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Do older adults underestimate their actual computer knowledge?

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Abstract. This work examined the hypothesis that elderly people are less confident than young people in their own computer knowledge. This was done by having 49 young (M = 22.6 years) and 42 older (M = 68.6 years) participants to assess their global self-efficacy beliefs and to make item-by-item prospective (feeling-of-knowing: FOK) and retrospective (confidence level: CL) judgments about their knowledge in the two domains of computers and general knowledge. The latter served as a control domain. Item difficulty was equated across age groups in each domain. In spite of this age equivalence in actual performance, differences were found in FOK and CL ratings for computers but not for general knowledge, with older people being less confident than young people in their own computer knowledge. The greater age difference in ratings observed in the computer domain, as compared with the general domain, was even greater for the FOK than for the CL judgments. Statistical control of age differences in global self-efficacy beliefs in the computer domain (poorer in the older participants, but not in the general domain), eliminated age differences in FOK and CL judgments in the same domain. These findings confirm earlier ones. They suggest that underconfidence in their relevant abilities is one possible source of the difficulties that the elderly may encounter in mastering new computer technologies.

1. Introduction

The integration of elderly people in our modern societies depends increasingly on their ability to master new technologies, especially computer technologies. However, a number of factors have been reported as being likely to render the learning of new tools more difficult for older adults. One possible reason lies in the age-related changes in basic cognitive skills such as speed of information processing, spatial abilities, memory, and perceptual and attentional processes (Sharit and Czaja 1994). More generally, the cognitive, metacognitive and emotional characteristics of the older adult, and training methods assumed to be unsuitable for these specificities, have been shown to be associated with less efficient learning performance in computer training situations (see Kelley and Charness 1995, Marquié and Baracat 1998, Westerman *et al.* 1998). Negative stereotypes concerning the ability and willingness of older adults to learn new computer technology have also been reported (Ryan *et al.* 1992). In the workplace, the methods used to introduce new computerized technologies have been shown to cause anxiety in older workers with respect to their working conditions and even job security, and are likely to generate negative attitudes toward computers (Cohen *et al.* 1981, Marquié *et al.* 1994). However, earlier work has shown that negative attitudes were less predicted by age than by the lack of computer experience (Zoltan and Chapanis 1982, Arndt *et al.* 1983, Jay and Willis 1992, Marquié *et al.* 1994).

As can be seen, a number of previous studies suggest that some difficulties experienced by older people in mastering new information and communication technology are caused or mediated by non-cognitive factors, such as fears of computerization and its consequences in the workplace, age-related negative stereotypes, attitudes and lack of confidence. However, to our knowledge, few if any researchers have studied the extent to which stereotypes, attitudes or beliefs are related to the actual competence of the older learner, or, in other words, to what extent there is a bias in other- and self-evaluations. Some earlier results have either suggested or shown higher learning anxiety in older than in young people in computer training situations (Charness *et al.* 1992, Baracat and Marquié 1994, Kelley and Charness 1995, Delgoulet *et al.* 1997). This can be interpreted as revealing a larger perceived gap between self-efficacy beliefs and task demand. In these studies, however, no evidence was available about whether this discrepancy was actual and not only perceived.

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Metacognition research methods can be used to explore the magnitude of the discrepancy between self-efficacy beliefs and actual performance, as well as the direction of the subject's judgment bias, called over-confidence. Such methods are relevant to study age-related computer learning differences because findings obtained in other fields suggest that under- or over-estimating one's own abilities may influence learning performance (Janis and Mann 1977, Pajares 1997). For instance, according to Bandura (1986) subjects who lack confidence in their own skills are less likely to engage in tasks and more likely to give up when they encounter difficulties; on the other hand, a slight overestimation of capacities seems to increase effort and persistence. Marquié and Huet (2000) adressed this issue of over-confidence in relation to age. They did so by matching, for every item of a large set of knowledge questions, the participants' prospective judgments on their knowledge, called feeling-of-knowing (FOK) and their retrospective judgements on their answers, called confidence level (CL) on the one hand, with their actual knowledge as measured by a multiple choice questionnaire, on the other hand. The FOK is a judgment of one's ability to later retrieve a particular piece of information that cannot be brought to consciousness at that moment; the CL is a judgment about whether a particular piece of information has been correctly retrieved from memory. One important aspect of the authors' method is that they examined the gap between predictions (FOK and CL) and actual knowledge for two different domains, general knowledge and computers. It was thus possible to examine the relationship between the subjects' domain-related global self-efficacy beliefs and the processes activated when scanning their long-term memory for a given information in the corresponding domain. Besides testing hypotheses on age and domain effects on online metamnemonic processes (Lovelace 1990), the study revealed one possible source of age related computer learning difficulties, namely under-confidence. Indeed, older particpants were more lacking in confidence in their prospective judgements (FOK) than the young, but only in the computer domain, in which the abilities perceived by oneself and by others are usually, as they were in this study, favorable to young people (e.g. Brickfield 1984, Breakwell and Fife-Schaw 1988, Ryan *et al.* 1992, Marquié *et al.* 1994). This greater degree of underconfidence was not clearly observed for the general knowledge domain where efficacy is generally perceived and in fact turned out to be similar or favorable to older people (Marquié and Huet 2000). Furthermore, it appeared that age differences in the FOK judgments in the computer domain were mainly explained by age differences in the participant's global computer-related self-efficacy beliefs.

