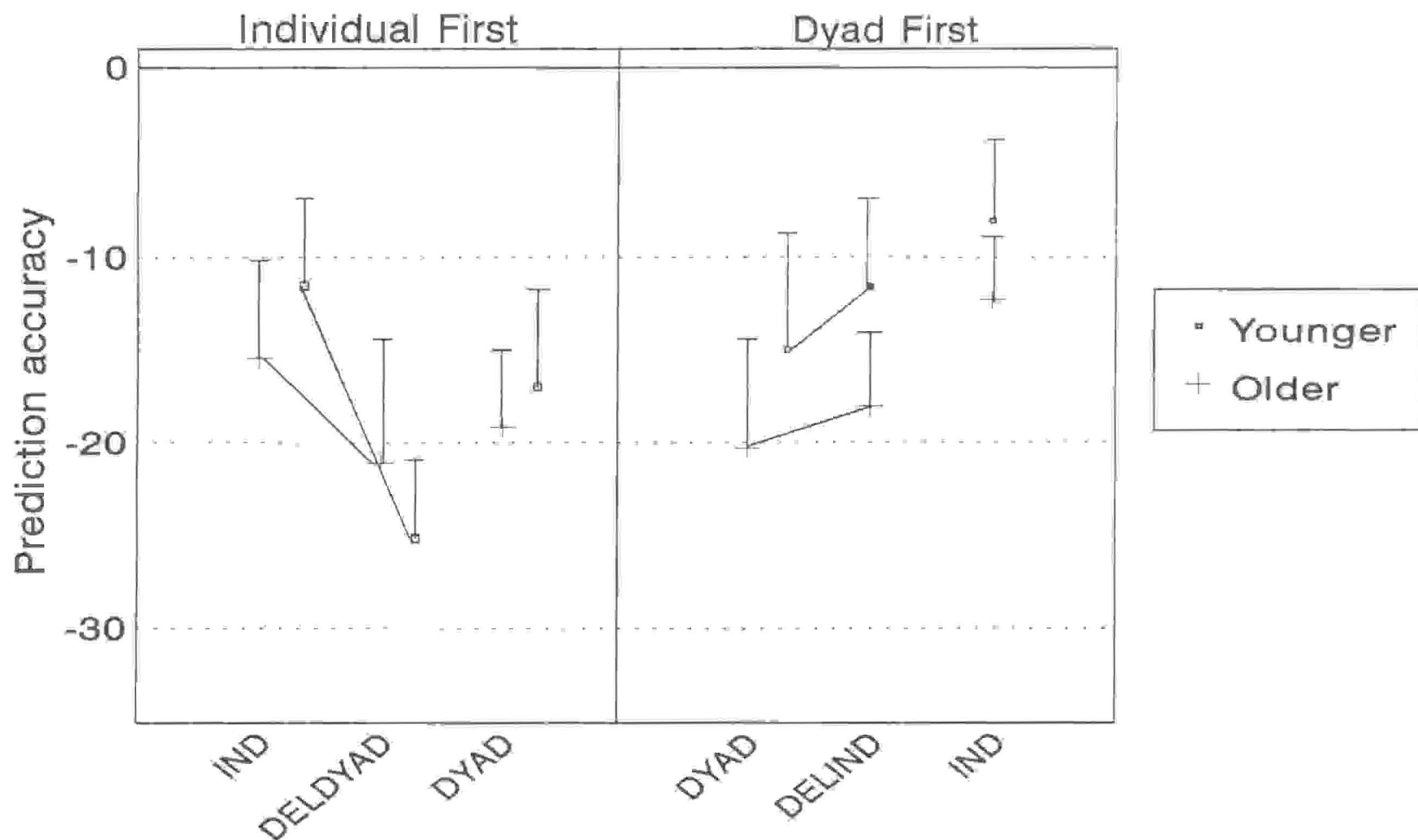
similar number of errors ($\underline{M} = 2.34$, $\underline{SD} = 1.86$; $\underline{M} = 2.12$, $\underline{SD} = 1.32$, respectively), whereas younger dyads ($\underline{M} = 1.50$, $\underline{SD} = 1.32$) made fewer errors than older dyads ($\underline{M} = 3.13$, $\underline{SD} = 1.54$). The means for younger stranger dyads ($\underline{M} = 1.38$, $\underline{SD} = 1.19$) and younger couples ($\underline{M} = 1.63$, $\underline{SD} = 1.92$) were similar, as were the means for the older stranger dyads ($\underline{M} = 3.25$, $\underline{SD} = 1.67$) and couples ($\underline{M} = 3.00$, $\underline{SD} = 1.59$).

Individuals separately. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) ANOVA was performed on the percentage of stories recalled with delay by individuals. Only a main effect of age was found to be significant, $F(1, 62) = 9.44$, $p < .003$. Younger individuals ($\underline{M} = 39.73\%$, $\underline{SD} = 14.10$) recalled more story information than older individuals ($\underline{M} = 29.68\%$, $\underline{SD} = 12.36$).

Dyads separately. A 2 (age) x 2 (collaborative condition) ANOVA was performed on dyads' delayed story recall performance. Only a main effect of age was found significant, $F(1, 28) = 10.78$, $p < .003$. Younger dyads ($\underline{M} = 45.81$, $\underline{SD} = 11.10$) recalled a higher percentage of story information than older dyads ($\underline{M} = 34.89$, $\underline{SD} = 6.84$).

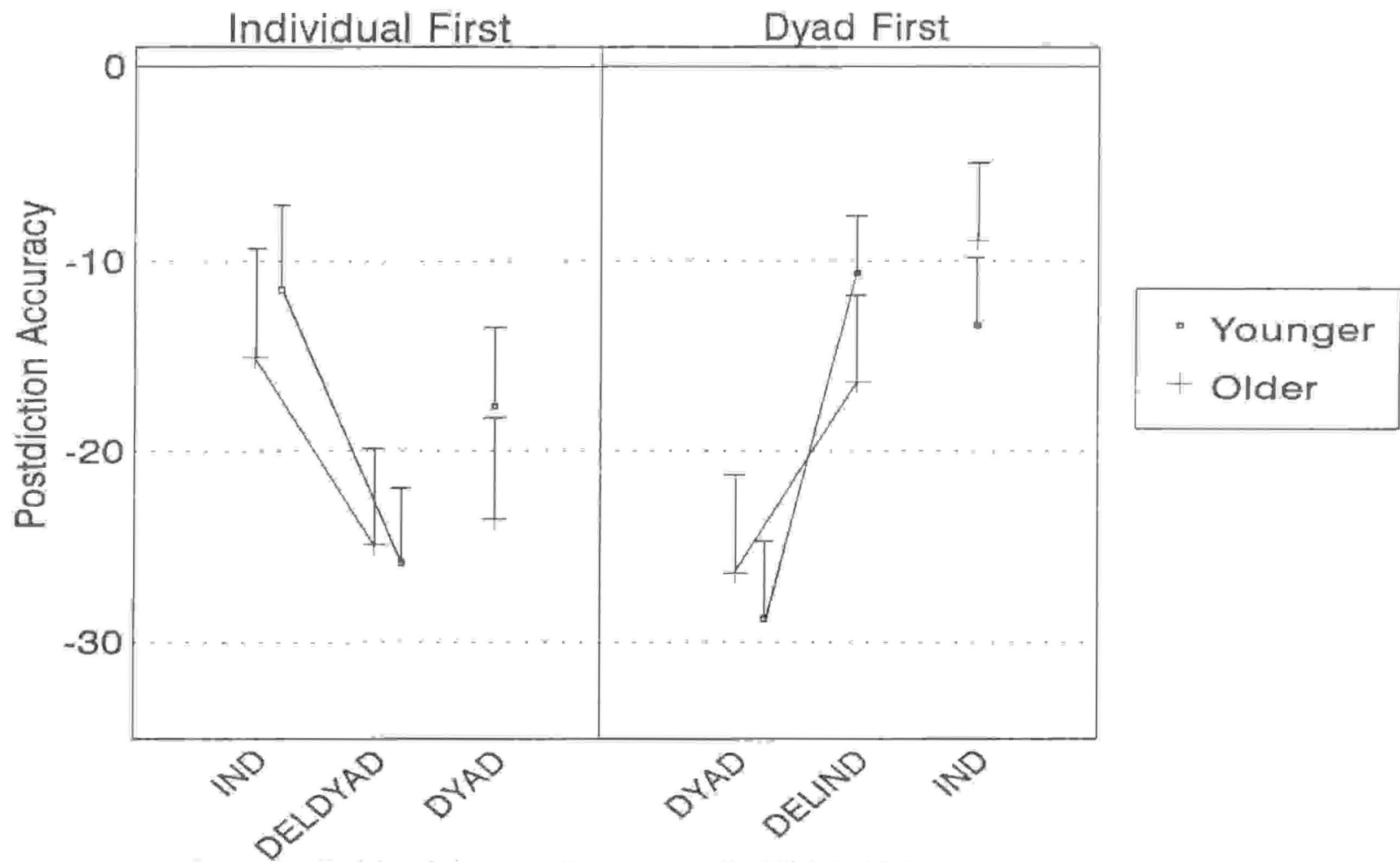
Monitoring of Delayed Recall

Change in accuracy of estimation. Figure 13 and Figure 14 represents spouses' prediction and postdiction accuracy, respectively, according to age, order, and recall condition. The accuracy measure used here, was simply the difference between performance and prediction (or postdiction).



Note. IND = individual immediate recall, DELDYAD = dyad delayed recall, DYAD = dyad immediate recall, and DELIND = individual delayed recall.

Figure 13. Spouses' prediction accuracy.



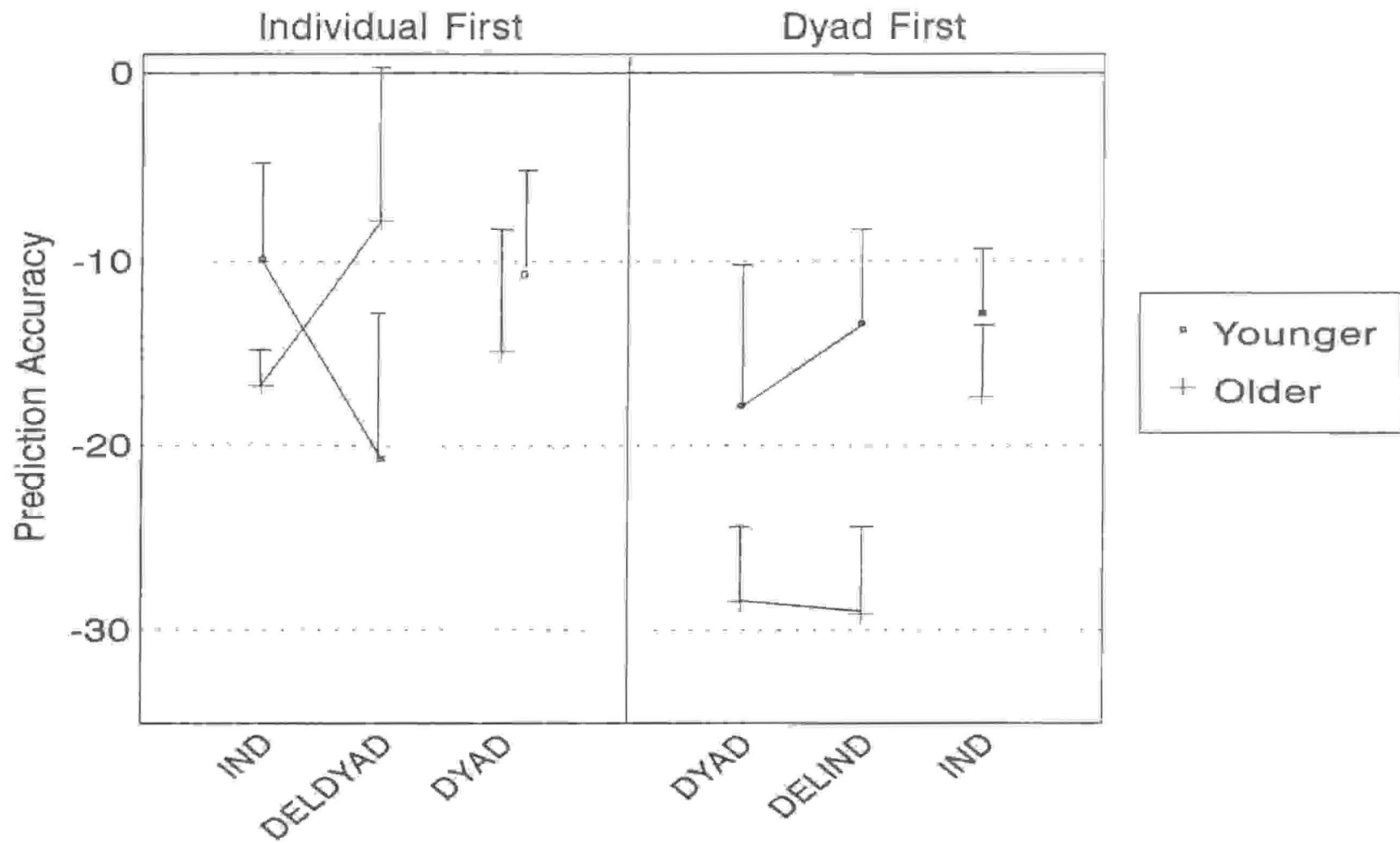
Note. IND = individual immediate recall, DELDYAD = dyad delayed recall, DYAD = dyad immediate recall, and DELIND = individual delayed recall.

Figure 14. Spouses' postdiction accuracy.

Therefore, while a positive difference indicates underestimation of performance, a negative difference indicates overestimation. Values closer to zero indicate better accuracy. As shown in both Figure 13 and Figure 14, individuals and couples were inaccurate in their predictions and postdictions by overestimating their performance. Moreover, prediction and postdiction accuracies were lower for both younger and older adults when working as couples than when working alone. It seems that younger and older adults, aware of the benefits of working with a partner, overestimated the benefit of working with another.

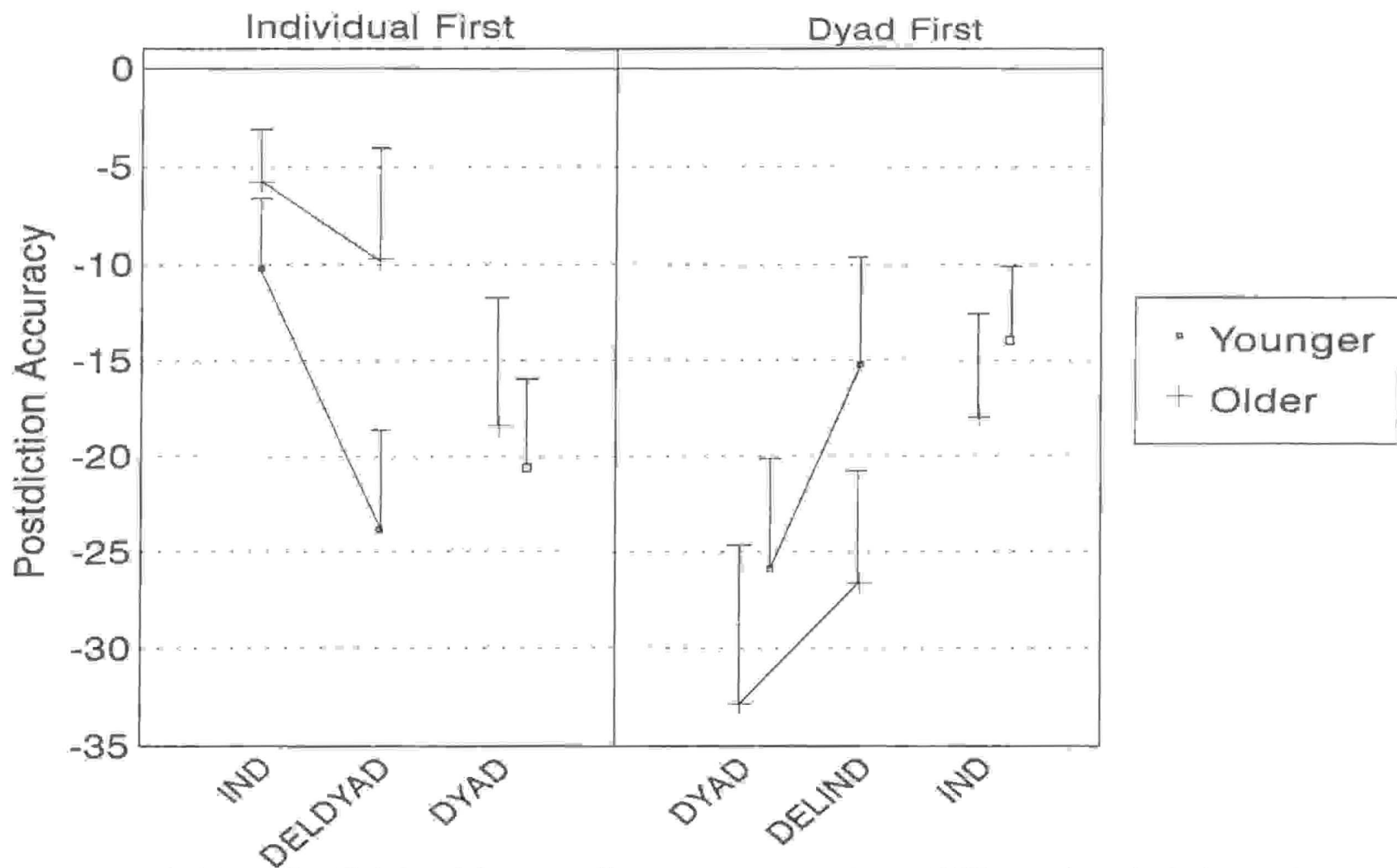
Figure 15 and Figure 16 represents strangers' prediction and postdiction accuracy, respectively, according to age, order, and recall condition. As was observed with couples, prediction and postdiction accuracies were, for both younger and older adults, generally lower in the collaborative situations than when working alone. Comparing the patterns for couples and strangers, suggest that postdiction accuracies in the two recall conditions were quite similar. Slightly difference pattern were observed for the prediction accuracies. For example, for strangers in the dyad-first recall condition, delayed individual prediction accuracies were slightly lower than were the immediate dyadic accuracies.

