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Gary Charness
Marie-Claire Villeval

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Forschungsinstitut
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Gary Charness
University of California, Santa Barbara

Marie-Claire Villeval
CNRS-GATE and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

Cooperation, Competition, and Risk Attitudes: An Intergenerational Field and Laboratory Experiment*

The population of most developed societies is 'graying'. As life expectancy increases and the large baby-boom generation approaches retirement age, this has critical consequences for maintaining a high standard of living and the sustainability of pension systems. In the light of these labor-force and social concerns, we consider experimentally the comparative behavior of juniors (under 30) and seniors (over 50) in both experiments conducted onsite with the employees of two large firms and in a conventional laboratory environment with students and retirees. Our results are compelling. First, seniors are not more risk-averse, as opposed to the conventional stereotype. Second, both juniors and seniors react to the competitiveness of the environment and there is no significant difference in performance in the real-effort task across the generations when they are competing. Third, seniors are typically more cooperative than juniors in a team-production game. Cooperation is highest in groups in which there is a mix of juniors and seniors, suggesting that there are indeed benefits in maintaining a work force with diversity in age. Overall, the implication is that it is beneficial to define additional short-term incentives near the end of the workers' career to motivate and to retain older workers. A secondary, but important, issue is the external validity of conventional laboratory experiments. In general we do not find strong differences in behavior between workers and non-workers, indicating that laboratory experiments may not be such a bad approximation for the field environment.

JEL Classification: A13, B49, C91, C93, J14, J18, J38, J70

Keywords: age, performance, labor market, discrimination, diversity, stereotypes, experiments

Corresponding author:

Marie-Claire Villeval
CNRS-GATE
93, Chemin des Mouilles
69130 Ecully
France
E-mail: villeval@gate.cnrs.fr

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1. INTRODUCTION

The population of most developed societies is 'graying'. Life expectancy continues to increase, while fertility has been declining. At the same time, the large baby-boom generation is approaching (or in some countries, has reached) retirement age. The combination of these factors has critical consequences for maintaining productivity and a high standard of living in these societies. An immediate consideration involves the funding of pension systems, since in many societies workers are still retiring at an early age and in many cases the replacement generation of young workers is small.[1]

Further implications of aging for human resource policies include an increasing heterogeneity of the workforce, likely to lead to an increased need for inter-generational cooperation and an increase in the capacity of the firm to organize the transfer of knowledge between the old and the new generations. In addition, there may well be new requirements in terms of competences and adaptability due to more rapid organizational and technological change entailing skill obsolescence.

As mentioned in Kovalchik, Camerer, Grether, Plott, and Allman (2005), there is a common belief that ability and performance declines with aging (see Peters, Finucane, MacGregor, and Slovic, 2000). The tension between this belief and seniority-based wage policies plays against the employment of seniors, leading to discrimination against the hiring of seniors (Bendik, Brown, and Wall, 1999; Riach and Rich, 2006). [2]

[1] See Banks, Blundell, Disney, and Emmerson (2002) for a discussion of the sustainability of public-pension programs in European countries. The labor-force participation rate for employees between the ages of 50 and 64 was only 53% in France and Germany in 2003, 64% in the United Kingdom, 67% in the U.S.A., 68% in Japan and 74% in Sweden (OECD, 2006).

[2] In a survey conducted in the United States in 2002, two-thirds of employees between 45 and 75 years of age report having witnessed or personally suffered from age discrimination in their company (OECD, 2006). This seems to be

The importance of negative stereotypes about seniors was highlighted in a recent OECD report (OECD, 2006). This report mentions survey results showing that even in Sweden, where the participation rate of the seniors is the highest, half of the employers believe that seniors are less flexible and less willing to change. A survey in the United States reveals that even if employers believe that seniors are more reliable and determined than juniors, seniors are also believed to be less willing to learn. A third survey indicates that the lower adaptability to technical change is the most common reason French employers state for not employing people over the age of fifty (Monso and Tomasini, 2003).[3]

But are these views justified? Studying the wage premium for experience, Katz and Murphy (1992) have shown that older workers are less affected by their degree of technological skills. This may be partly due to the ability of older workers to compensate in other ways (e.g., with better judgment, intuition, or self-knowledge). Nevertheless, to answer this question it is essential to study the implications of aging on behavior, individual and group decision-making and abilities. In particular, are there different attitudes towards dimensions that are critical to the management of innovation, such as cooperation (see for example Ichniowski, Shaw and Gant, 2003), competition and sensitivity to incentives, and risk-taking?

Another important issue concerns the effect of age heterogeneity on group performance. Lazear (1998a) suggest that heterogeneity with respect to group composition may be desirable, as there are possible gains in production from complementarities among workers. He also argues

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particularly true for females: in a labor-market experiment, Lahey (2005) finds that a younger female worker is more than 40% more likely to be offered an interview than an older female worker.

[3] There is a negative correlation between senior employment and the introduction of innovation (Aubert, Caroli, and Roger, 2004; Hujer and Radic, 2006). Some suggest that technical and organizational changes are age-biased against seniors through a direct negative effect on their productivity (Behagel and Greenan, 2005). Others suggest that this bias results from the relatively small time horizon before retirement, which discourages employers to provide seniors with the training necessary to cope with innovation (d'Autume, Betbeze, and Hairault, 2005). Bartel and Sicherman (1993) show that, due to the diversity of access to training, employees retire at higher ages in industries characterized by a permanent higher rate of innovation, and retire early when the introduction of innovation is more sporadic.

that young employees have new ideas and more skill with new technologies, while older employees have knowledge about firm structure and relevant markets and networks (Lazear, 1998b).[4] Hamilton, Nickerson, and Owan (2003, 2004) examine how group composition affects productivity under team incentives, using field data from a garment factory. They find that teams with more heterogeneous ability levels are indeed more productive, which is consistent with mutual learning across types and the notion of complementarities. On the other hand, demographic heterogeneity, in terms of ethnicity and age, has a negative impact on productivity.

To date, economists have focused more on the macro-economic dimensions of aging for the future of pension systems and on its micro-economic implications on the labor market than on its behavioral implications.[5] Yet, a behavioral analysis of the impact of aging on decision-making may help in understanding how firms can, in the coming years, deal with the major issues mentioned above. Here, we wish to assess the behavior and attitudes of old and young cohorts, to provide an analysis of the impact of age and age pairing on attitudes toward cooperation and competition, and to gather data on the effects of endogenous or exogenous age pairing.

In this light, we consider experimentally the comparative behavior of juniors (under 30) and seniors (over 50) in rather novel subject pools. First, we conduct experiments with employees at two large French firms at their work sites. Second, we conduct a conventional laboratory experiment, where we invite students and retirees. The laboratory experiment allows us to extend the age dispersion in the observations. It is also justified by the fact that survey data on the relationship between productivity and age frequently suffer from a selection bias, since

[4] Similarly, Bellmann, Kistler, and Wahse (2003) find that a majority of the managers of German firms assign advantages to older employees for know-how, working morale, and awareness of quality, while assigning advantages to younger employees regarding ability, willingness to learn, and physical resilience.

[5] One experimental exception is Kovalchik *et al.* (2005), who find that older adults' decision behavior is generally similar to that of students in several experimental tasks. Also, Holm and Nystedt (2004) find that a younger cohort exhibits considerably more trust than does an older cohort in a mail-based game in Sweden, and that participants prefer to place trust in other people in their own age cohort. These studies are discussed in more detail in section 2.

one cannot otherwise observe those older potential workers who are no longer employed. Our design permits more comprehensive comparisons of productivity and behavior. Our experiments consist of a public-goods (or team production) game in which we vary whether participants are informed about the age composition of their three-person groups, a real-effort task (solving anagrams) in which individuals can choose a piece-rate pay scheme or can elect to compete against a counterpart for a higher pay rate if successful (but a lower pay rate if unsuccessful), and a test of the degree of risk aversion. We also ask people for their preferences with respect to age composition in one phase of the public-goods (team-production) experiment.

To clarify our contribution, a number of other researchers have experimentally, empirically, or theoretically considered the question of how one's age and the age composition of groups might affect issues of decision-making and performance, particularly in work environments. However, we are at least one of the first to go directly to the workplace and conduct direct tests of behavior and performance. In addition, we are unaware of any other study that explores this issue across a work environment and a laboratory environment, or that brings both students and retirees together in a laboratory. Lastly, we bring new results on the impact of generation on the level of cooperation and risk taking, on the degree of competitiveness and on sensitivity to incentives; we also show how the willingness to cooperate and to compete are affected by the generation of the group members; and we provide the first results on the effects of age and heterogeneity on behavior in a team-production game.

Our results are compelling and may surprise many people, including human-resource managers. First, seniors are **not** more risk averse, as opposed to the conventional stereotype. Second, seniors react to incentives and the competitiveness of the environment as strongly as juniors and there is no significant difference in performance in the real-effort task across the

generations. Third, seniors are typically more cooperative than juniors, in the sense of making more contributions to team production while being less conditional than juniors. In accordance with the results in Lazear (1998b), we observe beneficial effects from having groups in which there is a mix of juniors and seniors, suggesting that there are indeed benefits or complementarities in maintaining a work force with diversity in age; it is also interesting that the participants reveal a preference for being in age-heterogeneous groups and do not express a taste for age discrimination. Overall, the implication is that it may well be inadvisable to exclude seniors from the labor force; instead defining additional short-term incentives near the end of a worker's career to retain and to motivate older workers may provide great benefits to society.