However, in this study, it was not clear whether or not retrospective judgments in the computer domain were related to age and to global self-efficacy beliefs for the domain in question. Despite significant lower CL judgments for computers than for general knowledge in all age groups, and a tendency for middle-aged and older participants to rate their CL judgments lower than the young in this domain, in the absence of any age difference in performance, the age difference in CL ratings was not statistically significant ($p = 0.11$), perhaps because of a lack of statistical power. It is important to establish whether such an age effect actually exists because, along with FOK ratings, CL ones may be easy and thus useful indicators of the effectiveness of training in restoring more accurate self-efficacy beliefs (i.e. less lack of confidence) in one's computer learning ability. The goal of the present work was, therefore, to repeat the previous study with a larger sample, in order to confirm the reliability of the age effect on overconfidence in FOK and CL judgments in the computer domain as compared with the general domain, which served as a control domain. Participants were given questions pertaining to the general information and computer domain and, for every question that they could not immediately answer, they were asked to rate their FOK. In the subsequent phase, and for every unanswered question, they had to indicate the correct answer out of four possibilities (multiple-choice recognition) and then to assess how confident they were of their own answer (CL rating). Our hypothesis was that, for a given level of recognition performance, older people would rate their FOK and CL lower than young people in the computer but not in the general domain, thus indicating less confidence in their own computer knowledge. Global self-efficacy beliefs were also assessed for the two domains. Our hypotheses were (i) that they should be higher for the younger people in the computer domain and similar in both age groups for the general domain, and (ii) that such age differences in memory self-efficacy beliefs in the computer domain should account for the age difference obtained in the FOK and CL ratings in the same domain.

Finally, this work was also intended to shed light on a more theoretical issue, namely the specificity of the underlying mechanisms of FOK and CL judgments. According to Costermans *et al.* (1992) (see also reviews by Miner and Reder (1994) and Schwartz (1994), for instance), FOK is more likely to be derived from familiarity effects elicited by the question and the related domain than is CL, which seems to be based more on the retrieval of at least some elements of the right answer. Drawing on this previous work, it may be expected that using age differences to manipulate differences in computer familiarity and self-efficacy beliefs should result in greater age effects in the computer domain as compared with general knowledge, and even more so for FOK than for CL judgments.

2. Method

2.1. *Participants*

A completely distinct and larger sample than in the previous study was defined with approximatively the same age and educational characteristics, in order to facilitate comparison of the two studies. It was made of 91 volunteers divided into two age groups, ranging between 18 and 29 for the young participants ($n = 49$) and between 58 and 78 for the older ones ($n = 42$). Means and standard deviations for participants' demographic characteristics are shown in table 1 by age group. As can be seen, the two age groups did not significantly differ in the number of years of education ($p = 0.10$). Health was self-rated on a 100 mm long scale, with 100 indicating excellent health. Ratings revealed fairly good health in both groups, with young subjects reporting a health status that was slightly but signifcantly better than that of older subjects, $F(1, 89) = 21.74$, $p = 0.0001$. Furthermore, care was taken not to include subjects whose health troubles or medication was likely to influence cognitive functioning. The digit-symbol substitution subtest of the WAIS and the Binois-Pichot vocabulary test were administered. They revealed the typical age patterns, with older participants showing significantly poorer scores in the first test, $F(1, 89) = 57.21$, $p = 0.0001$, and significantly better scores in the second, $F(1, 89) = 68.71$, $p = 0.0001$. Finally, computer familiarity was self-assessed on a 100 mm long rating scale, with higher scores indicating greater expertise. Since in the experimental paradigm used, FOK and CL judgments were only made for questions which were not answered in a first stage, we did not include participants whose score was higher than 85 in the sample. As expected, ratings of the older subjects revealed significantly less computer familiarity than their younger counterparts, $F(1, 89) = 11.06$, $p = 0.001$.