Counter-balance results. A 2 (age: young, old) x 2 (recall condition: individual, dyad) x 2 (collaborative



Note. IND = individual immediate recall, DELDYAD = dyad delayed recall, DYAD = dyad immediate recall, and DELIND = individual delayed recall.

Figure 15. Strangers' prediction accuracy.

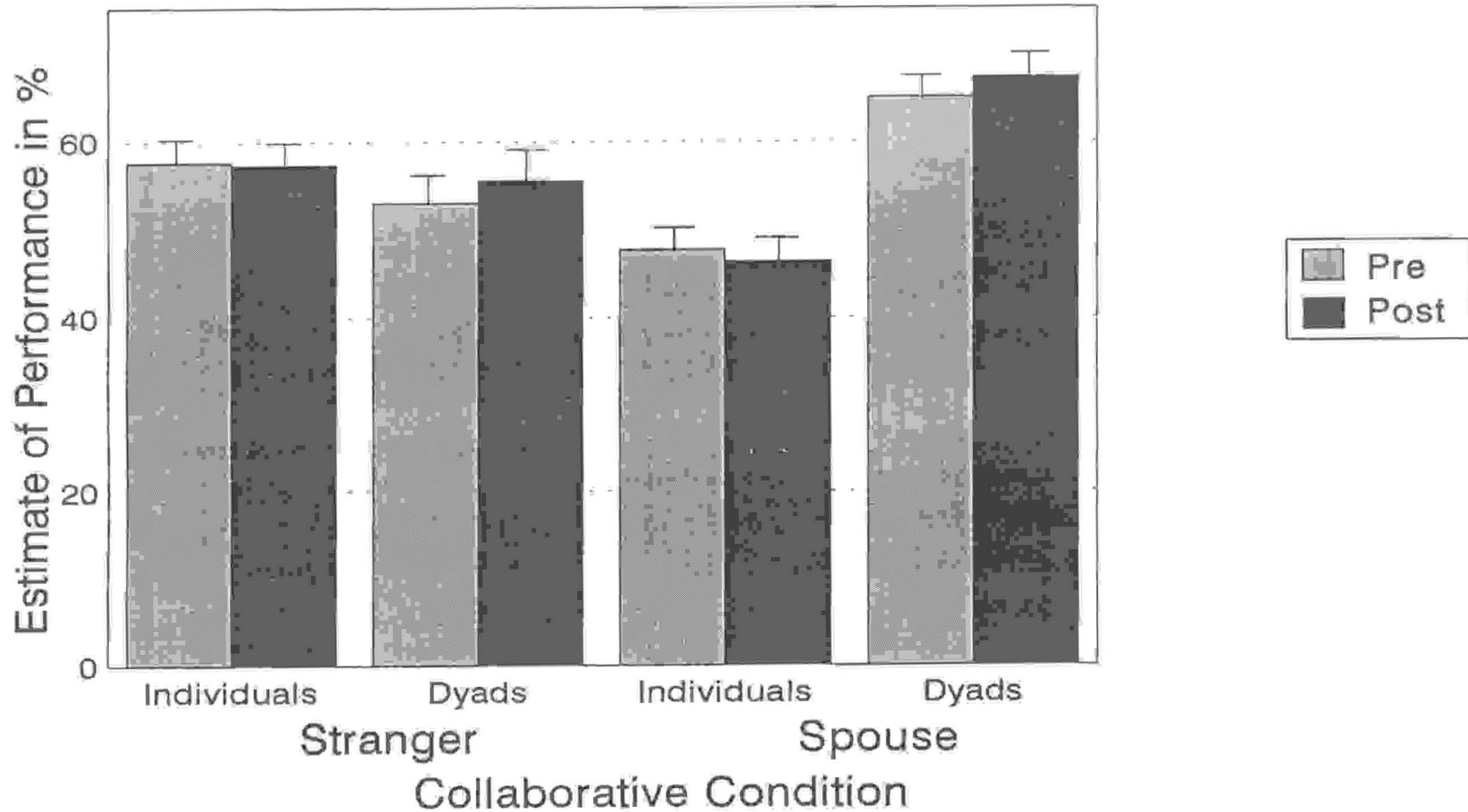


Note. IND = individual immediate recall, DELDYAD = dyad delayed recall, DYAD = dyad immediate recall, and DELIND = individual delayed recall.

Figure 16. Strangers' postdiction accuracy.

condition: spouse, stranger) x 2 (story: "Playing Cards," "ATrip Abroad") MANOVA was performed to test the effects of story on individuals' and dyads' estimates of delayed recall performance. A multivariate test of a three-way interaction with age, collaborative condition, and story was significant, Wilks' $F(2, 81) = 3.74, p < .028$. The follow-up univariate test was only significant for postdiction, $F(1, 82) = 6.36, p < .014$. As the multivariate main effect of story and the two-way interactions with story were nonsignificant, story was removed from subsequent analyses.

A 2 (age: young, old) x 2 (recall condition: individual, dyad) x 2 (collaborative condition: spouse, stranger) MANOVA was performed on predictions and postdictions of delayed story recall performance. The multivariate test of the two-way interaction between recall condition and collaborative condition was significant, Wilks' $F(2, 89) = 3.91, p < .024$. Both follow-up ANOVAs for predictions and postdictions, $F(1, 90) = 7.41, p < .008$ and $F(1, 90) = 6.43, p < .013$, respectively, were significant. The patterns were similar for both interactions. As shown in Figure 17, strangers working as individuals ($M = 57.66, SD = 13.68$ predictions; $M = 57.34, SD = 20.40$ postdictions) gave estimates that were similar to those given when working in dyads ($M = 53.12, SD = 24.69$ predictions; $M = 55.63, SD = 23.73$ postdictions). In contrast, for both predictions and postdictions, married



Note. Pre = predictions and Post = postdictions.

Figure 17. Predictions and postdictions of delayed story recall performance as a function of collaborative condition and recall condition.

couples gave lower estimates when working as individuals (\underline{M} = 47.79, \underline{SD} = 20.23 predictions; \underline{M} = 46.47, \underline{SD} = 21.02 postdictions) than when working as dyads (\underline{M} = 65.00, \underline{SD} = 19.32 predictions; \underline{M} = 67.19, \underline{SD} = 18.25 postdictions), although post hoc analyses showed this difference was nonsignificant.

The multivariate test of the two-way interaction between age and recall condition was significant, Wilks' \underline{F} (2,89) = 3.26, \underline{p} < .043. The follow-up univariate test for predictions of performance, \underline{F} (1, 90) = 6.58, \underline{p} < .012, was significant. As shown in Figure 18, younger adults working alone (\underline{M} = 52.19, \underline{SD} = 17.82) gave similar estimates of performance as older adults working alone (\underline{M} = 52.94, \underline{SD} = 18.30), but younger dyads (\underline{M} = 68.75, \underline{SD} = 19.28) gave higher estimates than older dyads (\underline{M} = 49.38, \underline{SD} = 22.05). The remaining results were nonsignificant.

Accuracy of estimation. The predictions and the postdictions of delayed recall performance was subtracted from performance to get prediction and postdiction accuracies, respectively. A 2 (age) x 2 (recall condition) x 2 (collaborative condition) multivariate analysis of variance was performed on prediction and postdiction accuracies. All results were nonsignificant.

The accuracy scores computed as the absolute difference between performance and estimates of performance (Devolder et al., 1990), were used in a 2 (age) x 2 (recall condition)

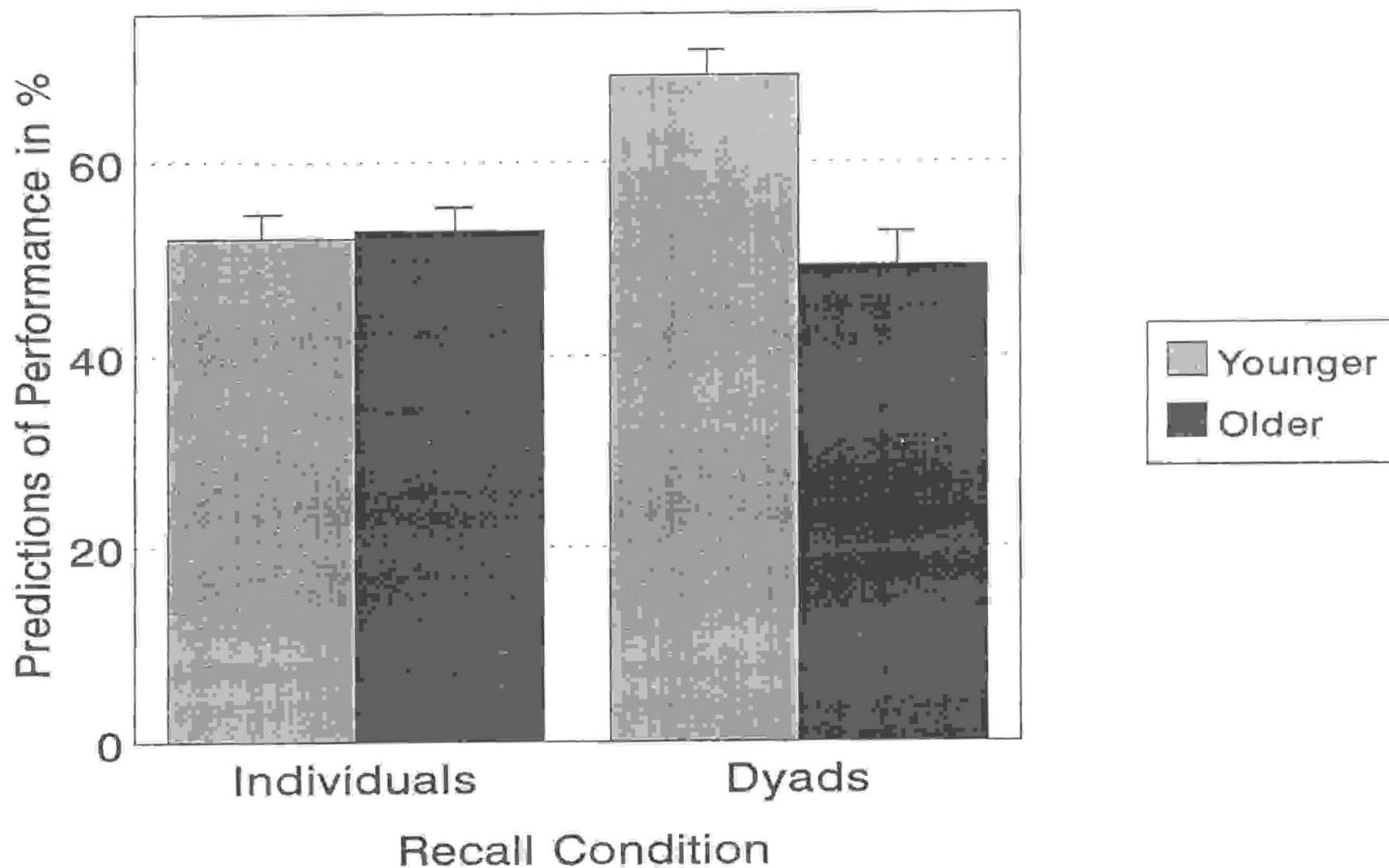


Figure 18. Predictions of delayed story recall performance as a function of age and recall condition.

x 2 (collaborative condition) MANOVA. The prediction accuracy and postdiction accuracy were the dependent variables. All the results were nonsignificant.

Table 6 shows the correlations between delayed recall performance and estimates of performance according to collaborative condition and age. The accuracy with which participants estimated their performance was quite variable ($r = -.40$ to $.88$). The correlations for individuals from the spouse condition ($r = .53$ to $.78$) were much better than those from the stranger condition ($r = -.40$ to $.37$). Also, older couples predictions ($r = .00$) and postdictions ($r = .39$) were less accurate than older stranger dyads ($r = .22$).

Individuals separately. A 2 (age) x 2 (collaborative condition) MANOVA was performed on individuals' predictions and postdictions of performance when recall was delayed. All results were nonsignificant.

A 2 (age) x 2 (collaborative condition) MANOVA was performed on the accuracies of prediction and postdiction estimates made by individuals recalling a second time. All results were nonsignificant.

Dyads separately. A 2 (age) x 2 (collaborative condition) MANOVA was performed on dyads' predictions and postdictions of performance when recall was delayed. The multivariate main effect of age was significant, Wilks' $F(2, 27) = 3.84, p < .034$. The follow-up ANOVAs revealed that for both predictions, $F(1, 28) = 7.26, p < .012$, and

Table 6

Correlations Between Delayed Story Recall Performance and Estimates of Delayed Recall Performance

| | Couples | | Strangers | |
|-------------------|---------|-------|-----------|-------|
| | Younger | Older | Younger | Older |
| <u>Individual</u> | | | | |
| Prediction | .53* | .55* | -.40 | -.02 |
| Postdiction | .78* | .60* | -.38 | .37 |
| <u>Dyad</u> | | | | |
| Prediction | .76* | .00 | .62 | .22 |
| Postdiction | .88* | .39 | .82* | .62 |

Note. * = $p < .05$.

postdictions, $F(1, 28) = 7.34$, $p < .011$, younger dyads ($M = 68.75$, $SD = 19.28$; $M = 70.63$, $SD = 20.24$, respectively) made higher estimates of performance than older dyads ($M = 49.38$, $SD = 22.05$; $M = 52.19$, $SD = 19.41$, respectively).

A 2 (age) x 2 (collaborative condition) MANOVA was used to analyze the accuracies of prediction and postdiction estimates made by dyads. Again, all results were nonsignificant.

Reminisced Items and Forgotten Items

A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (recall condition: individual, dyad) ANOVA was performed on the number of reminisced items (RI). The two-way interaction between age and recall condition was the only significant result, $F(1, 90) = 6.30$, $p < .014$. As shown in Figure 19, younger individuals ($M = 6.28$, $SD = 2.95$) had a higher number of RI compared to older individuals ($M = 4.62$, $SD = 2.82$). In contrast older dyads ($M = 6.56$, $SD = 3.74$) had a higher number of RI compared to younger dyads ($M = 4.81$, $SD = 3.27$).