A secondary, but important, issue is the external validity of conventional laboratory experiments, as students may well not be the most representative sample upon which to base vital policy decisions. Gneezy and List (2006) contend that gift exchange is an ephemeral laboratory phenomenon and that it is unprofitable for employers to rely upon it when setting wages. Levitt and List (2006) suggest that results obtained inside and outside of the laboratory need not correspond, in part due to differences in the demographics in these different environments. We test whether we observe differences in behavior across working and non-working subpopulations. In general we do not find strong differences in behavior between workers and non-workers, indicating that laboratory experiments may not be such a bad approximation for the field environment; however, we do observe some modest differences in the behavior of students compared to the other groups, for example, students contribute less in the team-production game.

The remainder of this paper is organized as follows. In section 2, we discuss the related literature, and in section 3, we describe our experimental methodology. In section 4, we present our results, and in section 5 we discuss the implications of these results. Section 6 concludes.

2. RELATED LITERATURE

The two main theories of the labor market that establish a relationship between age and productivity deliver opposite predictions. On the one hand, the firm-specific human-capital theory (Becker, 1975) states that firms with older employees should outperform other firms as long as the growth of specific human capital outweighs the wage growth over time; this observation also finds some support from the theory of job matching (Jovanovic, 1979), since seniors have had more time than juniors to find the best match on the labor market. On the other hand, the theory of deferred compensation (Lazear, 1979) states that juniors are paid below their marginal productivity whereas seniors with long tenure are paid above their marginal productivity, for the purpose of offering career incentives. The employment of seniors is therefore associated with a higher cost-benefit ratio. The question remains to determine whether for a given wage cost, juniors and seniors differ in their productivity levels (for a review of the literature on the estimation of life-cycle productivity, see Lumsdaine and Michell, 1999).[6]

Productivity may be influenced by the evolution of cognitive and behavioral abilities. As mentioned in the introduction, there are pervasive stereotypes about the declining decision-making ability of older individuals and their more cautious behavior in terms of risk attitude (see Nelson, 2002). Further, many people also appear to have views that older workers are less willing to learn, and implicitly less interested in working hard and competing (see OECD, 2006).

The experimental research closest to ours is that conducted by Kovalchik *et al.* (2005). This innovative study compares the behavior of healthy elderly individuals (average age 82) and younger students (average age 20) with respect to confidence about their answers to trivia

[6] The accessibility to employer-employee datasets has recently permitted an estimation of the seniors' productivity, but the results are mixed. Hellerstein, Neumark and Troske (1999) find that seniors are paid more because they are more productive, whereas Aubert and Crépon (2004) find that productivity stabilizes after the age of 40.

questions, decision-making under uncertainty in gambling tasks, possible asymmetries between one's willingness-to-pay (WTP) and willingness-to-accept (WTA) for an item (reflecting the "endowment effect"), and strategic thinking in the Nagel (1995) guessing game. Participants were interviewed individually, rather than in a group environment. The main conclusion of the paper is that it does not appear that older individuals do substantially worse on these decision-making tasks. Both cohorts displayed overconfidence, but this was lower for older individuals at intermediate levels of reported confidence; there were no significant differences across age cohorts in the gambling tasks. There were no significant differences between WTP and WTA for either cohort, and both young and old samples behave similarly in the guessing game.

The relationship between trust and age has been recently studied experimentally. Holm and Nystedt (2004) analyze behavior in the Berg, Dickhaut, and McCabe (1995) investment game, where a first mover can send some or all of his or her endowment to a responder, with the responder receiving triple the amount sent; the responder can then send back an amount to the first mover. This experiment was performed by sending out mail to people selected from a public database in Sweden; one cohort consisted of people 20 years old, while the other cohort consisted of people 70 years old. It was found that the young cohort sent significantly more as first movers than did the older cohort. While the average amount returned was similar for both cohorts, the proportions dispersed for the older responders, suggesting a greater degree of responsiveness to the environment; this result goes against the stereotype that older people are less adaptable.[7]

At the other end of the age spectrum, Harbaugh, Krause, and Liday (2003) find that children are more selfish than young adults and that individuals learn to become more fair. Their evidence shows that bargaining behavior changes substantially with age; most of this change

[7] Studies conducted with representative surveys in Germany (Fehr *et al.*, 2003) and the Netherlands (Bellemare and Kröger, 2003) conclude that older cohorts express less trust and more reciprocity than the young ones.

appears to be related to changes in preferences for fairness, rather than bargaining ability. Younger children make and accept smaller ultimatum proposals than do older children. Sutter and Kocher (2004) find that the elderly appear to be more reciprocal, in a study with participants from various age groups, ranging from 8-year-old children to people in their late sixties. In their study, trust increases from early childhood to early adulthood, but stays constant thereafter.

Among the previous studies, only Holm and Nystedt (2004) manipulate the information about the partners' generation and find that first movers were more trustful with members of their own age cohort. This raises the question of the composition of teams and its impact on behavior and performance. Some theoretical and empirical work in personnel economics or management sciences supports the view that a heterogeneous work force is likely to lead to higher productivity if there are useful complementarities or simply positive spillovers from more able or knowledgeable workers to other workers, particularly in an environment where people work closely together. Lazear (1998a) proposes a theory explaining the development of multi-cultural teams despite increased costs of communication. The diversity gains in such teams may overcome its costs if there are complementarities between workers, if the information or skill sets are not completely disjoint but are instead related, and if communication costs are not too high.

Hamilton, Nickerson and Owan (2003, 2004) make a distinction between diversity in abilities and demographic diversity in teams. The first type of diversity may enhance productivity if there is mutual learning and cooperation, whereas demographic diversity is likely to harm productivity by making learning and peer pressure less effective. Using panel data from a garment plant, they show that teams with more heterogeneous workers achieve a higher productivity, supporting the Lazear (1998a) theory. However, holding the ability distribution constant, they observe that teams with a higher heterogeneity in age are less productive. They

suggest three reasons for a lower efficiency of demographic diversity: an inhibition of knowledge transfer, a reduction of peer pressure due to weaker social ties and a taste for discrimination.

However, it should be noted that the few studies examining the impact of age diversity in teams on performance have not reached a consensus. In the vein of Hamilton, Nickerson and Owan (2004), some studies identify a negative correlation between heterogeneity in age and within-team cohesion and communication (Zenger and Lawrence, 1989) or the growth of sales (Simons, Pelled, and Smith, 1999; Leonard and Levine, 2004). On the other hand, other studies (Pelled, Eisenhardt, and Xin, 1999; Kilduff, Angelmar and Mehra, 2000) conclude this heterogeneity has a positive impact on overall team performance.

Grund and Westergård-Nielsen (2005) use a comprehensive linked employer-employee dataset covering the whole population of firms and employees in Denmark to estimate the relationship between the corporate age structure and the value-added per employee. They obtain an inverse U-shaped relationship between mean age of employees and firm performance; the same relationship is found with the age dispersion. This indicates that firms who have either a very homogenous or a very heterogeneous age structure perform less well than those who have a moderate degree of age dispersion. These results tend to support a combined version of the firm-specific human capital theory and the deferred compensation theory. Thus, in our team-production game we might expect that teams composed of participants with a mix of ages will achieve the highest level of contribution.

In contrast with the last studies, in this paper we focus on the impact of both the generation of individuals and the age structure of teams on individual behavior in various types of situations. It is only after analyzing the behavioral dimensions of age and diversity that we will derive an analysis of efficiency in teams.

3. EXPERIMENTAL DESIGN AND IMPLEMENTATION

Our experiment was comprised of three different decision-making tasks, performed in sequence. We conducted the sessions in both the field and the laboratory.

3.1 The decision tasks

Each session consisted of a team-production task designed to measure cooperation, and a real-effort task where competition was an integral aspect of the payoff structure, and a simple test of an individual's degree of risk aversion.

The team-production task

The first task was a standard linear public-good game, featuring groups of three participants. There were 17 periods in this game, divided into three respective segments of eight periods, eight periods, and one period; we varied the sequence in the two eight-period segments to mitigate possible order effects. In one case, participants played a standard public-good game the first eight periods, in which no information is given about the generation of the other players. This was followed by eight periods in which information is provided about the generation composition of the group. In the second case, we began with eight periods in which information was provided, and followed this with eight periods without this information.

In both cases, a two-stage game (the 'selection treatment') was played in the 17th period. In the first stage of this game, each person could select the composition of his or her group; i.e., he or she chose to be matched with two juniors, two seniors, or one junior and one senior.[8] The

[8] Each person in the selection treatment was always matched with his or her generation composition. We implemented this as follows: Suppose that person X chose to be matched with two seniors. We randomly drew two seniors in the session and added their contributions to that of person X to determine X's payoff. Now, suppose that one of these two seniors, person Y, has expressed a preference to be matched with two juniors. We randomly drew two juniors from the population and added their contributions to that made by person Y determine Y's payoff. In other words, a participant's contribution may well be added to the contributions of people belonging to different

choice cannot depend on information about the others' behavior in previous stages of the game, but could only be conditional on an exogenous attribute, i.e. the generation. The second stage of the game consisted of the contribution decision, as in the earlier periods.