Table 1. Mean and standard deviation for the participant's demographic characteristics by age group.

	Age group				
	Young ($n = 49$)		Older ($n = 42$)		
Variables	*M*	SD	*M*	SD	
Age (years)	22.59	3.38	68.57	5.41	*
Education (years)	13.88	1.29	13.24	2.27	
Health	76.45	10.64	64.36	14.05	*
Digit-symbol	65.69	10.44	48.98	10.60	*
Vocabulary	25.04	3.85	31.55	3.60	*
Computer familiarity	60.51	19.34	44.71	25.88	*

Note: *age difference statistically significant at $p \leqslant 0.05$. Except for age and education, all variables are scores with higher values indicating better health status, higher performance in the digit-symbol and vocabulary tests and higher computer familiarity.

2.2. *Material*

The material was nearly the same as that used in the previous study (Marquié and Huet 2000). It consisted of a metacognitive questionnaire, modeled on the Metamemory In Adulthood (MIA; Dixon *et al*. 1988), and of the test itself, made up of questions and related correct answers and distractors. For the metacognitive questionnaire, nevertheless, we only used the Capacity dimension, which is known to most directly measure perceived competence or self-efficacy beliefs (Hertzog *et al*. 1989), and which turned out to be the metacognitive dimension most correlated with FOK and CL judgments in the previous study. Four statements measured Capacity in the general domain, and four in the computer domain. One example for the general domain (computer domain in parentheses) was: 'In most areas of general knowledge such as literature, history, geography, music, science, current events, and sports (in the area of computers), I have as much knowledge as the others, on average'. Ratings were made on a 100 mm long scale ranging from 'fully agree' to 'completely disagree'. The knowledge domains were pseudo randomly mixed within the metacognitive questionnaire. The internal consistency obtained for the Capacity scale was fairly good for the general knowledge domain (Cronbach's alpha = 0.66), and even better for the computer domain (Cronbach's alpha = 0.85). Thus scores were computed for each domain by taking the mean of the four corresponding participant's ratings.

The test material consisted of two 138-item sets, one for each age group. The two sets were the same as the one used in the previous study for the two extreme age groups that corresponded to the current ones. Half ($n = 69$) of the item-set was made of general knowledge questions on various but equally represented cultural, scientific and sport-related topics, and the other half was made up of computer-related questions. General and computer related questions were randomly mixed. These subsets had previously been constructed so as to be equally difficult, as far as possible, for the age-groups studied, and in such a way that the rate of the correct answers would be around 50%. This precautionary measure was taken because it has been shown that the error bias between predicted and actual performance (under- or overconfidence) is affected by the level of task difficulty (e.g. Nelson 1984, Schraw and Roedel 1994). Overconfidence increases with item difficulty, and when items are easy, judgment errors are minimized (Schraw and Roedel 1994).

For the first, recall + FOK phase, the questions were individually printed in large characters on one side of 140 mm x 210 mm cards. A FOK 100 mm long rating scale was also printed on the same side. It included the five, evenly-spaced following labels ranging from the lowest to the highest FOK: (i) I am absolutely sure I do not know the answer, (ii) I am fairly sure I do not know the answer, (iii) I have a vague impression I know the answer, (iv) I am rather sure I know the answer, and (v) I am absolutely sure I know the answer. The other side of the card was used for the second, multiple choice recognition + CL phase. The same question was again printed, but with four possible answers given, the correct one being randomly mixed with three distractors. The latter were chosen so as to be moderately tempting but not tricky. The CL scale was also 100 mm long and was printed on the same side of the card. It included five labels ranging from the lowest to the highest CL, as follows: (i) I am not at all sure my answer is correct, (ii) I am not so sure my answer is correct, (iii) I am more or less sure my answer is correct, (iv) I am practically sure my answer is correct, and (v) I am absolutely sure my answer is correct.