A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the number of items forgotten (FI) in the delayed story recall task. A two-way interaction between age and collaborative condition was significant, $F(1, 90) = 6.62$, $p < .012$. As shown in Figure 20, younger individuals and couples participating in the spouse condition ($M = 12.79$, $SD = 6.64$) forgot fewer items

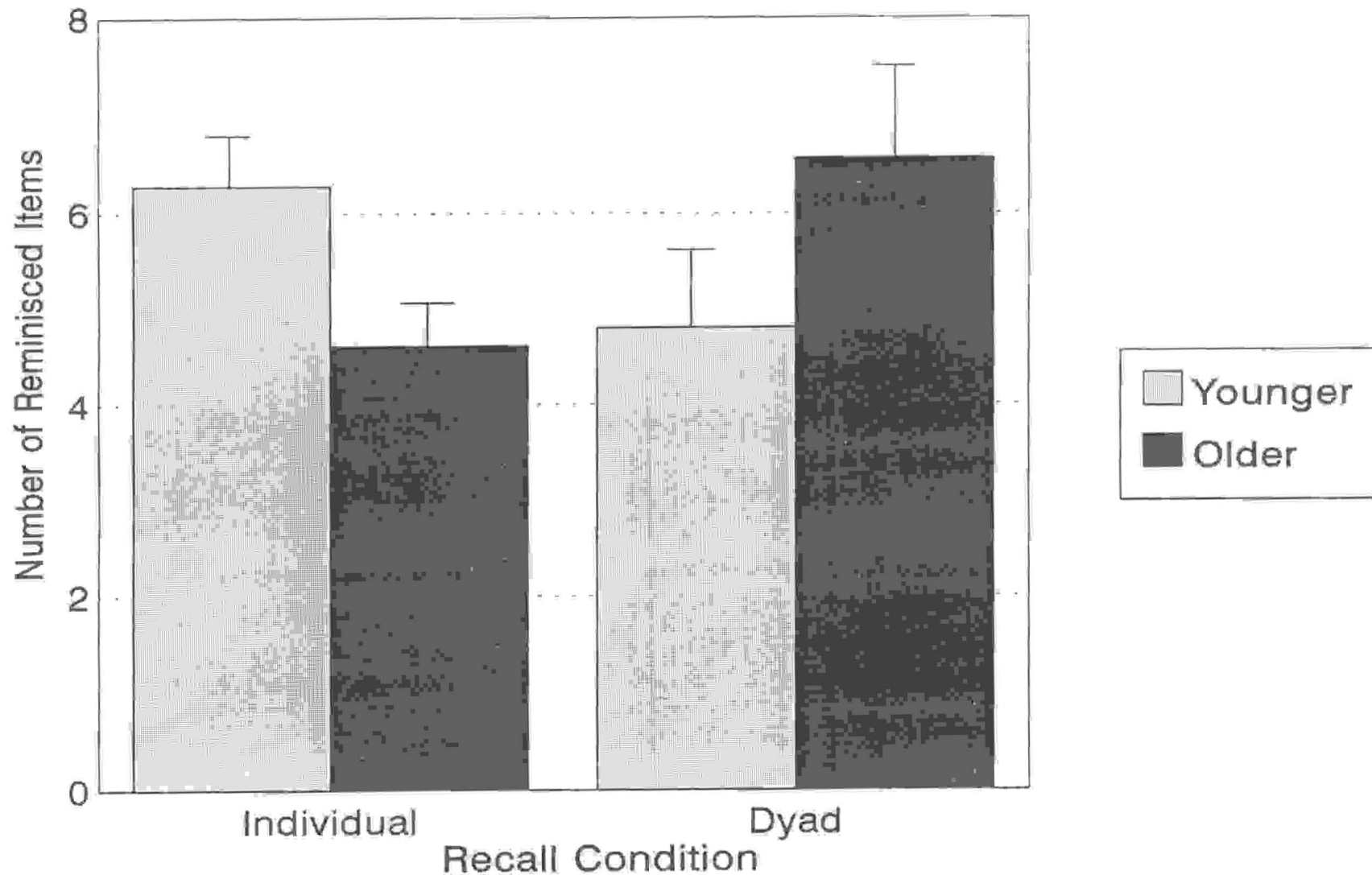


Figure 19. The number of reminisced items as a function of age and recall condition.

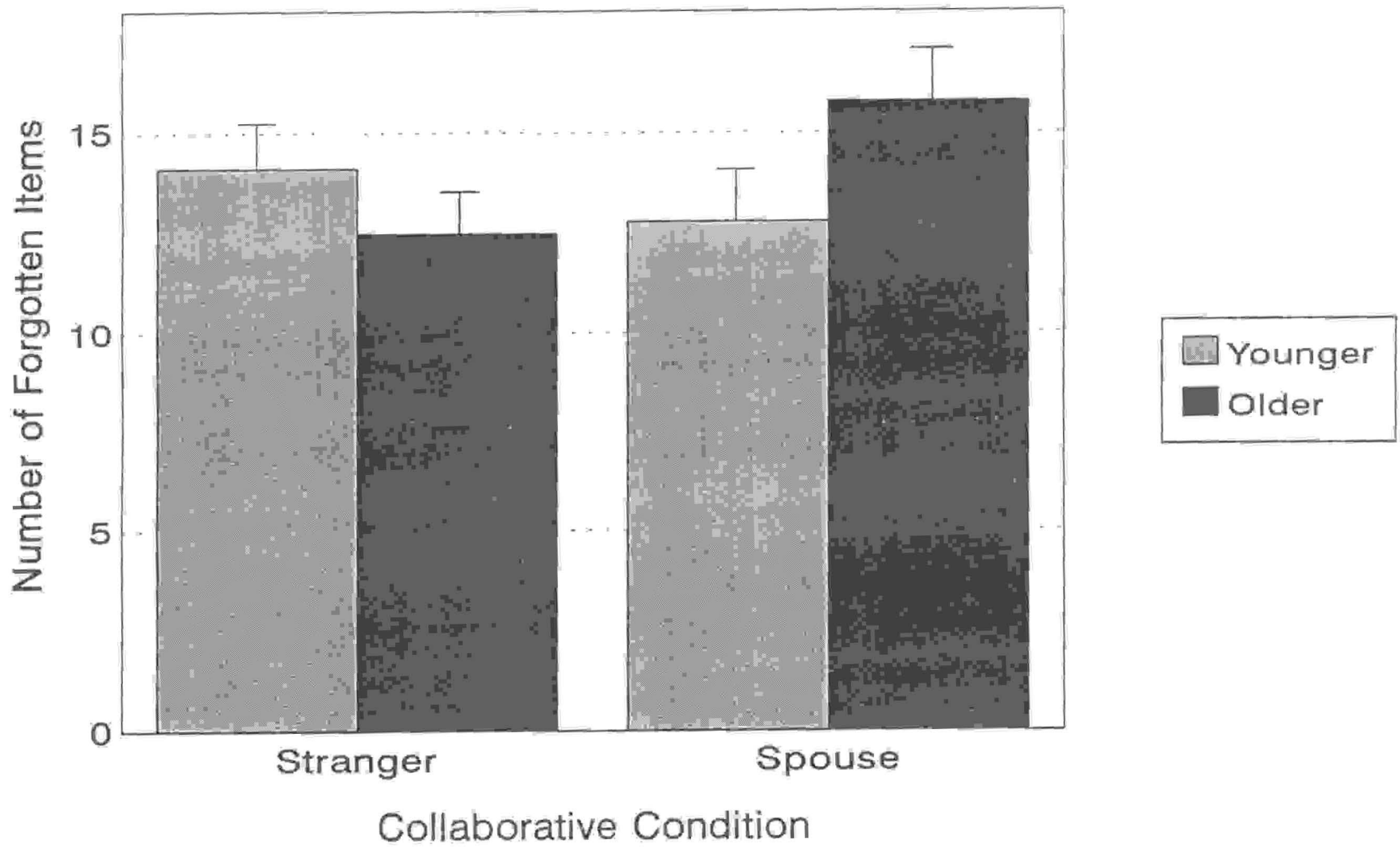


Figure 20. The number of forgotten items as a function of age and collaborative condition.

than older individuals and dyads in the spouse condition ($\underline{M} = 15.77$, $\underline{SD} = 6.47$). In contrast, younger individuals and dyads participating in the stranger condition ($\underline{M} = 14.13$, $\underline{SD} = 5.72$) forgot more items than older individuals and dyads in the stranger condition ($\underline{M} = 12.50$, $\underline{SD} = 5.09$).

A two-way interaction between age and recall condition was also significant, $F(1, 90) = 5.75$, $p < .019$. This interaction, seen in Figure 21, shows that younger individuals ($\underline{M} = 12.09$, $\underline{SD} = 6.01$) forgot fewer items than older individuals ($\underline{M} = 14.82$, $\underline{SD} = 6.04$). Whereas younger dyads ($\underline{M} = 16.19$, $\underline{SD} = 5.71$) forgot more items than older dyads ($\underline{M} = 12.88$, $\underline{SD} = 5.95$). The three-way interaction between age, collaborative condition and recall condition was also significant, $F(1, 90) = 4.72$, $p < .032$. As shown in the left-hand panel of Figure 22, younger individuals from the stranger condition ($\underline{M} = 11.88$, $\underline{SD} = 4.49$) forgot fewer items than older individuals from the stranger condition ($\underline{M} = 14.06$, $\underline{SD} = 5.13$). Similarly, younger individuals from the spouse condition ($\underline{M} = 12.31$, $\underline{SD} = 7.38$, respectively) forgot fewer story items than older individuals from the spouse condition ($\underline{M} = 15.50$, $\underline{SD} = 6.82$). As shown in the right-hand side of Figure 22, younger stranger dyads ($\underline{M} = 18.63$, $\underline{SD} = 5.45$) forgot many more items than older stranger dyads ($\underline{M} = 9.38$, $\underline{SD} = 3.46$). In contrast, older married couples ($\underline{M} = 16.38$, $\underline{SD} = 6.00$) forgot more story information than younger married couples

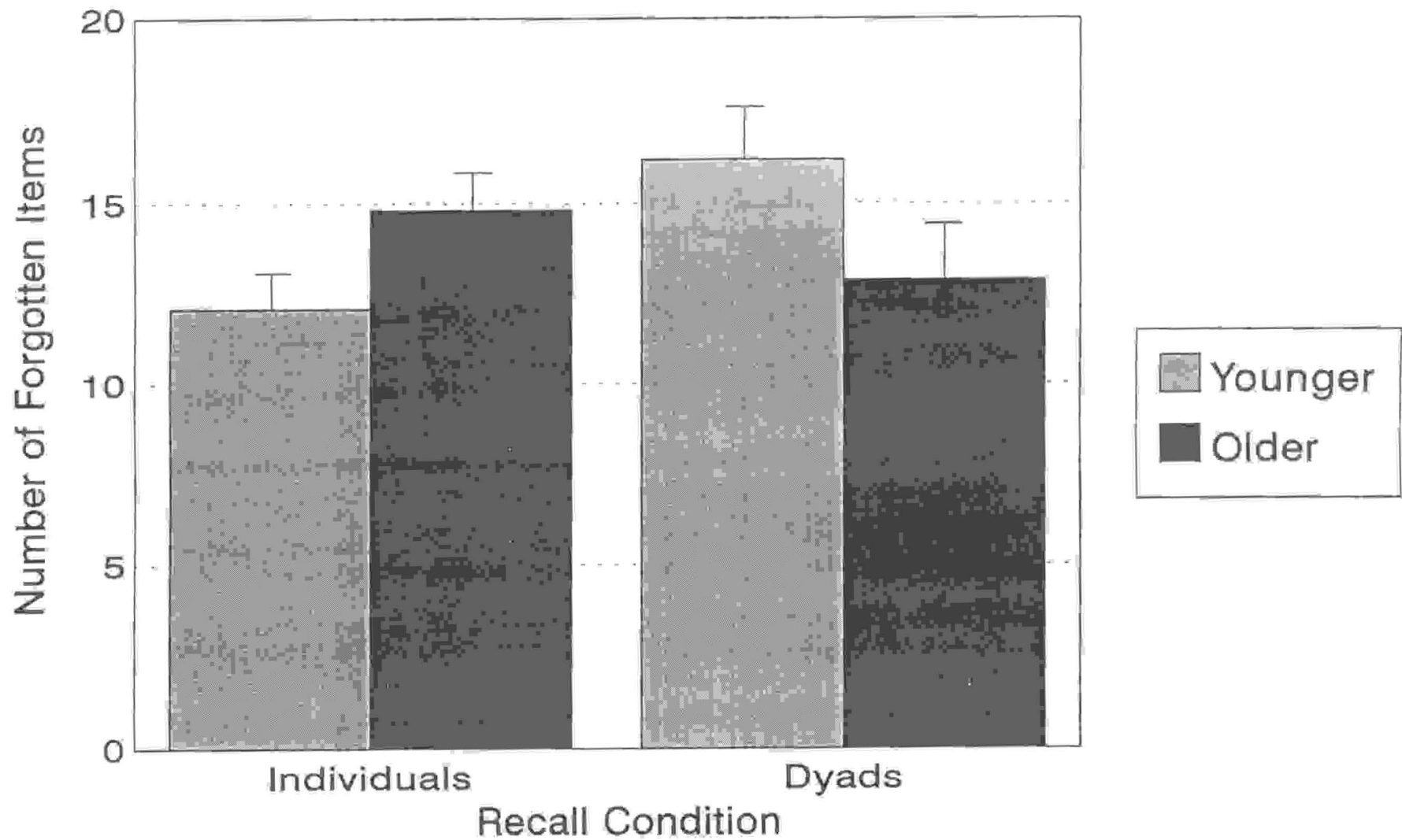


Figure 21. The number of forgotten items as a function of age and collaborative condition.

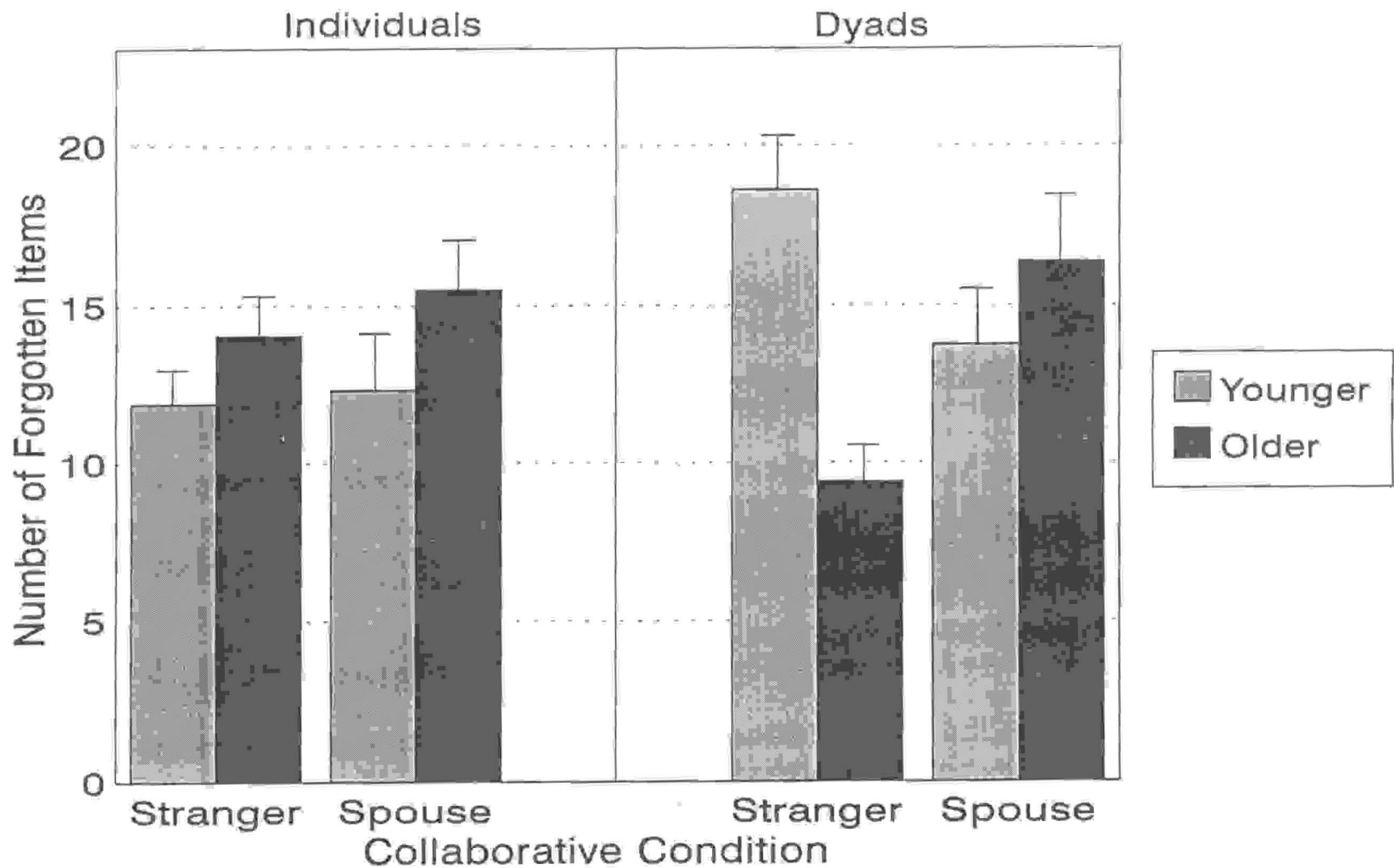


Figure 22. The number of forgotten items as a function of age, recall condition, and collaborative condition.

($M = 13.75$, $SD = 5.15$).