At the beginning of each period, each group member *i* is endowed with 20 units. Each member simultaneously chose a fraction g_i of his or her endowment to contribute to a group project, while keeping the remainder in his or her private account. All funds in the group project paid a positive return to each member whatever his or her contribution. The marginal per capita return from a contribution to the group project was 0.5; this parameter value meant that full free-riding (contributing nothing) was the dominant strategy, whereas full contribution to the public good corresponded to the social optimum. Subject *i*'s payoff was given by:

$$\pi_i = 20 - g_i + 0.5\sum_{j=1}^{3} g_j \,. \qquad (1)$$

After they have made their contribution decisions, the group members were informed of both the amount of the group contribution and their own individual payoffs.

The no-information treatment allows us to determine whether juniors and seniors are equally cooperative or selfish in a group. The information treatment informs us about whether people condition the contribution to the group project on the generation composition of the group, and also indicates whether this effect (if any) differs across generations. The selection treatment tells us about the participants' preferences between homogenous and heterogeneous groups in this game. It also provides evidence concerning whether people condition the willingness to cooperate on the possibility of choosing the generation composition of the group.

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groups. This artifact guaranteed that each person's matching preference was always respected, and it did not cause any subsequent problems, since this procedure was only used in the last period of this one-shot game.

The real-effort competition task

Our second task consisted of two stages. In the first stage, people were randomly matched in pairs, and each person received information about the generation (junior or senior) of the other person. Each person then simultaneously chose his or her payment scheme, having been informed about the task that must be performed in the second stage of the game; this task consisted of solving anagrams, as detailed below.[9] The choice was between a payment scheme based on absolute performance and a tournament payment scheme. Before performing the task, each person was informed about his or her co-participant's choice of payment scheme.

If an individual chose the pay scheme based on absolute performance, he or she was paid 18 points for every anagram subsequently solved. If both people in the pair chose the tournament, the person who creates most anagrams receives 30 points for every anagram solved, while the other person received six points for every anagram solved. In case of a tie, the winner was randomly selected. If only one person chose the tournament, he or she received 30 points for every anagram solved. Note that in our tournament, there is no fixed payment from winning *per se*; instead, one's payoff was increasing in the number of anagrams created, so that there was always an incentive to exert full effort, even if one's co-participant has decided to not compete.

After a participant has chosen a payment scheme and received information about the co-participant's choice, he or she has four minutes in which to perform the task. Anagrams must be solved from a series of seven letters.[10] When the allotted time had elapsed, each person was only informed about the number of valid words he or she had created and the corresponding payoff.

Because one's choice of payment scheme is likely to depend on one's beliefs about both one's own ability and the ability of the co-participant, we elicited the participants' beliefs. After

[9] The structure of this game is adapted from Datta Gupta, Poulsen and Villeval (2005).

[10] We alternated between two series of three vowels and four consonants across sessions to counter the effect of a possible dissemination of information between sessions. These combinations offer the same number of solutions.

choosing a payment scheme but before performing the task, people report the number of words they estimate they can generate in four minutes. This provides us with a measure of the individual's self-confidence. Each person also estimated the average performance of juniors and seniors in the session. Every accurate answer paid one additional Euro. By comparing these values, we can observe whether an individual believes he or she is more, less, or equally able than the generation of the co-participant; this provides us with a proxy for the individual's relative ability. We can also measure whether a person believes that seniors are on average less able at this task than juniors. These data allow us to observe whether juniors or seniors are more accurate when predicting their absolute and relative performance. This game indicates whether the attitude towards competition is affected by the individual's generation. It provides us with measures of self-confidence and stereotypes in relation to an individual's generation.

A test of risk aversion

At the end of the session, we used a very parsimonious procedure to elicit an individual's degree of risk aversion, as in Charness and Gneezy (2003). Each person was endowed with 100 points and was confronted with a one-shot decision task, to choose how much of his or her endowment to invest in a risky asset and how much to keep. It is common information that there is an even chance for the investment in the risky asset to be a success or a failure. In case it fails, the amount invested is lost; in case of a success, the investment returns 2.5 times its amount. In addition to the amount of the risky investment, each person chose one of two colors. If the chosen color is randomly drawn in an even lottery, the risky investment is considered a success. If the subject decides on the basis of the expected value of the lottery, he should invest all his endowment in the risky asset. The lower the amount invested in the risky asset, the higher the degree of risk aversion. This test allows us to measure the sensitivity of risk aversion to age.

3.2 Artefactual field experiments and lab experiments

Our artefactual field experiments (Harrison and List, 2004) were conducted with 87 employees of two large private companies in the neighborhoods of Lyon, France.[11] Forty-eight juniors below 30 years old and 39 seniors above 50 years of age participated in a total of seven sessions.[12] The human-resource department in each company recruited volunteers by means of email and phone calls, with special attention to the balance of occupations (manager or non-manager) in each age category; volunteers were allocated to sessions so as to maintain a balance in terms of both generations and occupations. We wrote the text of the recruiting message that clearly mentioned participation in an experiment managed and funded by researchers.

At the beginning of each session, the participants were reminded that no individual data would be communicated to their company. At one firm, the experiment was conducted in the training center; it was conducted in a meeting room at the other firm. We equipped the rooms so that the usual laboratory conditions were met; in particular, each place was separated from the next by a high mobile fence; fences prevented people from seeing their neighbors. The experiment was computerized using the REGATE program developed at GATE (Zeiliger, 2000).

The experiment was replicated with 37 students and 35 retirees, in five sessions that were conducted at the Groupe d'Analyse et de Théorie Economique (GATE), CNRS, France. The students were recruited from undergraduate courses in local Engineering and Business schools. The retirees were recruited from various places in Lyon and in the neighborhood of Lyon, by

[11] Gambro is a Swedish company and one of the leading makers of products used for dialysis for chronic kidney disease. The Lyon facility produces plastic products for hemodialysers and employs about 600 employees. Renault Trucks is the second company in importance within the Volvo group, which is the leader in truck building in Europe. Its Lyon plant employs about 5,000 employees.

[12] Initially we planned to recruit below 25 and above 55, but the age structure of the companies did not permit this. In France, where the official retirement age is 60, the participation rate of the 15-24 years old was 30% in 2003; the corresponding rates for the 55-59 years old, the 60-64 years old and above 64 were 54%, 13% and 2%, respectively, despite the introduction of a tax against the firing of seniors in the late nineties.

means of leaflets and phone calls to associations and one municipality. We contacted associations offering computer classes, as we needed to attract retirees able to use a computer.

In total, 159 subjects took part in this experiment. No subject participated in more than one session of the study. The working juniors who participated were on average 25.3 years old (min = 18, max = 29) and the working seniors 54.1 (min = 51, max = 57). The students were 20.6 years old on average (min = 18, max = 28) and the retirees were an average of 65.9 years old (min = 58, max = 77). Table 1 shows the session structure.

Table 1: Session structure

Location	Treatment / Game	Session	# of subjects	# of observations
Field	No-Info /Info PG	1,3,5,7	48	768
	Info /No-Info PG	2,4,6	39	624
	Selection PG*	1-7	81	81
	Anagram Competition*	1-7	81	81
	Risk decision**	2-7*	62	62
Laboratory	No-Info /Info PG	8,9	30	480
	Info /No-Info PG	10,11,12	42	672
	Selection PG	8-12	72	72
	Anagram Competition	8-12	72	72
	Risk decision	8-12	72	72

* For technical reasons, six subjects could not participate in the game after period 16.
** In the first session, we did not play the risk game due to time constraints.

At the beginning of the session, participants entered their age on their computer and chose between two colors.[13] Next, the instructions for the first eight periods of the public-good game were distributed and read aloud; these instructions (see the Appendix) included a series of examples. The participants then filled out a questionnaire to check their understanding of this game; all questions were asked and answered privately. It was common information that the

[13] We introduced this choice of colors (orange and green), in order to try to divert attention from the age issue. This artifact has almost no impact. The individuals who chose the orange color invested more in the test of risk attitude (5% level of significance) but the other decisions are not affected.

matching was random and that groups remained fixed for the first eight periods. New instructions were distributed for the next eight periods. People were aware that we re-matched the groups for the new series of periods and that the new groups were fixed for these periods. Finally, instructions were distributed for the selection treatment in period 17. During this game, a table was displayed on the subjects' screen, with one row for each group member indicating when applicable the color chosen by the participant and his or her generation (junior or senior). In addition, a feedback table was available to remind one of his own contribution, the amount of the public good, and his or her payoff in each past period.

At the end of the previous game, we distributed the instructions for the competition game, we read them aloud, we checked for whether people understood the game, and we answered questions privately. As soon as the game was launched, each person was informed about the generation and color choice of his or her co-participant and then chose a payment scheme. We then elicited the beliefs about one's own performance and the performance of juniors and seniors. At this point in time, we distributed a sheet of paper to each participant to record anagrams. Next, we read aloud the series of seven letters and started the clock. After four minutes had elapsed, an experimenter validated the number of qualifying words and entered this number on the computer, using a password. Except for this exercise, the experiment was fully computerized. After the completion of this game, we distributed the last set of instructions for the test of risk aversion. At the end of the session, participants reported their gender and occupational category.