2.3. *Procedure*

All participants were tested individually. After biographical data had been collected, participants completed the metacognitive (Capacity) questionnaire. The test itself was divided into two major phases. In the first, recall + FOK phase, participants were successively shown the question cards. For every question, they had about ten seconds to give the answer. They were instructed to give it only if they were sure it was correct, and that they would have a further opportunity to find the answer, with some hints and more time. Whether right or wrong, the answer was recorded if it was provided, and the next question-card was presented. If they failed to give an answer, participants were asked to rate their FOK on the scale. Thus, only questions that were not answered received an FOK (and later a CL). In the second, multiple choice recognition + CL phase, all questions which were not answered in the recall phase were presented again, in the same order. Participants were asked to indicate which out of the four proposed answers was the right one, and then to rate their level of confidence in the correctness of their answer on the appropriate scale. No time limit was imposed.

Before starting the test, participants were informed of the kind of questions they would be given (general and computer related), and that they would encounter questions that were easy, moderately difficult and very difficult. They were instructed that they could make ratings at any place on the scale, not only on the labels. The entire procedure took about two hours, including three compulsory rest periods of at least five minutes. The Digit-Symbol and Vocabulary tests were administered after the first and second rest period, respectively.

3. Results

3.1. *Initial and equalized performance*

Two types of accuracy of memory monitoring judgments, such as FOK and CL, can be assessed: absolute and relative (Nelson 1984). Absolute accuracy, also called calibration, reflects the relationship between absolute levels of prediction and absolute levels of performance. Relative accuracy taps a distinct aspect of accuracy, also called resolution. It is measured through the Goodman-Kruskall gamma, a correlation coefficient between two ordinally scaled variables. For a given subject, it measures the degree to which judgments accurately predict the performance of one item relative to another. Only the absolute accuracy measure can be used to assess overconfidence, namely the magnitude as well as the direction of the judgment error, which is the purpose of the present study. This is why absolute accuracy was used here. Furthermore, because test difficulty seems to affect judgment bias (e.g. Nelson 1984, Schraw and Roedel 1994) and can unduly maximize or minimize differences in between age-group comparisons, we tried to design the test material so as to equalize task difficulty for the two age groups, as indicated above. In spite of this effort, we were not able to tell ahead of time, whether this goal would be reached. To find out wether it did, we compared young and older participants' recognition performance, which is relevant for examining age differences in judgment bias. One-way ANOVAs were thus conducted for each domain with Age as a factor (two levels) and multiple-choice recognition performance as a dependent variable. As can be seen in table 2, initial recognition performance, as assessed by the mean percentage of correct recognitions, was higher for older than for young participants in the general domain, while in the computer domain it was the young who performed better than the older participants. These differences were statistically significant in both domains, with *F*(1,

Table 2. Mean (and standard deviation) initial and equalized recognition performance (correct recognition rate) by age group and knowledge domain.

	Young	Older
Initial recognition performance		
General domain	41.74	48.88
	(9.32)	(7.65)
Computer domain	57.51	49.56
	(11.33)	(13.45)
Equalized recognition performance		
General domain	45.13	45.29
	(9.30)	(7.52)
Computer domain	55.22	54.28
	(12.16)	(14.17)

89) = 15.61, $p \leqslant 0.0001$, for the general domain, and $F(1, 89) = 9.37$, $p \leqslant 0.01$, for the computer domain.

We, therefore, further equated recognition performance between young and older participants by ranking items by level of difficulty (% correct recognitions) in each domain and age group, and discarding some of them for subsequent analyses. For the general domain, the expected result was achieved by discarding the eight items that were most difficult for the young, and the eight ones that were easiest for the older participants. For the computer domain, the seven most difficult items for the older and the seven easiest items for the young participants were discarded. A global ANOVA, with Age as a factor (two levels), Domain as a repeated measure (two levels), and multiple-choice recognition performance as a dependent variable, revealed no age effect, $F(1, 89) = 0.04$, $p = 0.83$, nor an Age x Domain interaction, $F(1, 89) = 0.16$, $p = 0.69$. It only revealed a significant domain effect, with higher performance being obtained in the computer domain ($M = 54.75$, $SD = 13.06$) than in the general one ($M = 45.21$, $SD = 8.47$), $F(1, 89) = 0.16$, $p = 0.69$. Within-domain ANOVAs with Age as a factor (two levels) and multiple-choice recognition as a dependent variable, confirmed that no age-difference remained after this equalization of recognition performance (see table 2), neither in the general domain, $F(1, 89) = 0.01$, $p = 0.93$, nor in the computer domain, $F(1, 89) = 0.12$, $p = 0.73$.