Reminisced and forgotten items difference. Like Andersson and Rönnerberg (1995), the difference between the number of reminisced items and the number of forgotten items was calculated. A negative difference indicates that there were more forgotten items than reminisced items, whereas a positive difference indicates that there were more reminisced items than forgotten items and better performance. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the RI and FI difference for individuals and dyads. Only a two-way interaction involving age and recall condition was found significant, $F(1, 90) = 9.68$, $p < .002$. As depicted in Figure 23, younger individuals ($M = -5.81$, $SD = 7.33$) had a much higher difference than older individuals ($M = -10.21$, $SD = 6.78$), which indicates that younger individuals reminisced more items when taking into account the number of forgotten items than older individuals. In contrast, younger dyads ($M = -11.38$, $SD = 5.94$) had a much lower difference than older dyads ($M = -6.31$, $SD = 7.89$). Younger dyads, in comparison to older dyads, reminisce fewer items when taking into account forgotten items. As shown in Figure 23, it seems that older dyads are benefitting in their collaborations when compared to older individuals, but younger dyads do not benefit from their collaborations when compared to younger individuals.

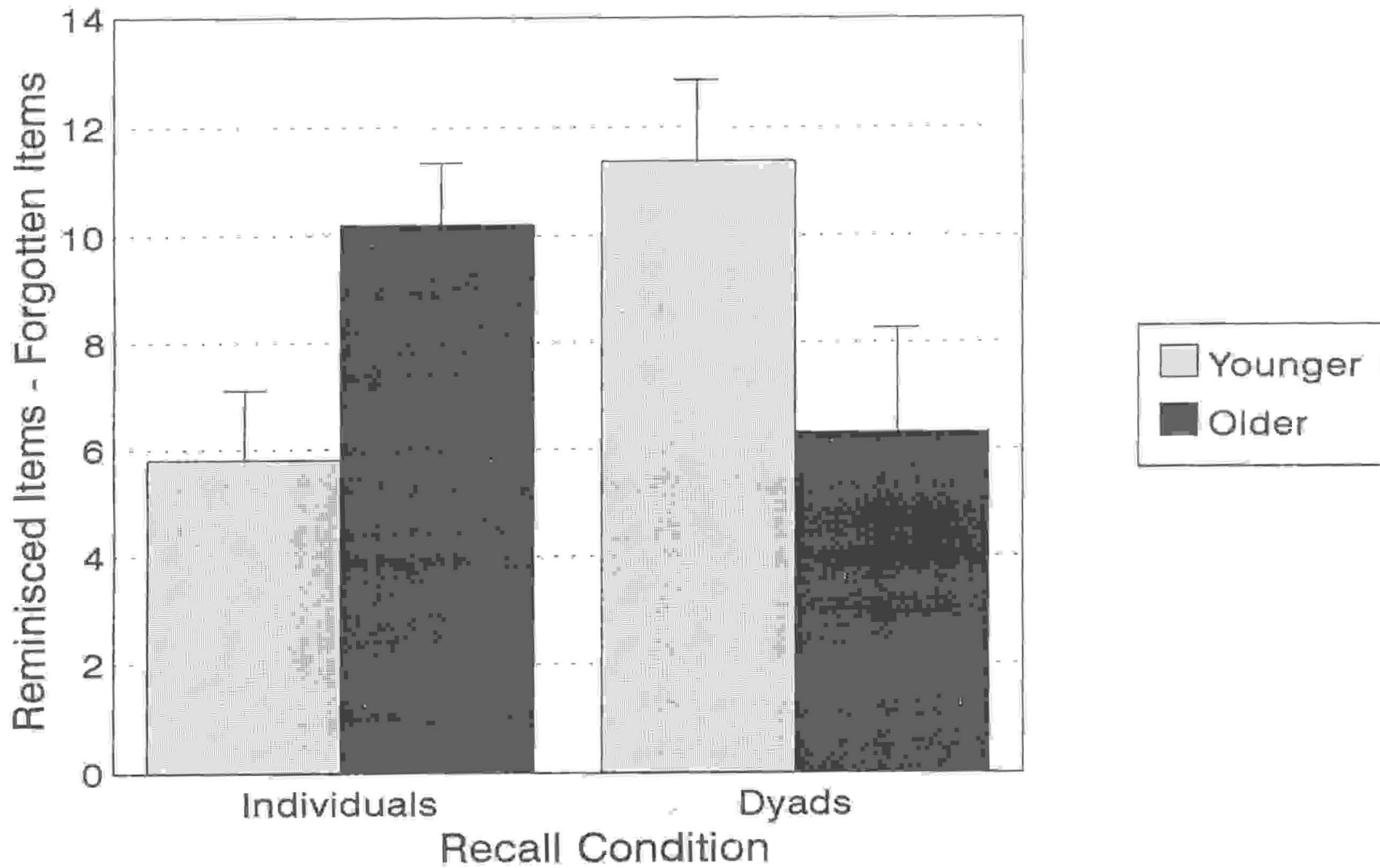


Figure 23. Reminisced items and forgotten items difference as a function of age and recall condition.

Reminisced and forgotten items ratio. As a more direct measure, the ratio between the number of reminisced items and forgotten items was also calculated. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on the ratio of reminisced items (RI) to forgotten items (FI) for individuals and dyads. A two-way interaction between age and recall condition was significant, $F(1, 90) = 7.21, p < .009$. Shown in Figure 24, younger individuals ($M = .84, SD = 1.14$) reminisced more items per forgotten item than older individuals ($M = .38, SD = .28$). In opposition, older dyads ($M = .71, SD = .68$) had a higher ratio reminisced items per forgotten item than younger dyads ($M = .31, SD = .21$).

Reminisced items and propositions ratio. A ratio between the number of reminisced items and the number of story propositions recalled, when recall was delayed, was calculated. A 2 (age) x 2 (collaborative condition) x 2 (recall condition) ANOVA was performed on this ratio. Only a main effect of age was observed, $F(1, 90) = 4.70, p < .033$. Older adults ($M = .21, SD = .21$) reminisced more items per proposition recalled than younger adults ($M = .15, SD = .09$).

Forgotten items and propositions ratio. The ratio between the number forgotten items and number of story propositions recalled, when recall was delayed, was calculated. A 2 (age) x 2 (collaborative condition) x 2

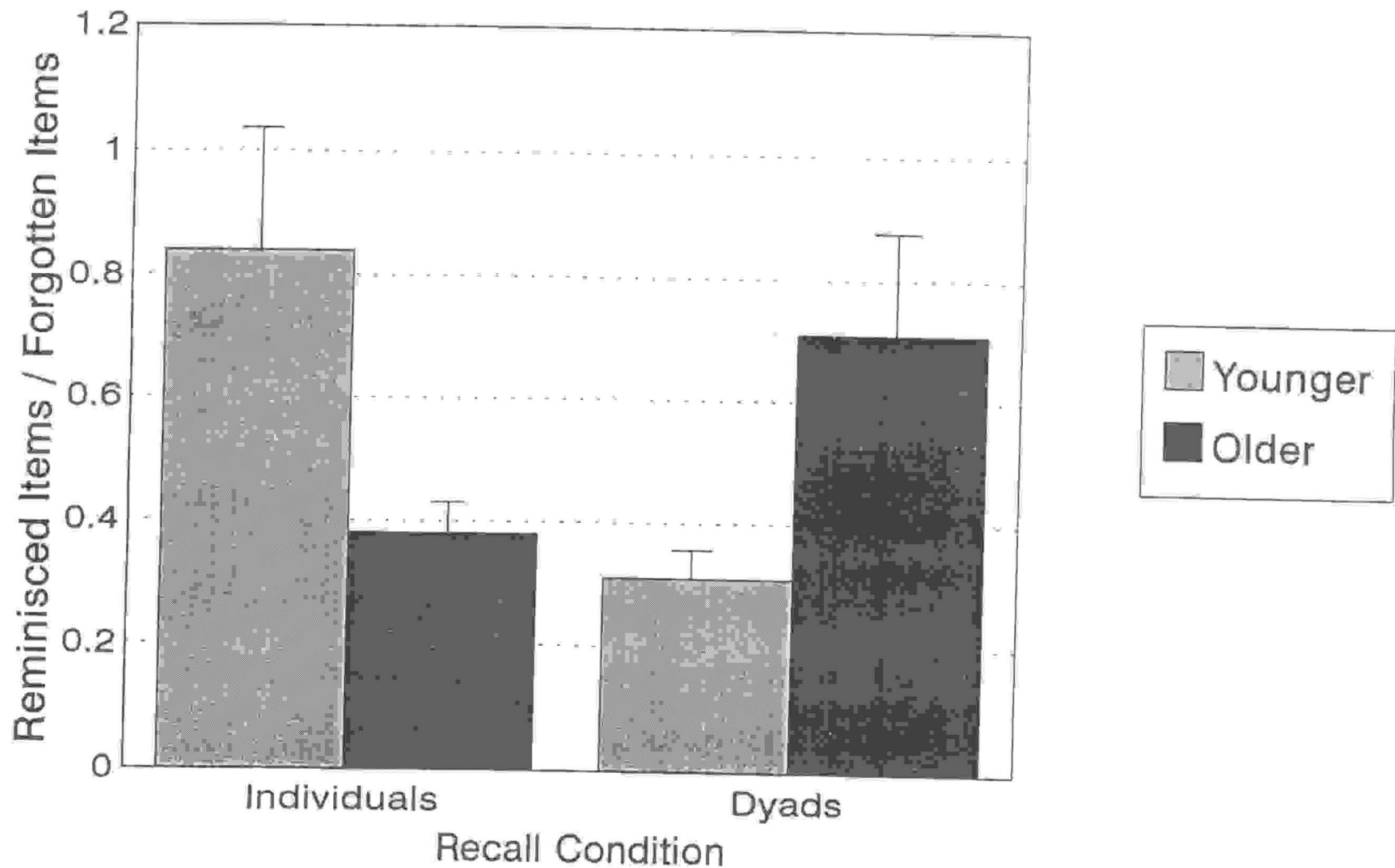


Figure 24. Reminisced items to forgotten items ratio as a function of age and recall condition.

(recall condition) ANOVA was performed on individuals' and dyads' ratio. All results were nonsignificant.

Individuals separately. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) ANOVA was performed on the number of reminisced items by individuals. The main effect of age was significant, $F(1, 62) = 5.22, p < .026$. Younger individuals ($M = 6.28, SD = 2.95$) reminisced significantly more items than older individuals ($M = 4.62, SD = 2.82$).

A 2 (age) x 2 (collaborative condition) ANOVA was performed on the number of forgotten items by individuals. The interaction and the main effects were nonsignificant.

A 2 (age) x 2 (collaborative condition) ANOVA was performed on the difference between reminisced and forgotten items for individuals. A main effect of age was significant, $F(1, 62) = 6.09, p < .016$. Younger individuals ($M = -5.81, SD = 7.33$) reminisced more items to forgotten items than older individuals ($M = -10.21, SD = 6.78$).

Dyads separately. A similar 2 (age) x 2 (collaborative condition) ANOVA was performed on the RI by dyads. All results were nonsignificant.

A 2 (age) x 2 (collaborative condition) ANOVA was performed on the number of forgotten items by dyads. The age by collaborative condition interaction was significant, $F(1, 28) = 10.83, p < .003$, such that younger spouses ($M =$

13.75, $SD = 5.15$) forgot fewer items than older spouses ($M = 16.38$, $SD = 6.00$), but younger unacquainted dyads ($M = 18.63$, $SD = 5.45$) more items than older unacquainted dyads ($M = 9.38$, $SD = 3.46$).

A 2 (age) x 2 (collaborative condition) ANOVA was performed on dyads' reminisced items and forgotten items difference. The main effect of age was significant, with $F(1, 28) = 4.48$, $p < .043$. Older dyads ($M = -6.31$, $SD = 7.89$) had a significantly higher difference than younger dyads ($M = -11.38$, $SD = 5.94$).

Memory Self-Efficacy Questionnaire

Confidence ratings. A 2 (age) x 2 (recall condition) x 2 (collaborative condition) MANOVA was performed on the confidence ratings for the story and the hardware scales of the MSEQ. The multivariate tests of recall condition, Wilks' $F(2, 185) = 7.43$, $p < .001$, and age, Wilks' $F(2, 185) = 13.61$, $p < .001$, were significant. The follow-up ANOVAs for the hardware task revealed a significant effect for recall condition, $F(1, 186) = 14.84$, $p < .001$, such that the average confidence ratings were higher when working with a partner ($M = 63.95$, $SD = 21.73$) than when working alone ($M = 51.46$, $SD = 21.71$). For both story and hardware, the univariate tests showed that there was a significant age difference, $F(1, 186) = 25.26$, $p < .001$ and $F(1, 186) = 7.25$, $p < .008$, respectively. For both story and hardware scales, older adults ($M = 10.67$, $SD = 10.87$; $M = 51.40$, $SD =$

22.03, respectively) gave significantly lower confidence ratings than younger adults ($M = 21.85$, $SD = 18.38$; $M = 60.01$, $SD = 22.15$, respectively). The remaining results were nonsignificant.

Change in confidence ratings. As a measure of the change in confidence ratings, going from easy to difficult tasks, a repeated measures analyses of variance was performed on the easiest two levels of the story scale of the MSEQ. The first two levels were chosen as most participants (both individual and dyad) responded that they were able to perform these two tasks, but responded that they were unable to perform tasks beyond the second level. Hence, the confidence ratings reported on the first two levels from the story scale were analyzed in a 2 (age: young, old) \times 2 (collaborative condition: spouse, stranger) \times 2 (recall condition: individual, dyad) \times 2 (confidence level: easiest, second easiest) ANOVA with repeated measures on the last factor. A main effect of age was found significant, $F(1, 187) = 26.37$, $p < .001$, such that younger ($M = 44.84$, $SD = 31.98$) participants gave higher confidence ratings, averaged across the two levels, than the older ($M = 23.84$, $SD = 25.76$) participants. Moreover, a main effect of collaborative condition was also significant, $F(1, 187) = 4.79$, $p < .030$, such that spouses ($M = 37.62$, $SD = 31.50$) gave higher confidence ratings than strangers ($M = 30.63$, $SD = 29.75$). There was a significant difference, $F(1, 187) =$

178.42, $p < .001$, between the confidence ratings for the easiest level ($M = 47.64$, $SD = 38.66$) and those for the second easiest level ($M = 20.72$, $SD = 28.17$).

Several interactions were also significant. The two-way interaction between age and confidence level was significant, $F(1, 187) = 178.42$, $p < .005$. Older adults gave more similar confidence ratings to the easiest ($M = 35.15$, $SD = 35.24$) and the second easiest ($M = 12.53$, $SD = 21.30$) tasks than younger adults ($M = 60.52$, $SD = 37.96$; $M = 29.17$, $SD = 31.78$, respectively). The three-way interaction between age, collaborative condition, and confidence level was significant, $F(1, 187) = 6.70$, $p < .010$. As seen in Figure 25, younger individuals and dyads from the spouse condition ($M = 63.54$, $SD = 38.06$; $M = 35.42$, $SD = 34.21$) gave slightly more similar confidence ratings to the easiest and the second easiest task levels than did younger individuals and dyads from the stranger condition ($M = 57.50$, $SD = 38.01$; $M = 22.29$, $SD = 28.13$). Whereas older individuals and dyads from the spouse and the stranger condition ($M = 12.55$, $SD = 20.28$; $M = 12.50$, $SD = 22.55$ respectively) gave similar confidence ratings to the second easiest level, those participants from the spouse condition ($M = 40.39$, $SD = 35.44$) gave higher confidence ratings than the participants from the stranger condition ($M = 29.58$, $SD = 34.52$) on the easiest level.