On average, a session lasted 75 minutes, including reading of the consent form, initial instructions and payment of subjects. At the end of each session, subjects were individually given an envelope including their payment in cash. On average, subjects earned 24 Euros in

companies and 22 Euros in the laboratory. The show-up fee was €5, except in one company in which we raised it to €10, as the experiment was not conducted during working hours.

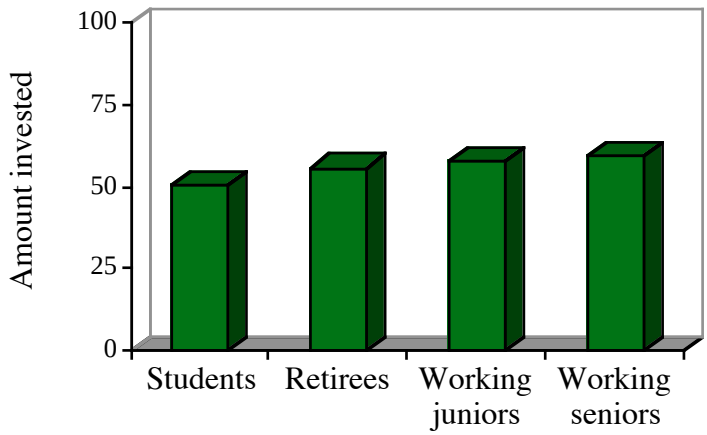
4. EXPERIMENTAL RESULTS

In this section, we first present the analysis of risk attitudes. Then, we analyze behavior in the team-production game. Last, we focus on the attitudes towards competition.

4.1 Risk attitudes

Figure 1 shows the average amount invested in the risky asset for each sub-population:

Figure 1 - Amounts invested in the risky asset



In terms of the idea that seniors would be more risk-averse than juniors, in fact retirees invest slightly more than students, and working seniors invest slightly more than working juniors. Table 2 shows the investment for each group.

Table 2: Investment in the test of risk aversion

Location	Generation	Avg. amount invested	# of subjects
Field	Juniors	57.58 (26.15)	36
	Seniors	59.23 (26.75)	26
	Total	*58.27* (26.20)	*62*
Laboratory	Students	50.32 (29.21)	37
	Retirees	55.57 (26.27)	35
	Total	*52.88* (27.75)	*72*

Standard deviations are in parentheses

These observations are close to those by Andersen, Harrison, Lau and Rutström (2004), who compare the results of a field experiment on risk conducted on a representative sample of the Danish population with those from a lab experiment. They show that age has no significant impact on the average risk aversion; however when looking at individual behavior, they also observe that risk aversion tends to be greater for students than older people.

To analyze the determinants of the individual investment decision, we estimate a Tobit model accounting for the right censoring of observations. The exogenous variables include each generation, with the working juniors as the reference, and gender. Table 3 displays the results.

Table 3: Determinants of the investment decision

Amount invested	Pooled data
Student	-5.802
	(7.423)
Working junior	*Ref.*
Working senior	2.043
	(8.129)
Retiree	-3.772
	(7.485)
Gender (male=1)	9.126*
	(5.541)
Constant	55.255***
	(6.001)
Nb observations	134
Right censored obs. (=100)	22
Log likelihood	-569.935
LR chi2	4.23
Prob>chi2	0.376
Pseudo R^2	0.004

Standard deviations are in parentheses. *** significant at the 0.01 level; * at the 0.1 level.

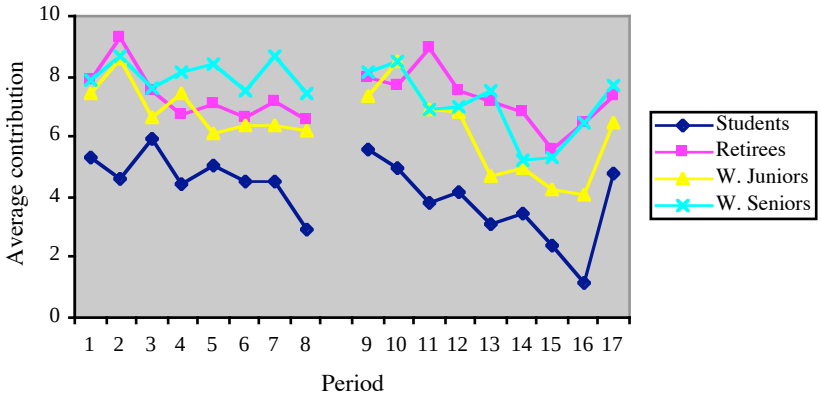
Table 3 confirms that there are no significant differences across generations or between working and non-working participants. Only gender is at all significant (but marginally), tending to confirm previous results (Eckel and Grossman, 2003; Charness and Gneezy, 2003) that males are less risk averse. This leads to our first result:

Result 1: There is very little difference in the average investment across juniors and seniors or across the field and the laboratory.

4.2 Attitudes toward cooperation in the team-production task

Figure 2 shows the contribution over time for each group in the team-production task:

Figure 2: Avg. individual contributions over time



The average contribution in the first 16 periods (exogenous matching) was 4.13 for students, 6.41 for working juniors, 7.31 for retirees, and 7.46 for working seniors. Contributions tend to decline over time, as is a standard result in the public-goods game, but the contribution of the seniors remains higher than that of the juniors in almost all periods. We also observe the familiar 're-start' phenomenon, where contributions go up after a new group is formed in period 9; this is particularly strong for students and working juniors, perhaps in part because their level

of contributions is so low by period 16. Finally, there is a definite jump in contributions in period 17, when groups are formed endogenously with respect to generation, with an average increase of 2.32 from the contributions in period 16.

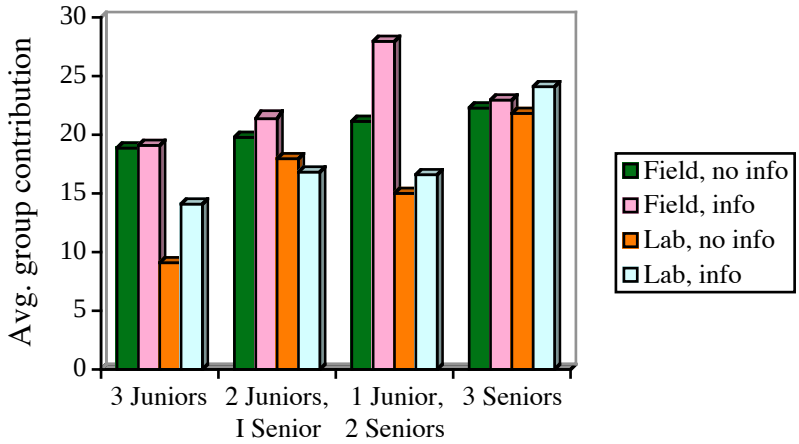
Recall that we vary whether information is provided about the composition of the group. The effects of information provision and heterogeneity on individual contribution and on the total group contribution in the team-production game are explored in Table 4 and Figure 3:

Table 4: Individual contributions in the team-production game

Location	Generation	Mean contribution			
		All periods 1 to 16	Periods with information		
			All groups	Homogenous groups	Heterogeneous groups
Field	Juniors	6.41 (5.38)	6.53 (5.52)	6.35 (5.62)	6.93 (5.30)
	Seniors	7.46 (5.66)	7.62 (5.74)	7.43 (6.03)	8.26 (4.64)
	Total	6.88 (5.53)	7.02 (5.64)	6.86 (5.84)	7.43 (5.09)
Laboratory	Students	4.13 (4.45)	4.54 (4.58)	4.69 (4.81)	4.33 (4.28)
	Retirees	7.31 (5.17)	7.61 (5.12)	8.01 (5.28)	7.01 (4.83)
	Total	5.67 (5.07)	6.04 (5.09)	6.35 (5.31)	5.59 (4.73)

Standard deviations are in parentheses

Figure 3 - Heterogeneous and homogenous group contributions



While information provision increases group contributions in seven of the eight comparisons (statistically significant at $p = 0.035$, one-tailed binomial test), the effect is primarily present in the field data, as is shown in the regressions in Table 5 below. It is particularly strong in the field data when there is one junior and two seniors; in this case, the average group contribution is one-third higher (28 instead of 21) when information is available. It is however also noticeable in the lab when subjects learn they are in an all-student group. Groups with only seniors do contribute more than groups with only juniors, and the difference is especially salient in the lab. Nevertheless, in companies, mixed groups on average contribute the most, particularly when they are given information about the group composition, as would be natural in a workplace.

Table 4 shows that working seniors increase their average contribution when matched with juniors (although they might realize that the latter contribute less on average), as if to teach them the 'good example' of cooperation; juniors react to this by contributing more than in all-junior teams. This generates a cooperative dynamic. In contrast, in the laboratory, heterogeneous age groups are less efficient than homogenous groups, due to the large difference in juniors' and seniors' contributions. Indeed, when informed that they are interacting with seniors, students increase their free-riding on the retirees' contributions and retirees react by contributing less than in an all-senior groups. This generates a non-cooperative dynamic. One interpretation is that heterogeneity should be encouraged, provided that each category's behavior is not too divergent.