All subsequent analyses were thus based on those items which did not receive any correct or wrong answer in the recall phase, i.e. items which received a 'Don't Know' answer ($M = 113.76$, $SD = 15.54$, and $M = 113.24$, $SD = 17.69$, for the young and the older group, respectively; $F(1, 90) = 0.02$, $p = 0.88$), minus the items which were then discarded in age equalization of recognition performance. Notice that young and older participants did not show any difference in the number of 'Don't Know' answers in this recall phase. This was also true for wrong answers ($M = 7.61$, $SD = 5.72$, and $M = 8.24$, $SD = 7.02$, for the young and the older group, respectively; $F(1, 90) = 0.22$, $p = 0.64$), and thus also for correct answers. This means that young and older participants complied similarly with the instruction that recommended giving an answer only if the participant was sure it was correct.

3.2. *FOK and CL ratings*

To the extent that no age difference in the participant's recognition performance can be found, any age difference in FOK and CL ratings can be viewed as reflecting reliable age differences in the error bias, or overconfidence. To adress the separate and combined effects of age, domain and type of judgment (FOK vs CL), we conducted a global, three-way ANOVA with Age (two levels) as an independent factor, Domain (two levels) and Type of judgment (two levels) as repeated measures, and the ratings as the dependent variable (see also figure 1). With all conditions taken together, age turned out to have no significant effect on the ratings, $F(1, 89) = 2.44$, $p = 0.12$. In contrast, the domain, $F(1, 89) = 20.13$, $p \leqslant 0.0001$, and the type-of-judgment effects, $F(1, 89) = 15.13$, $p \leqslant 0.0001$, were highly significant. The latter effects mean that participants rated higher in the general than in the computer domain, and rated the FOK lower than the CL. A significant Age x Domain interaction was found, $F(1, 89) = 15.36$, $p \leqslant 0.0001$. This means, as expected, that older participants made less confident judgments than the young in the computer domain while in the general domain their judgments were closer to those of the young participants. A significant Domain x Type of judgment interaction was also found, $F(1, 89) = 69.73$,

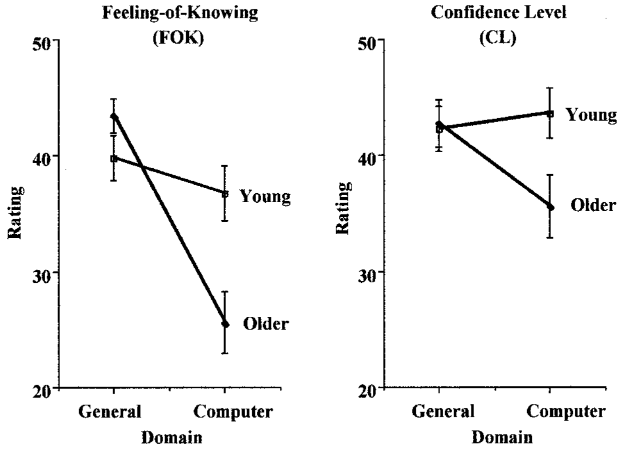

Figure 1. Mean (and standard error) FOK and CL rating according to knowledge domain and age group.

$p \leqslant 0.0001$, which means that the difference between the general and the computer domains was greater for FOK judgments than for CL judgments. Finally, a significant third-order interaction was obtained between age, domain and type of judgment, $F(1, 89) = 12.34$, $p \leqslant 0.001$. This means, as expected, that the greater age difference in ratings observed in the computer domain as compared with the general domain, was even greater for the FOK than for the CL judgments.