The three-way interaction between age, recall

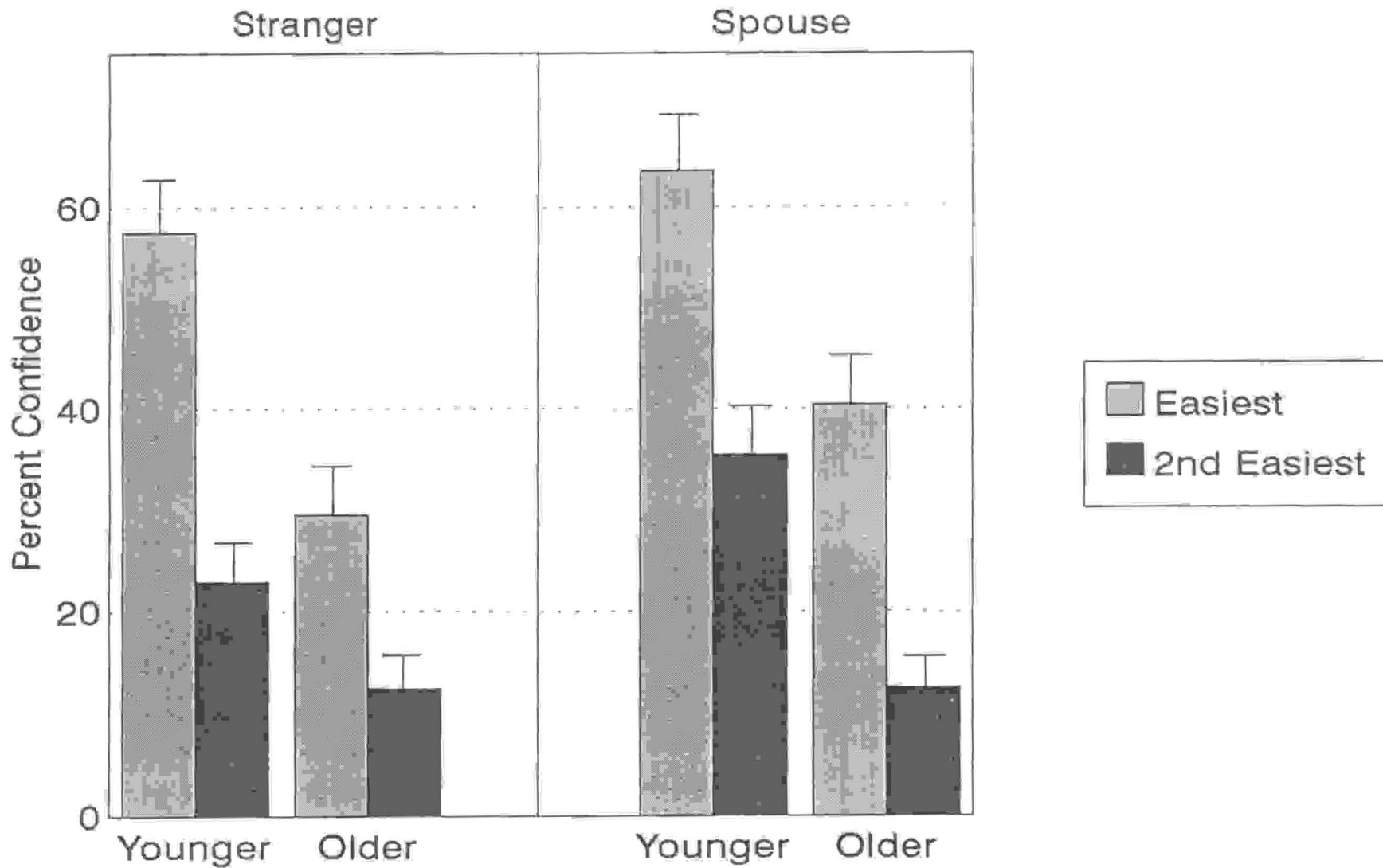


Figure 25. Change in confidence ratings for story as a function of collaborative condition and age.

condition, and confidence level was also significant, $F(1,187) = 4.43, p < .037$. Figure 26 shows that older adults give a similar confidence rating, both levels, when working alone ($M = 35.76, SD = 34.78; M = 11.67, SD = 21.60$, easiest and second easiest respectively) or when working with a partner ($M = 33.94, SD = 36.65; M = 14.24, SD = 20.92$). In contrast, younger adults give a much higher confidence rating to working with a partner ($M = 70.63, SD = 32.12$) than to working alone ($M = 55.47, SD = 39.84$) on the easiest task level, but gave similar confidence ratings on the second easiest task level ($M = 30.63, SD = 31.41; M = 28.44, SD = 32.18$, working with a partner and alone respectively). All remaining results were nonsignificant.

Again as a measure of change in confidence, a repeated measures ANOVA was performed on four subscales of the hardware scales of the MSEQ. The first four easiest subscales were chosen, as the majority of participants responded that they could perform these tasks. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) x 2 (recall condition: individual, dyad) x 4 (confidence level: easiest, second, third, fourth easiest) ANOVA, with repeated measures on the last factor, was performed. A main effect of age was significant, $F(1, 185) = 5.96, p < .016$, such that younger adults ($M = 68.06, SD = 20.57$) gave higher confidence ratings than older adults ($M = 60.62, SD = 22.41$), average across all four task level difficulties. A

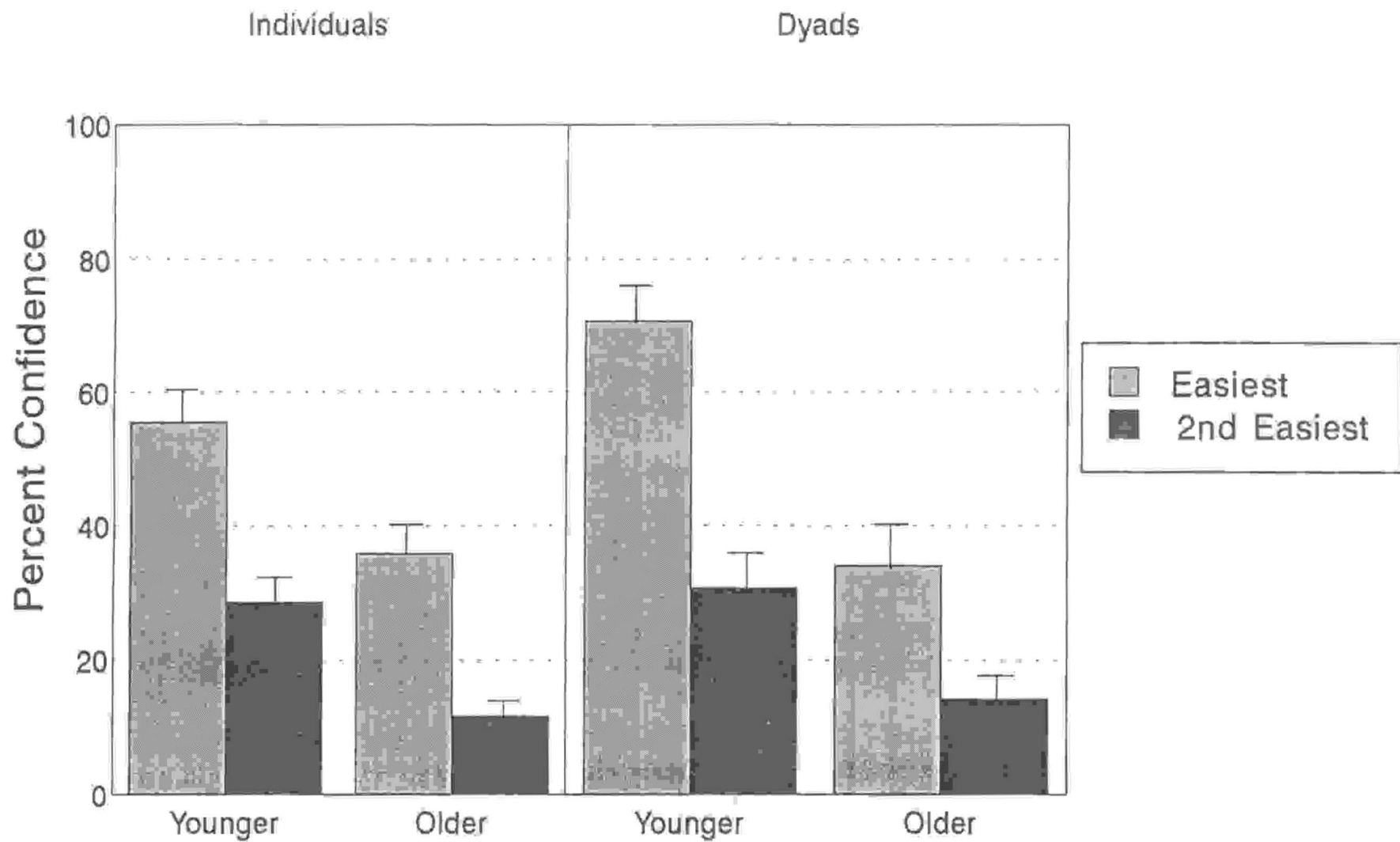


Figure 26. Change in confidence ratings for story as a function of age and recall condition.

main effect of recall condition was also significant, $F(1, 185) = 15.74, p < .001$. Participants gave higher confidence ratings when working with a partner ($M = 72.63, SD = 20.16$) than when working alone ($M = 60.10, SD = 21.43$). Finally, the main effect of confidence level was significant, $F(1, 555) = 447.49, p < .001$. Follow-up post-hoc analyses were done using Spjøtvoli and Stoline's procedure. This procedure is recommended for unequal sample sizes in which the samples are relatively similar (Kirk, 1982). The results showed that the easiest level ($M = 93.09, SD = 14.57$) was given a higher confidence rating than the second easiest ($M = 77.25, SD = 23.70$), $q'T' = 13.99, p < .05$. Similarly the second easiest level ($M = 77.25, SD = 23.70$) was given higher confidence ratings than the third easiest ($M = 52.45, SD = 30.45$), $q'T' = 21.91, p < .05$. Finally, the third easiest ($M = 52.45, SD = 30.45$) was given higher confidence ratings than the fourth easiest level ($M = 33.87, SD = 31.24$), $q'T' = 15.62, p < .05$.

A two-way interaction between recall condition and confidence level was significant, $F(1, 555) = 6.50, p < .001$. Follow-up post-hoc analyses were done using the Turkey-Kramer procedure which is recommended for sample sizes that are extremely different (Kirk, 1983). It should be noted that the cell size for recall condition was much smaller in the dyad ($n = 65$) than in the individual condition ($n = 130$). It was found that whereas there were

no significant difference in the confidence ratings given by individuals and dyads for the easiest ($\underline{M} = 91.78$, $\underline{SD} = 16.08$; $\underline{M} = 95.69$, $\underline{SD} = 10.60$), second ($\underline{M} = 72.58$, $\underline{SD} = 24.69$; $\underline{M} = 86.46$, $\underline{SD} = 18.58$), and fourth easiest levels ($\underline{M} = 28.53$, $\underline{SD} = 29.29$; $\underline{M} = 44.46$, $\underline{SD} = 32.50$), dyads ($\underline{M} = 63.92$, $\underline{SD} = 29.32$) gave significantly higher confidence ratings than individuals ($\underline{M} = 46.67$, $\underline{SD} = 29.46$) for the third easiest level, $q = 8.84$, $p < .05$. Also, individuals gave significantly higher confidence ratings to the easiest level ($\underline{M} = 91.78$, $\underline{SD} = 16.08$) than to the second easiest ($\underline{M} = 72.58$, $\underline{SD} = 24.69$), $q = 9.84$, $p < .05$. Whereas dyads gave similar confidence ratings to the easiest ($\underline{M} = 95.63$, $\underline{SD} = 10.60$) and the second easiest ($\underline{M} = 86.46$, $\underline{SD} = 18.58$) levels. The remaining differences between the confidence levels were significant.

Moreover, a three-way interaction between age, collaborative condition, and confidence level was also significant, $F(1, 555) = 2.68$, $p < .046$. Follow-up post-hoc analyses, again using Spjøtvoli and Stoline's procedure recommended for relatively similar size samples (Kirk, 1982), were done. As seen in Figure 27, the easiest level ($\underline{M} = 95.42$, $\underline{SD} = 9.44$; $\underline{M} = 94.17$, $\underline{SD} = 12.52$; $\underline{M} = 91.60$, $\underline{SD} = 19.10$; $\underline{M} = 91.25$, $\underline{SD} = 15.25$), younger adults from the spouse, younger adults from the stranger, older adults from the spouse, and older adults from the stranger conditions, respectively) was given slightly larger (but not



Figure 27. Change in confidence ratings for hardware as a function of age and collaborative condition.

statistically significant) confidence ratings than the second easiest level ($\underline{M} = 82.29$, $\underline{SD} = 18.93$; $\underline{M} = 79.58$, $\underline{SD} = 22.59$; $\underline{M} = 73.06$, $\underline{SD} = 26.00$; $\underline{M} = 74.17$, $\underline{SD} = 26.00$), younger adults from the spouse, younger adults from the stranger, older adults from the spouse, and older adults from the stranger conditions, respectively) by all groups. Moreover, all groups gave slightly higher confidence ratings to the third easiest level ($\underline{M} = 61.25$, $\underline{SD} = 29.72$; $\underline{M} = 54.06$, $\underline{SD} = 27.88$; $\underline{M} = 47.60$, $\underline{SD} = 29.25$; $\underline{M} = 47.08$, $\underline{SD} = 33.45$), younger adults from the spouse, younger adults from the stranger, older adults from the spouse, and older adults from the stranger conditions, respectively) than the fourth easiest level ($\underline{M} = 44.37$, $\underline{SD} = 35.18$; $\underline{M} = 33.33$, $\underline{SD} = 27.62$; $\underline{M} = 26.80$, $\underline{SD} = 25.35$; $\underline{M} = 31.25$, $\underline{SD} = 34.12$), younger adults from the spouse, younger adults from the stranger, older adults from the spouse, and older adults from the stranger conditions, respectively). In contrast, the older adults from the spouse, $g'T' = 11.33$, $p < .05$, and the stranger conditions, $g'T' = 11.93$, $p < .05$, as well as the younger adults from the stranger condition $g'T' = 11.93$, $p < .05$, gave significantly higher confidence ratings to the second easiest level ($\underline{M} = 73.06$, $\underline{SD} = 26.00$; $\underline{M} = 74.17$, $\underline{SD} = 26.00$; $\underline{M} = 79.58$, $\underline{SD} = 22.59$, respectively) than to the third easiest level ($\underline{M} = 47.60$, $\underline{SD} = 29.25$; $\underline{M} = 47.08$, $\underline{SD} = 33.45$; $\underline{M} = 54.06$, $\underline{SD} = 27.88$, respectively). While younger adults from the spouse condition gave more similar

confidence ratings to the second ($M = 82.29$, $SD = 18.93$) and third levels ($M = 61.25$, $SD = 29.72$). The remaining results were nonsignificant.

Affirmative responses. A 2 (age) x 2 (recall condition) x 2 (collaborative condition) MANOVA was performed on the number of affirmative responses (e.g., indicating that the task can be performed) given by individuals and dyads to the story and the hardware scales. In contrast to Kemper (1986), all affirmative responses (including those with a confidence rating of 10%) were included. Kemper argued that affirmative responses with confidence ratings less than 10% should not be included because they denote a lack of confidence in an affirmative response. Moreover, Kemper stated that it was rare for participants to give an affirmative answer with a confidence rating of 10%. In the present data 84 affirmative responses were paired with a confidence rating of 10% were observed. Hence, all affirmative responses were included in the analyses.

A multivariate effect of recall condition was significant, Wilks' $F(2, 186) = 4.88$, $p < .009$. A follow-up ANOVA on hardware revealed a significant effect for recall condition, $F(1, 187) = 9.81$, $p < .002$. Working alone ($M = 3.88$, $SD = 1.19$) resulted in significantly fewer affirmative responses on the hardware scale than working with a partner ($M = 4.40$, $SD = .90$). Furthermore, a

significant multivariate effect of age, Wilks' $F(2, 186) = 10.56, p < .001$, was found. Follow-up univariate ANOVAs for story, $F(1, 187) = 17.19, p < .001$, and hardware, $F(1, 187) = 6.88, p < .009$, were significant. Younger adults ($M = 1.98, SD = 1.46; M = 4.28, SD = .99$, story and hardware respectively) made significantly more affirmative responses to these scales than did older adults ($M = 1.21, SD = 1.22; M = 3.83, SD = 1.21$, respectively). No other main effects or interactions reached statistical significance.

MSEQ - performance correlations. Correlations between average confidence ratings from the story scale of the MSEQ and story recall, as well as the story scale and delayed recall, were calculated for each age, collaborative condition, and recall condition groups. Each scale of the MSEQ included five difficulty levels and the average confidence was based on the mean of these five. The purpose of computing these correlations was to examine the relationship between memory performance and task-specific (story recall) memory self-efficacy. As seen in Table 7, all but one of the correlations were nonsignificant. The correlation between story recall and confidence rating was only significant for younger individuals from the spouse condition ($r = .50, p < .05$). Some other patterns were notable. First, older couples' confidence ratings were moderately correlated with both immediate ($r = .35, p < .16$) and delayed ($r = .52, p < .18$) recall, whereas the

Table 7

Correlations Between Story Recall and Delayed Recall with the Average Confidence Ratings of the Story Scale of the MSEQ

| | <u>Couples</u> | | <u>Strangers</u> | |
|----------|----------------|--------------|------------------|--------------|
| | <u>Younger</u> | <u>Older</u> | <u>Younger</u> | <u>Older</u> |
| IND/STR | .50* | .16 | .02 | -.03 |
| IND/DR | .37 | -.09 | .14 | -.09 |
| DYAD/STR | .11 | .35 | .22 | .14 |
| DYAD/DR | .39 | .52 | .52 | -.11 |

Note. IND/STR = Individuals initial story recall, including individual recall from individuals tested first and individuals tested second. IND/DR = Individual delayed recall, including those participants that recalled a story as dyads first and recalled a second time (same story) as individuals. DYAD/STR = Dyad initial story recall, including the dyad recall from dyads tested first and the dyads tested second. DYAD/DR = Dyad delayed recall, including those participants that recalled a story as individuals first and recalled a second time (same story) as dyads.

corresponding correlations for older strangers were substantially lower ($r = .14$, $r = -.11$, respectively). In contrast, younger couples and strangers produced more similar correlations.