To explain the determinants of cooperation in the team-production game, we estimate a random-effects Tobit model; this accounts for the fact that we observe each participant's decision sixteen times and controls for both the left and right censoring of the observations. The first

column of Table 5 displays the results of the regression when we pool the data from all the sessions; the second column presents the analysis of the field data and the third column the analysis of the data generated in the lab.

The exogenous variables include each age category (with the working juniors being the omitted category), gender, whether one is a manager, a variable interacting generation and whether one is a manager, and the risk attitude (measured by the amount invested in the risky asset). In addition, we control for whether the participant is informed about the age composition of his or her group, and we interact this variable with the number of seniors among team members. These two variables aim at determining whether people condition their willingness to cooperate on their level of information and on the age of their teammates. Since conditional cooperation is likely, we include in the regressions the team members' average contribution to the public good in the previous period. We interact this variable with the generation to check whether seniors are more, less, or equally conditional than juniors. We control for a likely time trend in the level of contribution. Finally, we add a control for the order of treatments, to check whether informing the participants about the composition of their team at the beginning of the game influences behavior throughout the game.

Table 5: Determinants of cooperation in the team production game

Amount contributed to the public good	Random-effects Tobit model		
	Pooled data (1)	Field data (2)	Lab data (3)
Student	-1.014*	-	*Ref.*
	(0.605)		
Working junior	*Ref.*	*Ref.*	-
Working senior	2549***	1.755*	-
	(0.844)	(0.998)	
Retiree	2.952***	-	5.058***
	(0.721)		(0.812)
Gender (male=1)	-1.273***	-0.453	-2.149***
	(0.440)	(0.647)	(0.599)
Manager	2.182***	2.246***	-
	(0.779)	(0.809)	
Senior manager	-2.228*	-2.813**	-
	(1.239)	(1.326)	
Risk attitude	0.017**	0.029***	0.007
	(0.007)	(0.011)	(0.009)
Information on group composition	0.577*	0.908**	0.047
	(0.310)	(0.438)	(0.446)
Information*Number of seniors in the group	-0.042	-0525	0.438
	(0.242)	(0.373)	(0.326)
Average contribution of group members in (t-1)	0.427***	0.325***	0.560***
	(0.044)	(0.061)	(0.063)
Average contribution of group members in (t-1) * Senior	-0.187***	-0.054	-0.338***
	(0.064)	(0.094)	(0.089)
Time trend	-0.149***	-0.136***	-0.155***
	(0.027)	(0.040)	(0.035)
Order	-0.357	-0.144	-0.427
	(0.403)	(0.611)	(0.546)
Constant	4.329***	3.828***	3.430***
	(0.814)	(1 .144)	(0.832)
Nb observations	2010	930	1080
Left/right censored obs.	343 / 52	103 / 34	240 / 18
Log likelihood	-5341397	-2628.501	-2698.593
LR chi2	235.84	81.03	169.55
Prob>chi2	0.000	0.000	0.000

Standard deviations are in parentheses. *** significant at the 0.01 level; ** at the 0.05 level; * at the 0.1 level.

The results in Table 5 indicate that both working seniors and retirees are significantly more cooperative than working juniors and that students are significantly less cooperative than

working juniors. We find a strong effect of the generation in the three regressions, and we can also suspect a positive impact of the experience of work on the level of cooperation. We also observe that males contribute less than females, a result that is controversial in the literature (see Eckel and Grossman, 2006), but this effect is only significant in the lab. Managers are more cooperative only when they are young. In the field data, those who are less risk averse are more willing to cooperate; this makes sense since cooperating in such a game is taking the risk of being a sucker if the team comprises free riders.[14] This analysis supports our second finding:

Result 2: Seniors, whether working or retired, contribute more than juniors, whether working or students, in nearly all periods; students consistently contribute the least.

Consistent with the descriptive statistics above, we also observe that, in the pooled data, providing the participants with information about the composition of their group increases their level of cooperation. Interestingly, this effect is not driven by the age composition of the team and is not significant in the laboratory sample. This supports our third finding:

Result 3: Information provision *per se* improves team production for almost every group composition, but there is no effect from exogenous group composition of the group.

Not surprisingly, we observe that the participants condition their behavior on the contribution level of their teammates in the previous period. But our new finding is that this is less true for the retirees: they are less conditional than the other categories and this result probably explains the smoother evolution of their contributions over time displayed in Figure 2. Contributions decline over time in both samples. There is no order effect.

Next, we examine the results of the selection treatment played in period 17 with the pooled data. In Table 6, we analyze the determinants of the desired number of senior teammates,

[14] A negative relationship between risk aversion and contribution in a repeated prisoner's dilemma game has also been documented in Sabater-Grande and Georgantzis (2002).

using an ordered-probit model, in which the explained variable can take values 0, 1, or 2. In Table 7, we then estimate the determinants of the contribution in period 17, using a Tobit model that accounts for the left and right censoring of the data.

Table 6: Desired number of senior teammates in the selection treatment

Desired number of senior team mates	Ordered Probit model - Pooled data
Student	0.331
	(0.261)
Working junior	*Ref.*
Working senior	-0.538**
	(0.249)
Retiree	-0.638**
	(0.257)
Nb observations	153
Log likelihood	-157.536
LR chi2	17.17
Prob>chi2	0.001
Pseudo R^2	0.052

Standard deviations are in parentheses. ** significant at the 0.05 level.

The regression in Table 6 supports result 4:

Result 4: People have a preference for heterogeneous teams, since the number of desired senior teammates is significantly negatively correlated with being a senior.

In other words, there is no taste for discrimination regarding generations and there is no difference between students and working juniors. To delve more deeply into the motivation of such a choice, one must examine the contribution behavior, shown in Table 7.

Table 7: Determinants of contributions in the selection treatment

Amount contributed in the Selection treatment	Tobit model
Student	12.842
	(2.336)
Working junior	*Ref.*
Working senior	1.240
	(1.198)
Retiree	1.032
	(1.242)
Gender (male=1)	0.888
	(0.880)
Generation-homogenous group	-2.505**
	(1.177)
Number of seniors in the group	-0.274
	(0.666)
Number of seniors*Student	-2.737**
	(1.411)
Constant	76.061***
	(1.162)
Nb observations	153
Left censored obs.	18
Right censored obs.	3
Log likelihood	-428.839
LR chi2	187.475
Prob>chi2	0.008
Pseudo R^2	0.021

Standard deviations are in parentheses. *** significant at the 0.01 level; ** at the 0.05 level.

The regression displayed in Table 7 supports our fifth main finding:

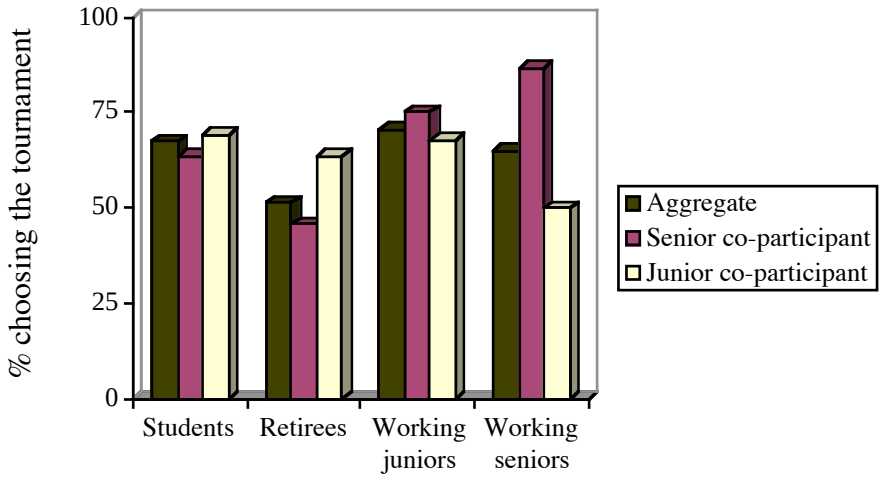
Result 5: When group formation is endogenous, age-homogenous teams are less cooperative than age-heterogeneous teams. Thus, diversity has a positive impact on performance.

However this cannot be directly related to the number of seniors in the group, as this variable is not significant. There is an exception, as students are willing to be matched with seniors and, conditional on this choice, they reduce the amount of their contribution. In other words, they try to exploit the retirees.

4.3 Attitudes toward competition and productivity in the real-effort task

Figure 4 shows the proportion of people who chose to enter the tournament in each sub-population in the aggregate and according to whether the co-participant was junior or senior:

Figure 4 - Tournament choice in the real-effort task



We see that there is a slightly greater degree of competitiveness among the working sub-population. Juniors are more likely to enter the tournament than seniors; the difference is strongest for students and retirees. Table 8 shows the entry rates for each category.

Table 8: Tournament entry rates in the real-effort task

Location	Generation	Aggregate Rate	N	Senior co-participant	N	Junior co-participant	N
Field	Juniors	0.705	44	0.750	16	0.679	28
	Seniors	0.649	37	0.867	15	0.500	22
	Total	*0.679*	*81*	*0.807*	*31*	*0.600*	*50*
Laboratory	Students	0.676	37	0.636	11	0.692	26
	Retirees	0.514	35	0.458	24	0.636	11
	Total	*0.597*	*72*	*0.514*	*35*	*0.676*	*37*

Whereas retirees are more likely to enter the tournament when facing a junior co-participant, the opposite is true for working seniors. This leads to our sixth main finding:

Result 6: Contrary to stereotypes about older people being less responsive to their environment, both retirees and working seniors show much greater sensitivity to the type of co-participant than do students and working juniors.