Subsequent contrast analyses were conducted to examine age effects for each domain and each type of judgment. One-way ANOVAs with Age (two levels) as a factor and ratings as a dependent variable were used. For the FOK, no significant age difference was obtained in the general domain, $F(1, 89) = 2.16$, $p = 0.15$, whereas in the computer domain the age difference was significant, $F(1, 89) = 9.76$, $p \leqslant 0.01$. This means that older participants rated their FOK lower than the young in the computer domain, which reveals that they are less confident in their ability to later retrieve the relevant information. The statistical analyses which were conducted for the CL showed the same pattern, namely no age difference in CL judgments in the general domain, $F(1, 89) = 0.22$, $p = 0.88$, but significant age differences in the computer domain, $F(1, 89) = 5.40$, $p \leqslant 0.05$, with the older participants showing less confident judgments than the young in their own answers in this domain.

3.3. *Global memory self-efficacy beliefs*

Age differences in global memory self-efficacy beliefs as a function of knowledge domain, were adressed by a two-way ANOVA, with Age (two levels) as a factor, Domain (two levels) as a repeated measure and Capacity score as the dependent variable. The analysis revealed a significant main effect of age, $F(1, 89) = 16.00$, $p \leqslant 0.0001$, of domain, $F(1, 89) = 92.06$, $p \leqslant 0.0001$, and an Age x Domain interaction, $F(1, 89) = 17.08$, $p \leqslant 0.0001$. This means that the young participants had a higher perception of their knowledge, on the whole, than did the older ones, that the knowledge was seen as greater in the general than in the computer domain, and that the age difference was greater in the computer domain than it was in the general domain (see table 3).

Within-domain one-way ANOVAs with Age as a factor (two levels) and Capacity as the dependent variable, showed that there was no significant age difference in self-efficacy beliefs in the general domain, $F(1, 89) = 0.48$, $p = 0.49$, but that highly significant age differences were obtained in the computer domain, $F(1, 89) = 23.81$, $p \leqslant 0.0001$. While capacity was rated similarly by young and older participants in the general domain, it was rated lower by the elderly than by the young in the computer domain.

3.4. *Relationships between global memory self-efficacy beliefs and FOK and CL ratings*

Table 4 shows the bivariate Pearson correlations between the main variables of interest in this study for the two domains. First, and consistent with the results obtained through ANOVAs, it reveals no significant correlation between age and recognition performance in either domain, and a significant association between age and FOK and CL ratings in the computer but not in the general domain. Then, and more importantly for the purpose of this section, one can see that Capacity is significantly associated with FOK and CL ratings in the general domain, thus confirming that global self-efficacy beliefs in a given domain are related to online, item-by-item memory monitoring judgments. Correlations between Capacity and FOK and CL ratings were even stronger in the computer domain (correlation comparisons: $p = 0.0006$ and $p = 0.0007$, respectively), most likely because the latter is a more specialized domain. For the computer domain we also included the

Table 3. Mean (and standard deviation) Capacity score by age group and knowledge domain.

	Young	Older	Total
General domain	67.22	64.97	66.10
	(13.23)	(17.63)	(15.45)
Computer domain	53.38	30.17	41.78
	(23.95)	(20.94)	(22.68)
Total	60.30	47.57	53.94
	(15.14)	(15.13)	(16.35)

Table 4. Pearson correlations.

Variables	1	2	3	4	5	
General domain						
1 Age	1					
2 Capacity	−0.10	1				
3 FOK rating	0.15	0.27*	1			
4 CL rating	0.02	0.28**	0.58**	1		
5 Performance	−0.02	0.28**	0.28**	0.18	1	
Computer domain						
1 Age	1					
2 Capacity	−0.46**	1				
3 FOK rating	−0.32**	0.65**	1			
4 CL rating	−0.25*	0.65**	0.72**	1		
5 Performance	−0.06	0.50**	0.53**	0.46**	1	
6 Familiarity	−0.35**	0.69**	0.61**	0.58**	0.40**	1

Note: $^*p \leqslant 0.05$; $^{**}p \leqslant 0.01$

Familiarity measure in the table. Note that Capacity and Familiarity reflected a largely common reality since the correlation between the two was $r = 0.69$.