One possible reason for the lack of significant correlations, could be the qualifier "word for word" in the story scale of the MSEQ. Participants, when noting that they were asked if they were able to remember some of a story word for word, routinely felt that this was a near impossible task. The story scale of the MSEQ may not, in fact, be the optimal task-specific measure of memory self-efficacy for story recall, as story recall in this and many other studies is constructed as a gist, rather than verbatim, task. Nevertheless, the apparently different patterns may be instructive.

The correlations between working memory performance and the average confidence ratings given to the hardware scale of the MSEQ was calculated by age, collaborative condition, and recall condition. Again the purpose of these correlations is to examine the relationship between task specific (working memory) memory self-efficacy and actual working memory performance. These correlations can be seen in Table 8.

As shown in Table 8, the correlations were significant for the older individuals from the stranger condition for alpha span ($r = .36$, $p < .05$) and older individuals from the

Table 8

Correlations Between Working Memory Performance and the
Average Confidence Ratings of the Hardware Scale of the MSEQ

| | Couples | | Strangers | |
|---------|---------|-------|-----------|-------|
| | Younger | Older | Younger | Older |
| IND/AS | -.29 | .39* | .04 | .36* |
| IND/SR | .03 | .44* | -.26 | -.05 |
| DYAD/AS | .08 | .26 | .08 | .55* |
| DYAD/SR | .19 | .68* | -.18 | .29 |

Note. IND = Individual, AS = Alpha Span, SR = Sentence Repetition, and * = $p < .05$. $r = .62$, respectively).

spouse condition for alpha span ($\underline{r} = .39, p < .05$) and sentence repetition ($\underline{r} = .44, p < .05$). Moreover, older married couples had a significant relationship for sentence repetition ($\underline{r} = .68, p < .05$) and older stranger dyads had a significant relationship for alpha span ($\underline{r} = .55, p < .05$). These significant relationships denote that those individuals or dyads that reported high confidence in their ability to perform hardware (working memory) tasks, performed well on the working memory measures. Whereas individuals or dyads that reported low confidence in performing working memory tasks, performed more poorly on working memory tasks.

Individuals separately. A 2 (age: young, old) x 2 (collaborative condition: young, old) MANOVA was performed on individuals' confidence ratings for the story and the hardware scales of the MSEQ. Multivariate analyses revealed significant effect of age, Wilks' $\underline{F} (2, 124) = 6.33, p < .002$. The follow-up ANOVAs of story and hardware were both significant, $\underline{F} (1, 125) = 10.29, p < .002$ and $\underline{F} (1, 125) = 4.86, p < .029$ respectively. Older individuals ($\underline{M} = 11.02, \underline{SD} = 14.15; \underline{M} = 47.34, \underline{SD} = 20.85$, story and hardware respectively) gave significantly lower confidence ratings, on average, than did younger individuals ($\underline{M} = 20.41, \underline{SD} = 18.78; \underline{M} = 55.69, \underline{SD} = 21.92$, story and hardware respectively). The remaining results were nonsignificant.

A 2 (age: young, old) x 2 (collaborative condition:

spouse, stranger) MANOVA was performed on the number of affirmative responses to story and hardware subscales of the MSEQ by individuals. The multivariate analyses revealed a main effect of age, Wilks' $F(2, 125) = 5.01, p < .008$. Both follow-up univariate tests were significant, $F(1, 126) = 5.92, p < .016$ and $F(1, 126) = 5.58, p < .020$, for story and hardware respectively. Younger individuals ($M = 1.86, SD = 1.50$; $M = 4.13, SD = 1.09$, story and hardware respectively) made more affirmative responses, on average, than older individuals ($M = 1.26, SD = 1.28$; $M = 3.64, SD = 1.25$, story and hardware respectively). The remaining results were nonsignificant.

Dyads separately. A 2 (age: young, old) \times 2 (collaborative condition: spouse, stranger) MANOVA was performed on dyads' confidence ratings for story and hardware. The multivariate analysis showed a main effect of collaboration condition, Wilks' $F(2, 60) = 3.36, p < .041$, and a main effect of age, Wilks' $F(2, 60) = 8.77, p < .001$. Follow-up univariate analysis revealed that spouses ($M = 21.58, SD = 18.41$) gave significantly higher confidence ratings than unacquainted dyads ($M = 12.81, SD = 12.86$) on the story subscale, $F(1, 61) = 6.57, p < .013$. Moreover, younger dyads ($M = 24.75, SD = 11.49$) gave significantly higher confidence ratings than older dyads ($M = 10.00, SD = 11.46$) on the story subscale, $F(1, 61) = 17.80, p < .001$. No other multivariate effects were significant.

A second 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) MANOVA was performed on the number of affirmative responses to story and hardware scales of the MSEQ made by dyads. The multivariate analyses revealed a significant effect of age, Wilks' $F(2, 60) = 6.89, p < .002$. The follow-up ANOVA showed that for the story subscale, $F(1, 61) = 12.96, p < .001$, younger dyads ($M = 2.22, SD = 1.36$) gave significantly more affirmative responses than older dyads ($M = 1.12, SD = 1.08$). All remaining results were nonsignificant.

Memory Functioning Questionnaire

A 2 (age: young, old) x 2 (recall condition: individual, dyad) x 2 (collaboration condition: spouse, stranger) ANOVA was performed on individuals' and dyads' reported general rating from the MFQ (Gilewski & Zelinski, 1988). There was a main effect of recall condition, $F(1, 187) = 19.39, p < .001$, and a main effect of collaborative condition, $F(1, 187) = 10.67, p < .001$. Working alone ($M = 4.43, SD = 1.17$) resulted in lower general ratings than did working with a partner ($M = 5.16, SD = .96$). Moreover, individuals and couples from the spouse condition ($M = 4.91, SD = 1.19$) gave a significantly higher general rating than individuals and dyads from the stranger condition ($M = 4.43, SD = 1.08$). The main effect of age, as well as the two-way interactions, were not significant. Finally a three-way interaction between age, recall condition, and collaborative

condition was significant, $F(1, 187) = 4.49, p < .035$. As shown in Figure 28, both older and younger adults from the spouse condition gave a higher memory functioning rating to working with their spouse ($M = 5.71, SD = .92; M = 5.31, SD = .95$, respectively) than to working alone ($M = 4.47, SD = 1.19; M = 4.75, SD = 1.19$, respectively). Also shown in Figure 28, older adults from the stranger condition gave a similar memory functioning rating if working with a stranger ($M = 4.44, SD = .81$) or if working alone ($M = 4.25, SD = 1.32$), yet younger adults gave a higher rating to working with a stranger ($M = 5.16, SD = .77$) than working alone ($M = 4.25, SD = .95$). Both younger and older adults from the couple condition rated their memory functioning as individuals ($M = 4.75, SD = 1.19; M = 4.47, SD = 1.19$ respectively) lower than they did as couples ($M = 5.31, SD = .95; M = 5.71, SD = .92$). Indeed, the increase was greater for older couples (approximately 1.2 x scale units) than for younger couples (.5 scale units).

MFQ - performance correlations. In order to examine the relationship between global ratings of memory self-efficacy and memory performance, the reported general rating of the MFQ was correlated with story recall, delayed recall, alpha span, and sentence repetition performance of all age, collaborative condition, and recall condition groups. These correlations are reported in Table 9.

As shown in Table 9, most of the correlations were

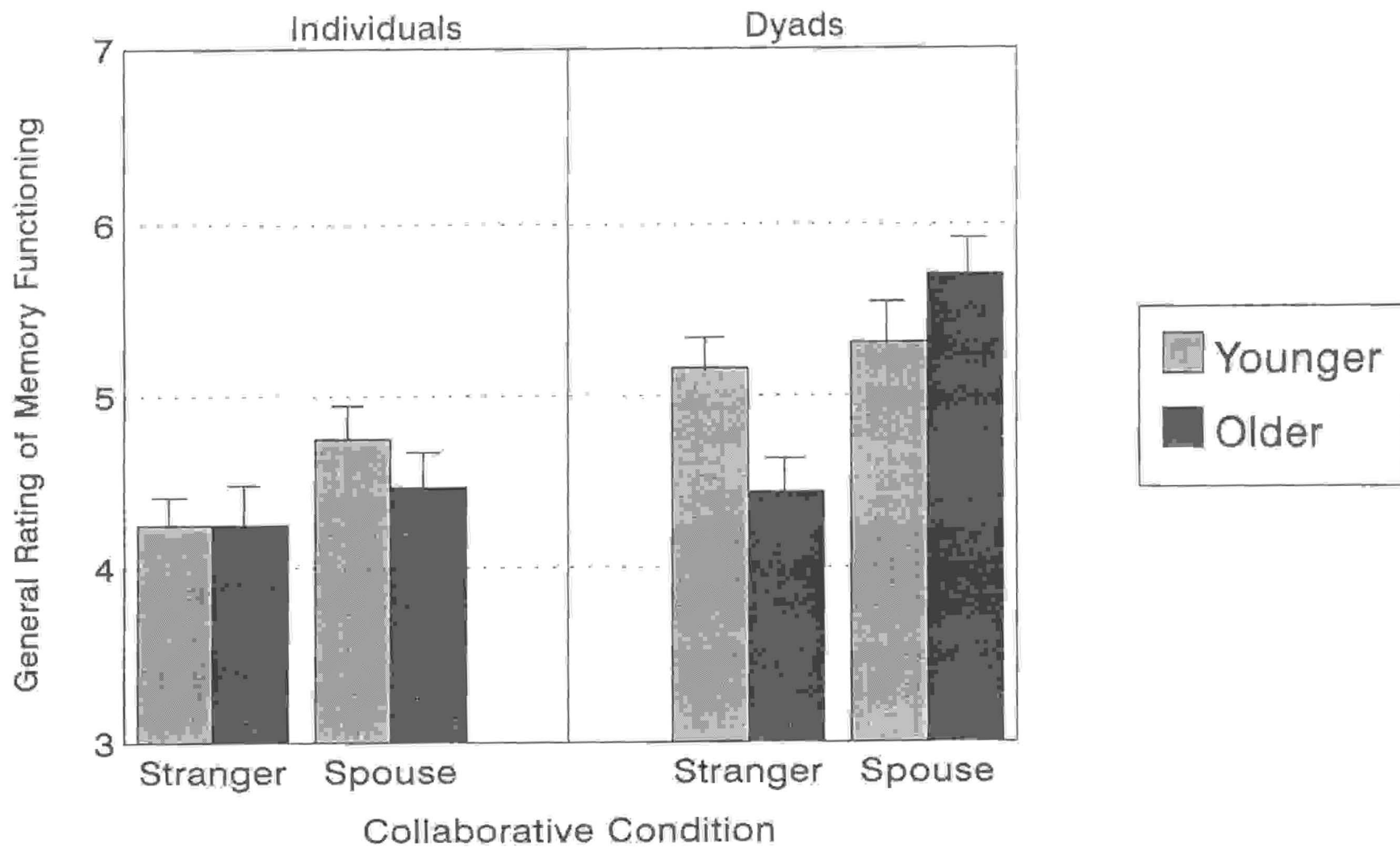


Figure 28. Global memory self-efficacy as a function of age, recall condition, and collaborative condition.

Table 9

Correlations Between Memory Task Performance and General Rating from MFO

| | Couples | | Strangers | |
|----------|---------|-------|-----------|-------|
| | Younger | Older | Younger | Older |
| IND/STR | .42* | .05 | -.12 | .03 |
| IND/DR | -.04 | .25 | -.09 | .40 |
| IND/AS | -.01 | .26 | -.23 | -.01 |
| IND/SR | .21 | .47* | -.29 | .001 |
| DYAD/STR | -.53* | -.14 | .34 | -.45 |
| DYAD/DR | .41 | -.37 | .13 | -.15 |
| DYAD/AS | -.34 | .05 | -.54* | .11 |
| DYAD/SR | .01 | .42 | .04 | .41 |

Note. IND = Individual, STR = Story Recall, DR = Delayed, Recall, AS = Alpha Span, SR = Sentence Repetition, and * = $p < .05$.

nonsignificant. Two of those significant, specifically younger married couples' story recall and younger stranger dyads alpha span, were actually in the opposite direction than expected ($r = -.53, p < .05$ and $r = -.54, p < .05$ respectively). These correlations indicate that couples and stranger dyads reporting high global memory self-efficacy are actually performing relatively poorly on memory-related tasks. Two correlations were found significant in the expected direction. Younger married couples' story recall performance ($r = .42, p < .05$) and older married couples' sentence repetition performance ($r = .47, p < .05$) was significantly correlated to global memory self-efficacy. Therefore, those younger and older couples reporting high global memory self-efficacy are performing well on memory tasks. The correlations are similar to expectations, as global memory self-efficacy, as measured by the General Rating scale of the MFQ, is traditionally not highly related to performance (Hertzog et al., 1990).

Individuals separately. The main analyses reported above, which included both individual and dyad data, was repeated with individual- and dyad-level data separated. A 2 (age: young, old) x 2 (collaborative condition: spouse, stranger) ANOVA was performed on individuals' reported general rating of memory functioning. The main effects and interactions were all nonsignificant.

Dyads separately. A 2 (age: young, old) x 2

(collaborative condition; spouse, stranger) ANOVA was performed on the reported general memory functioning of dyads. There was a main effect of collaborative condition, $F(1,61) = 10.98, p < .002$, and an age by collaborative condition interaction, $F(1, 61) = 6.69, p < .012$. The collaborative condition effect showed that spouses ($M = 5.51, SD .94$) gave higher general ratings than did unacquainted dyads ($M = 4.80, SD = .86$). The interaction denotes that whereas the younger couples ($M = 5.31, SD .95$) and the younger unacquainted dyads ($M = 5.16, SD = .77$) gave similar memory functioning ratings, the older couples ($M = 5.71, SD = .92$) gave higher ratings than the older unacquainted dyads ($M = 4.44, SD = .81$).

Collaboration Effectiveness Questionnaire

Table 10 shows the mean rank ordering, according to age, of the effectiveness of working with a spouse, a stranger of the different gender, a stranger of the same gender, a friend of the different gender, a friend of the same gender, and working alone. As shown in Table 10, older adults gave a higher effectiveness rating to working with a spouse than did younger adults. Moreover, it should be highlighted that younger adults gave working with a friend (both gender) a much higher effectiveness rating than working alone. Whereas older adults gave similar ratings of effectiveness to working with a friend (either gender) and working alone.

Table 10

Mean Rank Ordering of Collaboration Effectiveness

| Young (n=64) | Old (n=65) |
|---|--|
| 1. Spouse $\underline{M} = 1.73$ $\underline{SD} = 1.21$ | 1. Spouse $\underline{M} = 1.48$ $\underline{SD} = .97$ |
| 2. Friend Same Gender $\underline{M} = 2.48$ $\underline{SD} = 8.12$ | 2. Friend Same Gender $\underline{M} = 3.05$ $\underline{SD} = 1.13$ |
| 3. Friend Opposite Gender $\underline{M} = 2.81$ $\underline{SD} = 1.00$ | 4. Friend Opposite Gender $\underline{M} = 3.54$ $\underline{SD} = 1.04$ |
| 4. Alone $\underline{M} = 4.23$ $\underline{SD} = 1.95$ | 4. Alone $\underline{M} = 3.54$ $\underline{SD} = 2.06$ |
| 5. Stranger Same Gender $\underline{M} = 4.78$ $\underline{SD} = .826$ | 5. Stranger Same Gender $\underline{M} = 4.62$ $\underline{SD} = 1.13$ |
| 5. Stranger Opposite Gender $\underline{M} = 4.94$ $\underline{SD} = .96$ | 5. Stranger Opposite Gender $\underline{M} = 4.77$ $\underline{SD} = 1.11$ |

Chapter 5

Discussion

The discussion chapter is divided into several subsections, including working memory, story recall, delayed story recall, memory monitoring, reminiscence and forgetting, memory self-efficacy, and beliefs about collaboration. Finally, a subsection involving limitations of this study and general conclusions will end the chapter.

Working Memory

Like the findings in previous research, younger individuals performed better than older individuals on alpha span (Craik, 1986) and sentence repetition (Kemper, 1986) tasks. These age-related differences in individual working memory performance are standard and provide a useful baseline by which to compare collaborative working memory performance. Given that the individuals recruited for this study performed similarly to those in other studies, a stronger case regarding expected dyad-level performances may be made. The influence of collaboration, as well as collaborative experience, on working memory performance with age was examined.