The decision to enter the competition is influenced by beliefs about one's own absolute and relative ability. The first column of Table 9 shows the beliefs about own performance (self-confidence) in number of words created for the individuals who chose the pay scheme based on absolute performance and those who chose the tournament. The second column indicates the rate of individuals who believe they are able to create more words than the generation of their co-participant (and potential opponent in the competition), since they report a higher belief about themselves than about the generation of their co-participant.

Table 9: Own-performance beliefs and chosen pay scheme

Location	Generation	Beliefs on one's ability (1)		Beliefs on relative ability (2)	
		Absolute performance	Tournament	Absolute performance	Tournament
Field	Juniors	4.00 (1.22)	6.26 (2.35)	0.154 (0.376)	0.129 (0.341)
	Seniors	7.23 (5.93)	7.83 (6.58)	0.154 (0.376)	0.292 (0.464)
	Total	5.62 (4.51)	6.95 (4.70)	0.154 (0.368)	0.200 (0.404)
Laboratory	Students	7.50 (5.23)	8.12 (5.47)	0.083 (0.029)	0.440 (0.507)
	Retirees	5.94 (3.27)	11.44 (12.19)	0.059 (0.024)	0.500 (0.515)
	Total	6.58 (4.18)	9.51 (8.95)	0.069 (0.026)	0.465 (0.505)

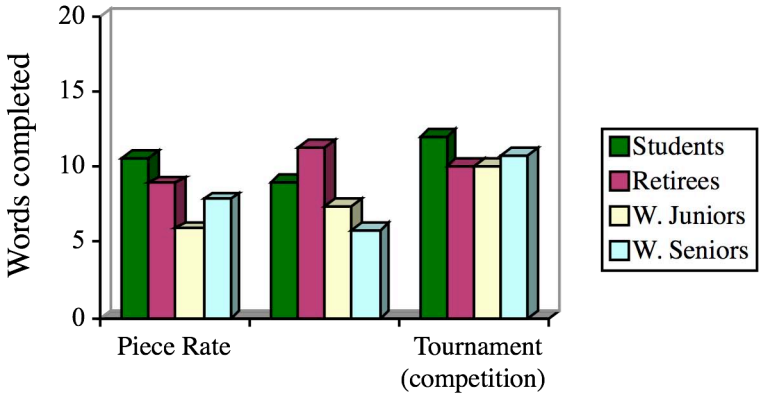
Standard deviations are in parentheses

We observe a consistent pattern in Table 9: for every group, those people who choose the tournament are more self-confident than those who choose the pay scheme based on absolute performance. With the exception of the working juniors, the rate of individuals who believe they

are more able than their co-participant is dramatically higher among those who chose the tournament. Overall, the working participants, and especially the working juniors, report a lower expected ability and are less likely to feel better than their opponent's generation than the non-working participants. It should also be noted that when we compare the individuals' beliefs about own ability and the ability of own generation, seniors are less over-confident than juniors: only a minority think they are better than the average of their generation.[15] Finally, when we compare self-confidence with the actual individual performance, workers are more optimistic than non-workers, especially when we compare working seniors with students.[16]

Figure 5 shows the average performance for each sub-population, according to whether people chose the pay scheme based on absolute performance, entered the tournament and won by default (when the co-participant has chosen not to compete), or entered the tournament and actually competed against another person who entered the tournament:

Figure 5 - Average performance in the real-effort task



[15] 29.2% of the working juniors and 40.5% of the students believe they are better than their generation; the corresponding percentages for the working seniors and the retirees are 20.5 and 22.9, respectively.

[16] 56.8% of the working seniors and 65.9% of the working juniors performed better than they expected; the corresponding percentages are 69.0% for the retirees and 73.0% for the students.

Every group produces more words when choosing the tournament and actually competing than when choosing the pay scheme based on absolute performance. Despite the fact that there is incentive to produce more words even when one has won the tournament by default, all groups except retirees produce substantially more words when in an actual competition than when they win the tournament by default. Table 10 shows the performance for each category, along with the number of observations and the standard deviation.

Table 10: Performance in the real-effort task

Location	Generation	Absolute performance	N	Tournament (default)	N	Tournament (compete)	N
Field	Juniors	5.92 (4.09)	13	7.43 (3.55)	14	10.12 (4.50)	17
	Seniors	7.85 (5.87)	13	5.86 (2.12)	7	10.76 (5.30)	17
	Total	*6.88 (5.05)*	*26*	*6.90 (3.18)*	*21*	*10.44 (4.85)*	*34*
Laboratory	Students	10.58 (2.39)	12	9.00 (4.80)	7	12.06 (3.39)	18
	Retirees	8.65 (4.31)	17	11.10 (4.01)	10	10.13 (5.11)	8
	Total	*9.45 (3.72)*	*29*	*10.24 (4.34)*	*17*	*11.46 (3.99)*	*26*

Standard deviations are in parentheses

We also see that working people seem to be much more motivated by actual competition, in comparison to winning the tournament by default; performance is more than 50% higher for this comparison in the workplace, but less than 15% higher in the laboratory.

To analyze the determinants of the individual performance, we estimate a model with a correction of the potential selection bias due to the choice of the payment scheme. To achieve this, we use the Heckman two-step estimation procedure. We first study the determinants of

choosing the tournament payment scheme using a Probit model. We then explain the number of words created, conditional on that decision, with an OLS model corrected for the selection bias.[17]

The hypotheses tested are that people who feel more able than the age category of their co-participants are more willing to compete. A person who has experienced the greater cooperation of seniors in the team-production game may be expecting a lower tournament entry rate for seniors, making his or her own entry more likely. The latter variables are not included in the performance specification, in order to ease the identification of the model and because they are assumed to exert no influence on performance (we checked for this assumption). In the second specification, we control for the existence of competition involving both pair members, since this is expected to generate an incentive to work harder. We also control for the series of letters we used. Finally, we include the inverse of the Mill's ratio (the "IMR" variable) in this equation in order to correct for a likely selection bias arising from the first-stage decision.

Table 11 displays the results from these regressions.

[17] In both regressions, the individual characteristics variables include generation, gender, whether the participant is working or not (and if so, whether he or she is a manager), and belief about own ability; the working juniors are the omitted category. In addition, we include a variable indicating whether the participant is paired with a senior in this game, since stereotypes regarding the lower competitiveness of seniors may have a positive influence on the decision to compete and a negative influence on one's performance. In the selection equation, we also control for the individual's risk attitude (measured by the amount invested in the risky asset), and for whether the individual has interacted with seniors in the information treatment of the team-production game (the "experience with seniors" variable). We also include a dummy variable regarding beliefs about relative ability, indicating whether the individual believes he or she is more able than the generation of his or her co-participant.

Table 11: Determinants of behavior in the competition game (Heckman two-step estimation procedure)

Exogenous variables	Tournament entry Probit model (1)	Performance OLS model (2)
Student	-0.378	2.432**
	(0.400)	(1.073)
Working junior	*Ref.*	*Ref.*
Working senior	-0.915**	0.136
	(0.446)	(1.145)
Retiree	-1.546***	0.836
	(0.462)	(1.227)
Gender (male=1)	-0.149	-0.001
	(0.270)	(0.791)
Risk attitude	0.011**	-
	(0.005)	
Belief on own ability	0.054	0.301***
	(0.037)	(0.058)
Belief on relative ability	1.707***	-
	(0.421)	
Manager	0.866*	1.842
	(0.504)	(1.224)
Senior opponent	0.750**	0.846
	(0.300)	(0.801)
Experience with seniors	1.352***	-
(Yes=1)	(0.348)	
2-person tournament	-	1.991***
		(0.775)
Set of letters	-	-0.272
		(0.781)
Constant	-1.311***	4.070***
	(0.512)	(1.299)
IMR	-	1.827*
		(1.126)
Nb observations	129	
Wald chi2	69.37	
Prob>chi2	0.000	

Standard deviations are in parentheses. *** significant at the 0.01 level; ** at the 0.05 level; * at the 0.1 level.

The first regression in Table 11 indicates that both working seniors and retirees are less likely to choose the tournament than working juniors. In contrast, there is no significant difference between students and working juniors. Not surprisingly, the probability of choosing the tournament is positively influenced by the risk attitude of the participants. Managers are also more willing to compete, perhaps because they are more used to doing so in their occupation

Logically, people are more influenced by their relative situation than by their belief about their own ability. Indeed, believing one is better than an average potential competitor increases the probability one chooses the tournament. Interestingly, this decision is influenced by the generation of the opponent: controlling for the other variables (including beliefs about relative ability), being matched with a senior in this game and in the team-production game increases the probability of choosing the tournament. One interpretation is that people expect the seniors to be more cooperative and thus less likely to enter the competition. Since if the co-participant chooses the piece-rate pay scheme, opting for the tournament automatically returns the high payment, such a belief about seniors may increase the probability of choosing the tournament.