As can be seen in the table, for the computer but not for the general domain, Capacity scores were significantly correlated both with FOK and CL ratings and with age. Further analysis was thus done to see wether the observed lower ratings of the older participants in the computer domain were an independent effect of age or were mediated by global memory self-efficacy beliefs relevant to the domain. ANCOVAs with Age as a factor (two levels), Capacity as a covariant, and computer-related FOK then CL ratings as a dependent measure, were performed, once all underlying assumptions had been checked. Capacity was chosen as a covariant because it showed higher correlations than computer familiarity with the relevant variables. For the FOK ratings, the ANCOVA showed that the age difference observed in the computer domain was fully accounted for by the global metacognitive beliefs in the relevant domain. Indeed, it found a significant effect of computer Capacity, $F(1, 87) = 48.01$, $p \leqslant 0.0001$, which resulted in the age effect being no longer significant, $F(1, 87) = 0.10$, $p = 0.75$. The same was true for CL ratings: Capacity showed a significant relationship with them, $F(1, 87) = 57.65$, $p \leqslant 0.0001$, and statistical control of this variable eliminated the earlier observed age difference in computer-related CL ratings, $F(1, 87) = 0.24$, $p = 0.63$.

4. Discussion

The results first revealed that, in spite of similar memory recognition performance in both age groups, older participants showed less confidence in prospective (FOK) and retrospective (CL) absolute judgments than the young in their computer-related knowledge: when faced with computer items, they rated their FOK and their CL significantly lower than their younger counterparts. However, this greater degree of underconfidence does not seem to be generally true for the older people. Indeed, for items pertaining to the general culture domain, which served here as a control domain, the age difference was not observed. This is consistent with the findings of earlier studies that suggested that elderly people are as accurate as the young when monitoring their memory for general culture items (see Lovelace 1990). We can thus conclude that there is something specific in the computer domain that makes elderly people less confident in their judgments. Our hypothesis that this is related to poorer, computer-related, global self-efficacy beliefs in these people was confirmed. Indeed, when statistically controlling for how participants globally assessed their knowledge in the computer domain, age differences were no longer observed in item-by-item FOK and CL judgments in the same domain.

The results clearly confirm those obtained in an earlier study by Marquié and Huet (2000), except for the CL. In the Marquié and Huet (2000) study, the age difference in the CL ratings in the computer domain was not significant. With a larger sample and thus more statistical power, this age difference was clearly significant in the present study. In addition, we were able to show here that, as for the FOK, this was totally explained by the poorer perception that the older participants had of their global, computer-related efficacy.

The outcome of the current study and the earlier one by Marquié and Huet (2000) has possible practical, methodological and theoretical implications. First, it suggests that low confidence in their ability is one reason why elderly people have difficulty in mastering new computer technologies. Indeed, if somebody believes he or she is not capable of performing a task, he or she will not make the required effort and will not use the approriate strategies in order to succeed. This view is consistent with findings in decision making (Janis and Mann 1977) and in self-efficacy (Pajares 1997) research, which suggest that poor self-efficacy beliefs are associated with a smaller likelihood of engaging in new tasks and with less effort and perseverance in task achievement. It may thus be that one way to help older learners of new technologies is to restore confidence in their actual ability (e.g. see Welch and West 1995). Note that the present study tells nothing about the origin of the observed underconfidence of the older people in the computer domain. Clearly, the phenomenon does not seem to be due to age *per se*, but to be cultural in nature. It thus may be subject to a cohort or generation effect. However, some arguments (see Baracat and Marquié 1998), especially the continual and rapid technological changes that characterize modern societies, have led the authors to believe that such age differences are likely to be extended to future generations. Note also that similar age differences in judgment bias may exist in other technological and cultural domains where factors such as *age role* come into play. A second, methodological implication of the present findings is that, though to a lesser extent than the FOK, it seems that the CL rating can be used to identify underconfidence and measure either interindividual differences in self-efficacy beliefs or individual changes occuring in the latter, throughout a training process. As the CL measure can be applied after any answer, and does not need a previous recall round as does the FOK, as it was defined above, CL can be even easier to use than the FOK. A third implication of the study is more theoretical. In agreement with the findings by Costermans *et al.* (1999), the present study reveals that FOK is more likely to be derived from familiarity effects elicited by the question and its related domain than is CL. Indeed, using age differences to manipulate differences in computer familiarity resulted in a stronger effect of the latter for the prospective than for the retrospective judgments in the computer domain. However, as also shown by our results, even if CL judgments seem to be based more on the retrieval of at least some elements of the right answer, age differences in the CL also appear to significantly predict age differences in overall self-efficacy beliefs in the computer domain.

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