Extending earlier work in which groups outperformed individuals with a variety of tasks (e.g., eyewitness testimony: Clark et al., 1990; Stephenson et al., 1986; Stephenson et al., 1983; or recognition tasks: Hinsz, 1990), it was shown that dyads outperformed individuals on both

working memory tasks. Moreover, age differences in collaboration were found with alpha span, such that younger dyads performed better than older dyads. Contrary to predictions, though, the results for alpha span did not support the notion that age-related differences in working memory performance may be moderated by collaborative experience. Therefore, working together with a partner with whom one has had a great deal of collaborative experience failed to facilitate performance in older adults. Older married couples performed similarly to older stranger dyads on alpha span and both of these dyad types performed at lower levels than younger couples and stranger dyads.

The results were somewhat different, though, for the sentence repetition task. The individual-level data revealed that the individuals from the stranger and the spouse conditions did not perform equivalently on sentence repetition. Individuals from the stranger condition performed better than individuals from the spouse condition for both the younger and the older adults. An inference that follows is that stranger dyads should have an advantage over couples. Because the stranger dyads were composed of individuals better able to perform the sentence repetition task than were the individuals comprising the couples, stranger dyads should have an advantage in collaborative-level performance over the couples. This was, in fact, the case for the younger adults. Younger stranger dyads

performed better than younger couples on sentence repetition. In contrast, however, older couples performed better than older stranger dyads. Indeed, they performed better than younger couples on this working memory task.

The differential pattern of results partially supports the expectation older individuals may, for some selected tasks, overcome their individual-level disadvantages through their interactive expertise (Dixon, in press). Although at an individual level, younger and older adults from the spouse condition were disadvantaged when compared to younger and older adults from the stranger condition, at a dyad level, older (but not younger) couples were still able to perform better than older stranger dyads. Older couples, having a great amount of experience working with one another, were able to perform exceedingly well when working together, but not when working alone. Further research focusing on the collaborative process through which this interesting pattern emerged should be conducted (e.g., Gould et al., 1994). In addition, one may question why this pattern of results emerged with sentence repetition and not alpha span. Two issues related to this question need to be addressed. First, although alpha span and sentence repetition are both working memory tasks, they are only moderately intercorrelated ($r = .24$ to $.58$). Therefore, an individual performing at a high level on alpha span may perform well on sentence repetition, but not always. Other

researchers (e.g., Dobbs & Rule, 1989; Salthouse, 1988) have similarly found small to moderate correlations between various working memory tasks. Second, these tasks may inherently be better suited to certain collaborative strategies. Sentence repetition may facilitate those collaborative strategies that tap interactive expertise, while alpha span does not. This would, therefore, lead to better performance in sentence repetition than in alpha span for groups having collaborative experience.

Indeed, sentence repetition and alpha span were better suited to different collaborative strategies. As a whole, dyads tended to use the strategy of dividing up responsibilities more in the sentence repetition task (48%) than in alpha span (28%). For example, collaborators would take turns at the sentences or each would be responsible for one-half of the sentence. In contrast, a shared, uniform responsibility was a more common strategy for alpha span (40%) than for sentence repetition (15%), such that both the collaborators would be responsible for recalling all the material. Furthermore, in line with the finding that older couples overcame their individual-level sentence repetition difficulties, older couples (52%) used the divided responsibility strategy more than older stranger dyads (44%) and younger couples (44%) in sentence repetition. Whereas younger stranger dyads (50%) used this strategy to a similar extent as older couples. Finally, older stranger dyads

(25%), as well as younger couples (12.5%) and stranger dyads (19%), used the shared responsibility strategy much more than did older couples (6%) for sentence repetition. Gould et al. (1994) argued that individual-based memory recall early in the task may be a particularly effective strategy. This pattern of results suggests that older couples and, to a lesser extent, younger stranger dyads were more likely to use individual-based memory strategies, leading to better performance. Dividing up tasks, lessens the amount of recall for each individual, increasing the amount of information remembered.

Working memory as a processing resource. Theorists (e.g., Tun et al., 1991) have argued that working memory may be the limited capacity system responsible for age-related differences in discourse recall. The results lend modest support to this contention. The intercorrelations between the performance on both working memory tasks with initial and delayed story recall performance ranged from significant in the expected direction ($r = .52, p < .05$) to near significance in the unexpected direction ($r = -.69, p < .06$). Correlations that were significant included the initial story recall performance with alpha span performance for younger and older individuals ($r = .36$ and $r = .32$, respectively) and older couples ($r = .52$), as well as the initial story recall performance and sentence repetition performance for older individuals ($r = .41$). Thus, for each

of these correlations, individuals (or couples) recalling a great amount of story information performed well on the respective working memory task.

It should be noted that the majority (3 of 4) of the aforementioned significant results involved individual-level, and not dyad-level, data. It was predicted that, like individual-level discourse recall (Norman et al., 1992; Stine & Wingfield, 1987; Tun et al., 1991), collaborative recall performance may be a function of working memory performance. Therefore, collaborative story recall performance should be highly related to collaborative working memory performance. The correlations, ranging from .52 (in the expected direction) to -.69 (in the unexpected direction), do not strongly support this prediction. Although younger and older couples ($r = .41$ to $.01$; $r = .52$ to $.09$, respectively) and older stranger dyads ($r = .40$ to $-.17$) have higher correlations than younger stranger dyads ($r = -.08$ to $-.69$), the majority of the correlations were low to moderate at best. It seems that collaborative recall performance cannot be largely explained by collaborative working memory performance.

In conclusion, working memory as a processing resource for individual discourse recall is modestly supported. Whether collaborative discourse recall is a function of collaborative working memory performance should be further explored, but at present this relationship is meagre.

Story Recall

Like previous research (e.g., Cohen, 1988; Hultsch & Dixon, 1984; Zelinski & Gilewski, 1988), younger individuals recalled more discourse-related material than older individuals. Moreover, younger dyads recalled more story information than older dyads (Dixon, in press). Finally, dyads recalled a higher percentage of story information than individuals. Contrary to predictions, though, collaborative experience did not significantly moderate the relationship between collaborative remembering and age. Therefore, older couples did not recall significantly more story-related information than older stranger dyads. Nor did older couples recall a similar amount of information when compared to younger couples, as found by Dixon (in press).

These findings do not jeopardize the collaborative expertise idea, in which older adults are thought to overcome individual-level memory decline by working with a partner with whom they have had extensive collaborative experience, such as a spouse (Dixon, in press). Although the differences were nonsignificant, older couples remembered nearly 8% more story information with immediate recall than older stranger dyads. They recalled only about 5% less story information than younger couples and younger stranger dyads. Also, individuals from the stranger and the spouse conditions performed similarly whether younger ($M = 40.23$; $M = 39.79$, respectively) or older ($M = 28.78$; $M =$

30.66, respectively). Therefore, differences in older dyad recall performance are unrelated to maintained individual-level performance in persons from long-term married couples. Thus, older couples still benefitted, if modestly, from working with a spouse.

One unexpected result was that individuals and dyads from the stranger condition recalled more story information when tested as dyads first and individuals second than when tested as individuals first and dyads second. In contrast, individuals and dyads from the spouse condition performed similarly regardless of order. It seems that collaborating and individual spouses may be less influenced in their performance by order factors than collaborating and individual strangers.

This result may be, in part, a function of an inherent discomfort in the stranger condition. Whereas spouses could be comforted by the idea that their spouse was participating as well, strangers must deal with both the unfamiliar laboratory tasks and the unfamiliar partner. Perhaps, then, the dyad condition first order was more effective for strangers because they immediately dealt with issues surrounding "getting to know one another." They were able to dismiss the discomfort with an unfamiliar person early in the session. In contrast, those participants from the individuals first condition must individually work through an anticipation of having to work with an unfamiliar other.

Story recall characteristics. The other characteristics of the immediate story recall, besides the amount of gist information recalled, revealed an interesting and illuminating pattern of results. First, dyads made more summary or macrostatements, more statements consistent with the story but not actually included in it (elaborations), and more repetitions than did individuals. When comparing the process of recall for individuals and dyads, one would expect more conversational type reiterations, elaborations, and repetitions for dyads. Sometimes these can be in the form of support statements for collaborators by repeating, elaborating, or summarizing statements made by partners. These types of support statements could, in part, help explain these differences between individuals and dyads. Second, it was shown that individuals made more metastatements or comments about their own thought processes than dyads. Given the fact that when working alone the product is a result of a single individual's memory efforts, while when working with a partner it is a combination of each individual's own efforts plus collaboration, one would expect more focus on an individual's memory processes when working alone. This explanation is compromised, though, by collaborative groups making metastatements in regards to their dyad-level memory processes.

Finally, individuals and dyads from the stranger condition, when compared to individuals and dyads from the

spouse condition, made more metastatements and errors and made fewer elaborations and macrostatements. These results suggest a number of things. Participants from the spouse condition made more story-based statements (elaborations and macrostatements) than participants from the stranger condition. Perhaps the fewer story-based statements on the part of stranger dyads could be a function of more "get acquainted" type statements, such as sharing thoughts regarding one's own memory processes. Moreover, the stranger condition may be inherently more discomforting, and thus leads to more metastatements, than the spouse condition. When working alone, those participants in the spouse condition may be comforted, and hence relaxed, in this laboratory situation by the knowledge that their spouse was sharing in this experience. Moreover, couples may be more comfortable than stranger dyads in working as a team. This comfort may lead to little focus on one's own memory processes. Interestingly, older couples made the fewest metastatements while older stranger dyads made the most.

The difference in the number of errors for those participants from the stranger and the spouse condition is somewhat more puzzling. One may suppose at the dyad level, spouses would more readily challenge one another's incorrect story recall than strangers, which would lead to fewer errors. Why individuals from the spouse condition produced fewer errors than individuals from the stranger condition is

less clear. Although it could be argued that the "inherent" discomfort in the stranger condition leads to a less effective encoding of information, there was no significant difference in the amount of story information recalled as a function of collaborative condition.

Summary. In sum, older couples benefitted modestly from their collaborative expertise. As expected, this benefit was not a function of maintained individual-level memory abilities associated accidentally or otherwise with long-term marriage (Dixon, in press). Furthermore, a story recall advantage for younger couples over younger stranger dyads, which was expected based on Wegner's (1986) transactive memory system and evidence for it (Wegner et al., 1991), was not shown. The slight advantage for older couples over older stranger dyads is in line with Wegner's (1986) model, but, because the difference was nonsignificant, the support for Wegner is limited. Although the remembering of stories, news articles, and the like, may be a somewhat common occurrence for couples, the retelling of a shared event, such as a vacation (as studied in Gould & Dixon, 1993) or a first date (as studied in Ross & Holmberg, 1990), would be a more frequent occurrence. Hence, the remembering of a narrative, as opposed to a shared memory for an event, probably underestimates the influence of collaborative experience in general, as well as the influence of collaborative experience with age. Finally,

with a similar theme to the findings of Gould et al. (1991; 1994) that older groups and couples conducted their task-related discussions differently than did other collaborative groups. Some difference in non-recall utterances were observed. Importantly, older couples made the fewest metastatements while older stranger dyads made the most. It would seem that working with a stranger led to a greater focus on one's own memory processes than when working with a spouse in older adults. This is important because older individuals, aware of their declining memory abilities (Hultsch et al., 1987), were able to relinquish some of the focus on their memory abilities when working with a spouse as compared to when working with a stranger.

Delayed Story Recall

The results with delayed story recall performance were nearly identical to those from the immediate condition. Younger individuals recalled more story-related information than older individuals, and younger dyads recalled more than older dyads. Further dyads recalled a higher percentage of information than individuals, which replicated previous work (Andersson & Rönnerberg, 1995; Meudell et al., 1995; Meudell et al., 1992). In contrast to the initial story recall, with delayed recall older adults did not seem to benefit overall from their collaborations with their spouse. Older couples recalled approximately 3% more story information than did older stranger dyads. In addition, older couples

recalled 10% less story information after delay than did younger couples. Perhaps with delay, the typical individual-level memory decline in discourse recall with age (e.g., Cohen, 1988; Hultsch & Dixon, 1984; Zelinski & Gilewski, 1988) cannot be compensated for by collaborative expertise.

Although collaboration was an important factor, collaborative expertise seemed to have little influence on level of performance in delayed story recall. Younger and older individuals recalled more story information when working with a partner, regardless of whether the partner was a spouse or a stranger, at delay than they recalled initially alone. Furthermore, younger and older couples and stranger dyads tested as dyads first, recalled less information at delay as individuals than at immediate recall. Although collaborative expertise seemed to have little influence, collaboration benefited both younger and older adults.

Hypermnnesia. Dixon et al. (1982) found that younger, middle-aged, and older individuals recalled less information with delay than they had individually recalled in the immediate condition. Such findings of forgetting with passage of time are common in cognitive aging research (Kausler, 1990). Another body of research (for summary see Payne, 1987), concentrating on the young only, has shown improvements in the total amount of information recalled

with repeated testing (but without repeated exposure). This improvement, called hypermnesia, has been found with a variety of materials, including prose passages (Wheeler & Roediger, 1992), videotapes of crimes (Dunning & Stern, 1992; Scrivner & Safer, 1988), and word lists (Payne, Hembrooke, & Anastasi, 1993; Payne & Roediger, 1987). Hypermnesia research has solely examined the influence of repeated testing on individual memory performance. Hence, initial individual recall performance has been compared with individual delayed recall performance.

One unique feature of the present experiment was that persons whose initial recall occurred alone, performed delayed recall in a dyad. Conversely, persons whose initial recall occurred in a dyad, performed delayed recall alone. Thus, the influence of hypermnesia cannot be directly assessed. It was found that if tested alone first and as dyads second, the delayed dyad recall was actually greater than initial individual recall. There was no decay with delay in this condition. Whereas if tested as dyads first and as individuals second, all groups had decay with delay. It is indeterminable if this improved performance of the dyads' delayed recall, when compared with their individual-level initial recall, is in part a function of hypermnesia. It may be (and probably is) a result of collaboration.

Unfortunately, hypermnesia cannot be indirectly explored through the reminisced or forgotten items results.

It was found that those groups having the highest amount of story recall were not necessarily those having the highest reminisced items to forgotten items ratio. Moreover, Payne (1987) argued that historically one difficulty with hypermnesia research is that reminiscence had been used interchangeably with hypermnesia. He suggested that hypermnesia should only be considered to be the total amount of information gained with repeated testing and not the recall of previously unrecalled items.

Reminiscence and Forgetting

Andersson and Rönnerberg (1995) argued that collaborative remembering of words, stories, and video-tapes is less effective than working alone. They found that individuals remembered more previously unrecalled items (reminiscence) and forgot fewer items than dyads when asked to recall a second time. However, they found that these "deficits" of dyads were minimized when the partners were friends rather than strangers. The results support Andersson and Rönnerberg's (1995) findings, but they also reveal that these relationships are more complex than they argued. Specifically, the advantage of individuals over dyads, as well as friends over strangers, was moderated by age, and may vary by task.

Like Andersson and Rönnerberg (1995), younger individuals reminisced more and forgot fewer propositions at delayed story recall than younger dyads. In contrast, however,

older dyads reminisced more and forgot fewer items than older individuals. Therefore, older dyads are more effective than older individuals at generating previously unrecalled story propositions, without losing as much information. In support of Andersson and Rönnerberg (1995), it was also found that younger couples forgot less information than younger stranger dyads. That is, collaborative experience benefitted reminiscence for younger adults. In contrast, older couples actually forgot more story-related information than older stranger dyads, but they reminisced a similar amount. For older adults, then, collaboration itself, and not collaborative experience per se, seems to produce efficient reminiscence. Finally, analyses involving the difference, as well as the ratio, between the number of reminisced and forgotten items, showed that younger individuals had a higher difference than younger dyads, but that the pattern of results was the opposite for older adults. Therefore, for younger adults, individuals reminisced more items per forgotten item (when referring to the ratio) than dyads, but for older adults, the dyads reminisced more items per forgotten items than did individuals. The results suggest that the effectiveness of collaboration depends in part on age. Collaboration, when compared to working alone, is more effective for older, but not younger, adults.

In opposition to predictions, collaborative experience

had little overall influence on the reminisced items to forgotten items ratio or difference. It was predicted that couples would have a higher ratio than stranger dyads. Although collaborative condition had some influence on the number of items forgotten, it had no significant effect overall.