The second regression in Table 11 indicates that the level of performance is similar across generations, except for the fact that the students outperform the working juniors. The latter observation can be explained by the great homogeneity of the student pool in terms of education. More generally, the self-confident participants do perform better than those who are less confident. Not surprisingly, the reality of the competition – and the associated risk of getting a low payment – makes people working harder than when the co-participant has chosen the pay scheme based on absolute performance, in which case the high payment is certain. The IMR variable is marginally significant, indicating that it is better to control for the selection bias. There is no significant impact from the other variables, such as gender, occupational category, or the nature of the task. These two regressions support our last main finding:

Result 7: While seniors are less attracted by competition than juniors, there is not much difference in word production among the various subpopulations when in an actual competition.

This result is important in that it shows that seniors react to competitive incentives as strongly as juniors.

5. DISCUSSION

Our results suggest that seniors do not, in general, differ so greatly from juniors. For example, we find no difference between juniors and seniors in terms of their degree of risk-aversion or their performance in tournaments involving real effort. In the competition, seniors also react to incentives as strongly as juniors, rather than being inflexible in their behavior.

These results are at variance with the widespread stereotypes about seniors, seen anecdotally and in several surveys in both the United States and Europe. Seniors are perceived to be less adaptable, overly cautious, and less willing to learn. These views are undoubtedly a contributing factor to age discrimination against seniors in the workplace, despite the laws against it. The stereotypes may be particularly strong among managers or supervisory and senior personnel. We confirm the existence of these stereotypes about seniors, particularly in the workplace. For example, both junior and senior workers are more likely to compete when they learn that their potential competitor is a senior.

In fact, seniors appear to be particularly valuable in the team-production game, both because they contribute more and because the heterogeneity they provide leads to better outcomes. Heterogeneous groups (or even groups comprised entirely of seniors) achieve substantially higher team production than homogeneous groups comprised of only juniors; this is particularly true when information is provided about the composition of the group, as would naturally be the case in a work place. Furthermore, people seem to anticipate the advantage of being in a heterogeneous group, as there is a distinct preference for this in the selection treatment.

It should be noted that the working seniors are especially willing to interact with juniors and increase their contributions in this treatment although they have observed in the past periods that juniors are less cooperative. One interpretation is that they were willing to teach the juniors

the benefits of cooperating in a group. This higher cooperation by seniors is a strong result because the experience of their working life did not lead them to become more selfish. This cannot be explained by a slower adjustment of the seniors to the others' behavior, since we also find that working seniors react similarly than juniors to the past contribution of their teammates.

All of these considerations suggest that it is worthwhile to include seniors in the work force, and to develop incentive schemes toward this end. This issue is particularly acute in countries such as France and Germany, although the prevalent age discrimination in the United States makes it clear that this is a real problem there as well. In both the United States and Europe, the demographics indicate that pension plans and retirement systems are in serious peril. Some governments have begun to realize the gravity of this problem. For example, after previously legislating early retirement for older workers, France has changed course in recent years and has tried to work on the supply side by ending the early retirement programs.

Some companies have also started to care about diversity management and seem aware of the benefits of such a policy. For example, BMW has begun to hire older workers to avoid an unbalanced age structure of the work force in many parts of the company (see Grund and Westergård-Nielsen (2005). Nevertheless, participation rates for older workers remain low and it is still unusual for a senior worker to be replaced by another senior worker. Much of the problem seems to stem from the demand side, despite the introduction of taxes against the firing of seniors. Will jobs be available, given the stereotypes against older workers? To address this problem, it seems necessary to confront the widespread stereotypes. Our behavioral analysis on the impact of aging on risk-taking, performance, and the willingness to compete suggests directions for governments and firms to confront a potential paucity of workers in the coming

years, as seniors may well be willing to stay on the job given appropriate incentives, thereby providing both a supply of workers and the valuable heterogeneity in a firm's work force.[18]

Indeed, keeping seniors at work also raises the issue of the management of incentives at the end of one's career. To prolong or to restore the seniors' motivation and willingness to learn, perhaps there is a need for the development of new career ladders, opportunities, and incentive schemes. Our experiment also shows that even if they are less attracted by competition than juniors, working seniors substantially increase their performance when they learn they must compete instead of receiving a high payment based on their absolute performance. Facing such a competitive incentive, they perform as well as the juniors. Thus, we do not observe the increasing discrepancy between wage and productivity that is at the core of the differed compensation theory. If this theory focuses on long-term incentives, our results suggest, in contrast, the need for the implementation of short-term incentives at the twilight of employment.

Beyond these considerations on personnel policies, our findings also have important implications regarding the evolution of cooperation and competition in humans. Our finding that seniors are more willing to contribute in the team-production game than juniors supports the argument that culture is a determinant of economic behavior, and that this is learned through experience. In combination with the Harbaugh *et al.* (2003) study, which indicates that people begin to acquire this culture during the course of their childhood, our experiment suggests that this is a long-life learning process. The insight developed over a more elderly person's lifetime may be particularly useful in providing a good example for younger workers to emulate.

Finally, a novel aspect of our study is the comparison between the behavior of actual workers and non-workers. Although in most cases there is not a major difference between

[18] One reason that we conducted our experiments in France was to provide evidence most convincing to French employers, given the difficulties experienced there in job creation for older workers.

behavior in the onsite experiments and the laboratory experiments, we do find some interesting contrasts. One such is that workers seem to be more attracted to competition than non-workers, although this is driven by the lower likelihood of the retirees to choose the tournament. In addition, winning by competing *per se* seems to motivate workers more than non-workers, given the larger disparity in behavior between performance when being in the tournament alone and actually having to compete to win the tournament.[19] Again, information about the composition of the team seems to matter most for workers, perhaps because they are accustomed to this in the work place. Students behave more selfishly and free ride more on the seniors' contributions. This suggests that the integration in the workplace contributes to people becoming more socially-oriented. It also indicates that the social orientations that we observe in standard laboratory experiments conducted with students may well be underestimated.

6. CONCLUSION

The employment of seniors has become a major issue in most developed countries. The difficulties in funding the pension systems and the end of the early retirement plans provided by firms are such that there is an additional potential older work force. However, these early retirement programs may have introduced several distortions playing against the demand for seniors, either because they have disseminated stereotypes about their lower productivity and adaptability (see for example Aubert, Blanchet, and Blau, 2005), or because they have contributed to reducing the work motivation of those employees approaching the age of early retirement. Nevertheless, in such imperfectly-competitive labor markets, the question of the

[19] Recall that there is a motivation to produce more even when winning by default, as people are still paid by each word produced.

productivity of the seniors compared to that of the junior employees remains unanswered. On the one hand, the econometric analyses of the relationship between age, wage and productivity do not deliver definitive answers. On the other hand, while psychologists and neuro-scientists have been studying the deterioration of cognitive abilities with age, the study of the behavioral impact of aging on individual and collective decision-making in economic situations is still in its infancy.

In this paper we have designed an experiment to study the comparative behavior of juniors (below 30) and seniors (over 50) in relation to risk, cooperation and competition. The experiment was conducted in two large companies and was replicated in the laboratory with students and retirees to extend both the variance in age and the diversity of situations regarding the labor market. The experiment consisted of a team-production game, a real-effort task in which the participants first chose between two payment schemes (a competitive one and a non-competitive one), and a test measuring risk aversion.

The experiment aimed at measuring whether juniors and seniors differ in their attitudes toward risk and cooperation, in their productivity at a specific task, and in their competitiveness. It also aimed at analyzing whether behavior differs according to age pairing, i.e. depending on the generation of the individuals people are interacting with, either in a cooperative or in a competitive environment. For example, we try to determine whether people are more or less cooperative when they interact with seniors in age-homogeneous vs. age-heterogeneous teams, and whether the interaction with seniors make them more or less competitive when they have to choose their payment scheme.

We obtain clear-cut results and we regard these results as important for a better understanding of both the behavioral dimensions of skill and productivity, and the potential benefits of team diversity. First, seniors are not more risk averse than juniors, contrary to a

pervasive stereotype according to which aging makes people becoming timorous. Second, seniors are more cooperative in our team-production game, in which there is a strong incentive to free ride on the contribution of others. A third result is that providing information about the group composition motivates workers to contribute more. A fourth result is that heterogeneous teams contribute more than homogenous ones in the sessions involving working subjects. Although they learn that juniors are less cooperative, working seniors cooperate more in heterogeneous teams than in all-senior teams, as if to teach the juniors the benefits of cooperation; working juniors react positively to this by also contributing more than in all-junior teams. We do not observe the same behavior in the laboratory, perhaps because the difference in contribution between students and retirees is too large and because the students reduce their contribution when they know they are teamed with retirees. This argues in favor of the formation of age-heterogeneous teams, provided that the average behavior is not too different. A fifth important result is that both generations are willing to interact with the other generation; they have a preference for heterogeneous teams and they do not express a taste for discrimination.

Our last two results go against common stereotypes about seniors. First, while seniors are less attracted by competition than juniors when they choose their pay scheme, they are as reactive and productive as juniors when they compete against an opponent, with the exception of the retirees who work hard even when there is no competition. Finally, both retirees and working seniors show much greater sensitivity (responsiveness) to the type of co-participant than do students and working juniors. In addition, we find that the seniors underestimate less their ability than the juniors and are less likely to feel better than the average of their generation. Only students (slightly) outperform the other categories when they compete and this probably reflects the difference in the average education level; simultaneously, they underestimate their ability in a

greater proportion than the others but more frequently feel better than the average of their generation.

Overall these findings tend to show that seniors constitute a valuable work force and that age diversity is a source of performance. The implication for personnel policies is that keeping an aging work force in companies may be profitable, provided that the seniors' propensity to cooperate is indeed valued and that they are provided with the appropriate incentives. For example, this suggests it would be valuable to implement additional short-term incentives near the end of a worker's career. The replication of the same experiment with working subjects and in the laboratory also delivers fruitful findings. Students are found to act more selfishly than the other categories and retirees act more socially and less conditionally. In addition, we note that there may be more 'closeness' across the generations in the workplace in the team-production game, perhaps because working seniors interact with working juniors every day, while students don't often interact with retirees and may therefore be interested in exploiting them.[20] Nevertheless, we do not generally find strong differences in behavior between workers and non-workers. This tends to support the external validity of laboratory experiments.

It is clear that we have only made a start, and that more work needs to be done in this area. Nevertheless, we hope that our findings will lead to further study and will help to influence policy regarding the employment and retention of senior workers.

[20] But recall that the vast majority of laboratory experiments are conducted with students, who do interact daily.

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Appendix: Instructions

During this experiment, which is conducted by researchers from the National center for Scientific Research, you will make choices. These choices are always anonymous. You will receive compensation, the amount of which depends on your choices and the choices made by other participants to this session.

We will use tokens. The conversion rate is **40 tokens = 1 Euro**.

All the tokens earned during this session will be added up and converted into Euros at the end of the session. You will also receive a show-up fee of 5 (*10 in the other firm*) Euros. The total amount of your compensation will be confidential and you will be paid privately.

This session consists of several parts. You have been given the instructions of the 1st part. The whole session will last about 1 hour.

In the beginning, you will answer two questions about your age and the choice of a color. Your answers can be disseminated during the session, but they do not enable anybody in the room to identify you.

Part 1

We form groups of 3 participants who will interact during this whole part. You will not know anything about the other two members of your group.

This part consists of 8 periods.

Rules for each period

The 3 members of the group can participate in a project by making a contribution. This project consists in contributing an amount that will be equally shared among the three group members. This amount is the sum of the individual contributions of each of the 3 group members.

At the beginning of each period, everybody receives 20 tokens.
The 3 group members choose, simultaneously and without any possibility of communicating, the number of tokens they are willing to contribute to the project, i.e. any number between 0 and 20 tokens included.

Once the 3 members have made their choice, each member of this group is informed about the amount contributed to the project and his or her individual payoff for the current period.

To sum up: You decide on the number of tokens you contribute to the project. To make your choice, you move the cursor on your screen with your mouse and you click the OK button to validate your choice:

0 1 2 3 ……20

How is your payoff calculated in each period?

Your payoff in each period consists of the sum of two elements:

- the tokens you keep by yourself (i.e. the starting 20 tokens – the tokens you contribute to the project)
- and your revenue from the project: each member of the group receives half the amount of the project, whatever his contribution. Indeed, we increase the amount of the project by half and the total amount is equally shared among the group members.

The computer then calculates your payoff for the period, as follows:

20 tokens – the tokens you contribute to the project
+ half the total amount of the contributions to the project

Let's have an example.

The total group contribution is 10 tokens. Each group member receives the following revenue from the project: 5 tokens (= half of 10).
If a member has contributed 4 tokens, he or she earns: 20 tokens – 4 tokens + 5 tokens = 21 tokens
If a member has contributed 10 tokens, he or she earns: 20 tokens – 10 tokens + 5 tokens = 15 tokens

Let's have another example.

The total group contribution is 40 tokens. Each group member receives the following revenue from the project: 20 tokens (= half of 40).
If a member has contributed 12 tokens, he or she earns: 20 tokens – 12 tokens + 20 tokens = 28 tokens
If a member has contributed 5 tokens, he or she earns: 20 tokens – 5 tokens + 20 tokens = 35 tokens

What occurs in the 7 subsequent periods?

At the end of each period, a new period starts automatically. At each new period, you receive 20 tokens and you choose your contribution. Of course, you can change the amount of your contribution in each period.

During the experiment, talking or making noise is not allowed. If you have any question regarding these instructions, please raise your hand. We will answer your questions immediately.

Part 2 (*Instructions distributed at the end of Part 1*)

- This part also consists of 8 periods.
- New groups of 3 are formed for the whole duration of this part. It is almost certain that the 2 other members of your new group are not the same as in the 1st part.
- Each period works as in the 1st part: you receive 20 tokens, you choose your contribution and your payoff is calculated as before and is added to your previous payoffs.

There is only one difference:

At the beginning of this part, you receive information about the 2 other members of your group. This information only indicates the age category ("Junior" if less than 30 years old, and "Senior" if more than 50) and the color chosen by each of these members.

Part 3 (*Instructions distributed at the end of Part 2*)

- This part consists of one single period.
- You are still member of a group of 3 participants but in contrast with the previous parts, you can choose the 2 other members of your group among the following combinations:

- 2 Juniors
- 2 Seniors
- 1 Junior and 1 Senior

❑ As before, you receive 20 tokens and you choose the amount of your contribution to the project.

To determine the amount of the project, we randomly draw the other 2 members of your group according to the preference you have mentioned. We add up their contributions to your own contribution to determine both the total amount of the project and your revenue from the project.

Your payoff is calculated as before and is added to your previous payoffs.

Part 4 (*Instructions distributed at the end of Part 3*)

We will now form pairs of participants. You will be informed about anonymous characteristics of your co-participant: the color he or she has chosen (green or orange) and his or her generation (junior or senior).

❑ **Content of the task**

The task consists of creating words using a series of 7 letters including 3 vowels and 4 current consonants (no X, Y, Z, W). You will respect the following rules:

- These words are French words (including nouns, conjugated verbs, excluding slang)
- They are at least 3 letters long
- They are not proper nouns (e.g. words cannot be names or places)
- They are made by using each of the 7 letters only once per word

Here is an example. Say there are 7 letters: GIEOPLS. Some examples of permissible words include: « pli », « sel », « épi ». However, the word « pipe » is not permissible because the letter « p » is used twice.

As soon as the 7 letters are written on the whiteboard, you will have 4 minutes to create words and to write them on the sheet of paper that you have received. After the time is over, you have to stop writing. We will come by to validate the words you will have created and to count them.

❑ **How is your payoff calculated?**

After being informed of your co-participant's attributes, but before knowing the series of letters, you choose between two options of payment, option A and option B.

<table>
<tr><th>You choose</th><th>and your co-participant chooses</th><th></th><th colspan="3">You personally earn</th></tr>
<tr><td>Option A</td><td>Option A or B</td><td rowspan="3"></td><td colspan="3">18 tokens for each accepted word you have created, whatever the number of words created by your co-participant</td></tr>
<tr><td>Option B</td><td>Option A</td><td colspan="3">30 tokens for each accepted word you have created, whatever the number of words created by your co-participant</td></tr>
<tr><td>Option B</td><td>Option B</td><td>30 tokens for each accepted word you have created, if you created more words than your co-participant</td><td>6 tokens for each accepted word you have created, if you created less words than your co-participant</td><td>In case of a tie, a random draw determines who receives 30 tokens and who receives 6 tokens per accepted word.</td></tr>
</table>

After you have chosen your option, you will answer questions that will appear on your computer screen. You will earn 20 tokens for each answer confirmed by the actual outcomes at the end of this part. You will then be informed of your co-participant's chosen payment option before performing the task.

To sum up: You are informed about two attributes of your co-participant; you choose your payment option; you answer the questions, then you create words during 4 minutes; we validate your words and the computer finally informs you about your payoff. Your payoff is added to the payoffs earned in the previous parts.

Do you have any questions?

Part 5 (Instructions distributed at the end of Part 4)

Description of the task
You receive 100 tokens.
You decide the amount of tokens (between 0 and 100 tokens, included) that you are willing to invest on a risky asset.
You keep the tokens that are not invested.

The investment
There is a 50% chance that the investment is a success.
If the investment is a success, you earn 2.5 times the amount that you have invested.
If the investment is not a success, you lose the amount that you have invested.

1st example: You invest 0 tokens. You earn: (100 –0) = 100.

2nd example: You invest 50 tokens. If the investment is a success, you earn: (100 – 50) + (2.5*50) = 175. If the investment is not a success, you earn: (100-50) + 0 = 50.

3rd example: You invest 100 tokens. I f the investment is a success, you earn: (100 – 100) + (2.5*100) = 250. If the investment is not a success, you earn: (100-100) + 0 = 0.

How is the success of the investment determined?

You are required to choose one color, either white or black. You then press the button « random draw » on your computer screen. The computer program selects randomly one of the two colors.

If the randomly drawn color is the color you have chosen, your investment is a success.
If the randomly drawn color is not the color you have chosen, your investment is not a success.

To sum up: You choose the amount you are willing to invest; then, you choose a color; you then press the random draw button. The computer program will inform you whether the investment is a success and the amount of your earnings for this part. This earning will be added to your earnings of the previous parts.

Do you have any questions?