Memory Monitoring

Based on Hertzog et al. (1994), it was predicted that younger and older individuals would be similarly accurate in predicting and postdicting their own performance. This expectation was supported when absolute accuracy was used -- the absolute difference between performance and predictions or postdictions (Devolder et al., 1990). In contrast, simple accuracies -- the difference between performance and estimates of performance -- showed that older individuals were less accurate at predicting their performance than younger individuals. The same age-related difference was also found for dyads. One advantage of simple accuracies over absolute accuracies is that it can be determined whether inaccuracies are a function of over- or under-estimating. Devolder et al.'s (1990) older individuals over-estimated their performance. This result was replicated for individuals in this study, and extended to dyads. Indeed, dyads were less accurate than individuals, presumably over-valuing the boost they would receive as a function of collaboration.

Change in memory monitoring. A third measure of accuracy, correlations between actual performance and each estimate of performance, is useful for examining if there are any age or collaborative condition differences in upgrading the estimates of performance from predictions to postdictions. While predictions occur before the task, postdictions occur after the task. It is expected that actual task experience should improve the accuracy of estimate from predictions to postdictions.

The correlations showed that both younger and older individuals improved the accuracy of their estimates from predictions to postdictions. For example, the younger individuals from the spouse condition had much higher correlations between postdictions and performance ($r = .75$) than predictions and performance ($r = .55$). Dyads were not quite as effective at upgrading their performance as individuals. In fact, older stranger dyads' postdictions ($r = .50$) were actually correlated less with performance than their predictions ($r = .74$). Also, older couples' predictions ($r = .60$) and postdictions ($r = .61$) correlated similarly with performance. In contrast, younger couples and stranger dyads correlations between estimates of performance and actual performance showed the expected improvement from predictions ($r = .27$; $r = .07$, respectively) to postdictions ($r = .49$; $r = .61$, respectively). Somewhat contrary to these results, Dixon

(in press) found that younger and older couples were effective at improving their estimates of performance at postdictions. Although when compared to individuals' dyads were less effective, some still upgraded their estimates of performance.

The delayed recall feature of this design enabled a further examination of whether upgrading, beyond postdiction, occurred. Hertzog et al. (1994) found that younger and older individuals were equally good at improving their estimates of performance with delayed recall. Based on Hertzog et al.'s (1994) finding, it was predicted that individuals and dyads (both young and old) would upgrade their estimates of performance. Interestingly, no statistical differences were found for delayed recall's prediction and postdiction accuracies. Therefore, dyads were as accurate as individuals and older adults were as accurate as younger adults. However, although many of the correlations between performance and estimates of performance were moderate to high, there were some negative correlations (indicating that those estimating high performance actually performed low) and some near zero correlations. Younger and older individuals from the spouse condition and younger couples were particularly effective at estimating performance. It would seem that inaccuracies in estimating performance mainly by younger couples was reduced with experience with the task. In contrast, older couples,

as well as younger and older individuals and dyads from the stranger condition, failed to improve estimates of performance with experience with the task.

Summary. In partial support of the prediction, there was some expertise advantage in estimating performance. It was predicted that couples, having extensive experience collaborating, would better estimate their performance than stranger dyads. Older couples immediate estimates of story recall performance and younger couples delayed estimates of story recall performance were highly correlated with actual performance. Therefore, collaborative experience seemed to facilitate memory monitoring.

Finally, Devolder et al. (1990) argued that absolute accuracies should be used instead of simple accuracies because with absolute accuracies over- and under-estimations of performance (within one group) would not cancel one another out. Besides the effect with simple accuracies, in which there were age differences in accuracy of predictions for the initial story recall, the results for simple and absolute accuracy were similar.

Memory Self-Efficacy

As memory self-efficacy was measured at a global (MFQ) and at a task-specific level (MSEQ), these shall be discussed separately.

Task-specific memory self-efficacy. The task-specific memory self-efficacy questionnaire (MSEQ) involved a story

and a hardware scaled based on Berry et al. (1989). There were two parts of the Memory Self-Efficacy Questionnaire that were used in analyses, including the number of affirmative (can do task) and the average confidence with which that affirmative response was given, across five levels of task difficulty. The results for these two variables were similar. Younger individuals made more affirmative responses and had a higher average confidence level than older individuals. Younger dyads similarly showed higher memory self-efficacy than older dyads. These results were significant for both the story recall (story) and the working memory (hardware) task-specific memory self-efficacy scales. Furthermore, on the hardware scale, dyads gave more affirmative responses and higher confidence ratings than individuals. It was expected that collaborative memory self-efficacy would be influenced by collaborative experience, particularly in older adults. Although this hypothesis was not supported with the number of affirmative responses or the average confidence measures, a change in confidence across the five levels of difficulties was more sensitive.

It was shown that older couples, when compared to older stranger dyads, gave higher confidence ratings to the easiest story task level. Moreover, younger couples gave higher confidence ratings to the easiest and the second easiest levels of the story scale than younger stranger

dyads. Similarly, younger couples gave higher confidence ratings to the third easiest confidence level than did all other individuals and dyads. Therefore, collaborative experience influenced the collaborative memory self-efficacy. Younger and older couples showed higher confidence in working with their spouse than did younger and older stranger dyads, respectively.

The correlations between initial and delayed story recall performance and the average confidence ratings for story, as well as between working memory performance and the average confidence ratings for hardware, of the MSEQ, were used to examine the relationship between task-specific memory self-efficacy and performance. The average confidence ratings were based on the mean confidence response given across the five task levels differing in task difficulty. Hertzog et al. (1994) argued that task-specific memory self-efficacy should be more highly related to performance than a global measure of memory self-efficacy. Global memory self-efficacy typically correlates with performance up to 0.3 (Hertzog & Dixon, 1994). Therefore, it was expected that these correlations should be moderate ($r = 0.3$) to high.

In terms of the story scale, the correlations with initial and delayed story recall were generally low (e.g., older individuals immediate recall $r = .16$) to moderate (e.g., younger individuals immediate recall $r = .37$). Only

one correlation was significant. Younger individuals immediate story recall performance correlated highly with their average confidence rating on the story scale ($r = .50$, $p < .05$). Generally, the correlations between individual-level recall performance and memory self-efficacy were smaller than dyad-level recall performance and memory self-efficacy. There were three negative correlations with individual-level data, while only one with dyad-level data. Further, whereas four of the correlations involving collaborating pairs were .35 or greater, only two of the individuals' correlations were of this magnitude.

One potential problem with the story scale of the MSEQ, was a qualifier "word for word." Participants were asked if they could recall a certain amount of a story "word for word." Many participants felt that this was a nearly impossible task. Perhaps, the story scale is not an optimal measure of task-specific memory self-efficacy for story recall, as our task is a gist rather than a verbatim task. In contrast, it seems that the story scale correlated more highly with story recall performance in dyads than in individuals.

The correlations between working memory performance and the average confidence ratings given to the hardware scale were ranged from low to high ($r = -.29$ in unexpected direction to $r = .68$ in expected direction). Although quite variable, the correlations were particularly high for the

older individuals and dyads. While the working memory performance of younger individuals and dyads did not have any significant correlations, older individuals and dyads had five. At least for older adults, working memory performance was largely related to task-specific memory self-efficacy as measured by the hardware scale.

Summary. In sum, task-specific memory self-efficacy was moderately related to task performance. The relationships were moderated by whether it involved individual or dyad level data, as well as younger or older adults. It was intriguing that for working memory performance, older adults' task-specific memory self-efficacy was highly related. Finally, although the number of affirmative responses and the average confidence ratings showed expected age and recall condition differences, no influence of collaborative experience on collaborative task-specific memory self-efficacy was observed. A more sensitive measure of change in confidence level across the levels of difficulty will be needed to show these expected influences.

Global memory self-efficacy. The General Rating Scale of the Memory Functioning Questionnaire (Gilewski & Zelinski, 1988) was used as a global measure of memory self-efficacy. It was found that higher self-efficacy ratings were given when working with a partner than when working alone. Also, individuals and dyads from the spouse

condition gave a higher general rating than individuals and dyads from the stranger condition. No age differences were found. Moreover, older adults rating their memory higher when working with their spouse than when working alone. This difference was not as exaggerated for younger adults. Older adults from the stranger condition gave similar ratings to working alone or working with a stranger. In contrast, younger adults gave higher ratings to working with a stranger than to working alone. This pattern of results suggests that older adults feel much more self-efficacious when working with a spouse than when working alone or with a stranger. Younger adults also show this same preference for working with a spouse, but it is not as exaggerated.

Correlations involving all the memory tasks, included initial story recall, delayed story recall, alpha span, and sentence repetition, with global memory self-efficacy was calculated. The purpose of these correlations was to test Hertzog et al.'s (1994) hypothesis that global memory self-efficacy is low to moderately correlated with performance. It was predicted that, like previous research (Hertzog & Dixon, 1994), the correlations would vary up to 0.3. The correlations were quite variable ranging from significant in the unexpected direction ($r = -.53$) to significant in the expected direction ($r = .47$). As expected the correlations were largely low. Less than one-third of all the correlations were .35 or higher. Of these ten correlations,

four were in the unexpected direction, such that an individual reporting high memory self-efficacy performed poorly on a task.

Beliefs About Collaboration

The collaboration effectiveness questionnaire was intended to tap implicit beliefs as to the effectiveness of working with various partners and alone. Although both younger and older adults rated working with a spouse as most effective, older adults distinguished between this and other partners more than younger adults. Furthermore, older adults distinguished between working with a friend of the same gender and working with a friend of the opposite gender, with the former being more effective. In contrast, younger adults gave a similar effectiveness rating to working with a same or a different-gender friend. Finally, it was predicted that older adults, aware of their declining memory abilities (Dixon & Hultsch, 1983), would give higher effectiveness ranking to working with partners (all types) than working alone. Contrary to this prediction, older adults gave working alone a higher effectiveness ranking to working with a stranger, regardless of gender. Younger adults, though, gave a similar rating to working alone or with a stranger of either gender.

General Conclusions

There are two limitations to this research which should be addressed. First, the design was extremely complicated.

There were four counter-balancing variables, some of which interacted with more central variables -- age, collaborative condition, and recall condition -- in the tests of the counter-balancing effects. At the risk of ignoring important influences, these variables were dropped from subsequent analyses. All of the interactions were three, four, or five-way interactions which were uninterpretable or theoretically empty.

Second, the individuals from the two collaborative conditions were slightly different. Individuals from the stranger condition performed better than individuals from the spouse condition in vocabulary and sentence repetition tasks. Although it does not seriously jeopardize the results because these groups performed similarly in all other tasks, it poses some difficulties. Perhaps individuals and dyads from the stranger condition were performing better than they would have had they been perfectly equivalent to the spouses. If this was the case, then the present experiment largely underestimates collaborative experience effects on memory (stranger dyads, in general, performed similarly to married couples). Future researchers could eliminate individual-level collaborative condition differences by testing two couples at once. Therefore, the performance of married couples working together, working with an opposite gender stranger (of the other couples), and working alone could be compared.

Despite these difficulties, plenty has been gained from this research. The influence of collaboration, collaborative expertise, and age on working memory, immediate and delayed story recall, memory monitoring, and memory self-efficacy was investigated. It was found that collaborative expertise benefitted older adults, if modestly, on sentence repetition and immediate story recall tasks. In contrast, collaboration, but not collaborative expertise, seemed important to the performance of younger adults. Younger stranger dyads and younger couples performed similarly on working memory tasks and on story recall tasks. Interestingly, estimates of performance, memory self-efficacy indicators, and the collaboration effectiveness questionnaire showed that younger and older adults are aware of the benefits to working with a partner with whom they have had extensive collaborative experience. To some extent, though, younger and older adults overestimated the influence of collaborative experience on their memory performance.

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|----|
| Grade School | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| High School | | | 1 | 2 | 3 | 4 | 5 | 6 |
| Technical, trade, nursing or business school | | | 1 | 2 | 3 | 4 | 5 | 6 |
| University (undergraduate) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| University (graduate School) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8+ |

5. What is the name of the town and the province where you were born?

6. What is the name of the town and the province where your SPOUSE was born?

7. If you attended high school, what was the name of the high school?

(name of high school)

8. If your SPOUSE attended high school, what was the name of the high school?

(name of spouse's high school)

9. If you graduated from high school, what year did you graduate?

(year of graduation)

10. If your SPOUSE graduated from high school, what year did he or she graduate?

(year of spouse's graduation)

11. What is your first language?

12. What is your spouse's first language?

13. How long have you been married to your present spouse?

(years)

14. Please give the exact date of your marriage?

(month) (day) (year)

15. What is your FAVOURITE type of music? (Please choose one)

- a. Blues
- b. Classical
- c. Country
- d. Easy Listening
- e. Jazz
- f. Pop
- g. Alternative
- h. Rock and Roll
- i. Big Band
- j. other (please name) _____

16. What is your spouse's FAVOURITE type of music? (Please choose one)

- a. Blues
- b. Classical
- c. Country
- d. Easy Listening
- e. Jazz
- f. Pop
- g. Alternative
- h. Rock and Roll
- i. Big Band
- j. other (please name) _____

17. What does your FAVOURITE breakfast consist of?

(favourite breakfast)

18. What does your spouse's FAVOURITE breakfast consist of?

(spouse's favourite breakfast)

19. What is your FAVOURITE type of food? (choose one)

- a. American
- b. Cajun
- c. Chinese
- d. East Indian
- e. French
- f. Greek
- g. Italian
- h. Japanese
- i. Mexican

- j. other _____
20. What is your SPOUSE'S FAVOURITE type of food? (choose one)
- a. American
 - b. Cajun
 - c. Chinese
 - d. East Indian
 - e. French
 - f. Greek
 - g. Italian
 - h. Japanese
 - i. Mexican
 - j. other _____
21. What is your FAVOURITE television program?
- _____
- (favourite t.v. program)
22. What is your SPOUSE'S FAVOURITE television program?
- _____
- (spouse's favourite t.v. program)
23. What is the first name of your closest friend?
- _____
- (name of closest friend)
24. What is the first name of your SPOUSE'S closest friend?
- _____
- (name of spouse's closest friend)
25. When did you last see your closest friend?

- c. Who is more likely to fill out the income tax forms? you____
your spouse____
- d. Who is more likely to know the meaning of a difficult word? you____
your spouse____
- e. Who is more likely to remember the exact price of an object a few days after it was purchased? you____
your spouse____
- f. Who is more likely to correctly calculate the price of a purchase that is reduced in price by a percentage? you____
your spouse____
- g. Who is more likely to keep in touch with friends through letter writing? you____
your spouse____
- h. Who is more likely to comprehend a difficult passage in a story? you____
your spouse____
- i. Who is more likely to remember a phone number? you____
your spouse____
- j. Who is more likely to correctly

Appendix B

Memory Self-Efficacy Questionnaire

Different people use their memories in different ways in their everyday lives. For example, some people make shopping lists, whereas others do not. Some people are good at remembering names, whereas others are not.

In this questionnaire, we would like you to tell us how you use your memory and how you feel about it. There are no right or wrong answers to these questions because people are different. Please take your time and answer each of these questions to the best of your ability.

In the following, we would like you to indicate whether you think you could or could not perform the task; if you believe you could perform the task, you would circle yes and if you believe you could not perform the task, you would circle no. If you circle yes, we would then like you to indicate your confidence in performing this memory task.

For example, a memory statement may be:

If I had just placed 10 items in different locations in a room, I could remember where I put 2 of the items.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

You would circle no if you think you could not remember the location of 2 of the items, whereas you would circle yes if

you think you could remember the location of 2 of the items. If you circled yes, we would like you to indicate how confident you are in remembering the location of 2 of the items; if you are not confident in your ability to perform this task, you would circle 10%, if you are moderately confident you would circle 50% and if you are extremely confident you would circle 100%. Please do not give a confidence rating if you circled no.

If you circled yes, you could choose any one of the percentiles. Please choose the one that best represents your confidence level. Keep in mind that there are no wrong or right answers, and be sure to answer every question.

STORY

If I heard a 1-page story about an event in a fictional person's life, I could remember 10% of the story word for word.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I heard a 1-page story about an event in a fictional person's life, I could remember 40% of the story word for word.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I heard a 1-page story about an event in a fictional person's life, I could remember 60% of the story word for word.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I heard a 1-page story about an event in a fictional person's life, I could remember 75% of the story word for word.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I heard a 1-page story about an event in a fictional person's life, I could remember 100% of the story word for word.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

HARDWARE

If I purchased 12 hardware items, five minutes later I could list 2 of the items from most expensive to least expensive without referring to the receipt.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I purchased 12 hardware items, five minutes later I could list 5 of the items from most expensive to least expensive without referring to the receipt.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I purchased 12 hardware items, five minutes later I could list 8 of the items from most expensive to least expensive without referring to the receipt.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I purchased 12 hardware items, five minutes later I could list 10 of the items from most expensive to least expensive without referring to the receipt.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If I purchased 12 hardware items, five minutes later I could list 12 of the items from most expensive to least expensive without referring to the receipt.

No Yes

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

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Author: _____

Lisa Marie Gagnon

July 31, 1995