Age Differences in the Reaction to Incentives – a Test of the Successful Ageing Extension of Social Production Functions Theory

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Abstract

The "aging employee" has recently become a hot topic in many fields of behavioural research. With the aim to determine the effects of different incentive schemes (piece rate, competition, choice between piece rate and competition, social or increased monetary incentives) on performance of young and older subjects, we look at behaviour of a group of younger and older adults on a well-established real effort task. Based on the theory of Social Production Functions, we hypothesize age effects that depend on the incentive schemes used. We show that older adults are less productive than younger adults in all conditions, but that different incentive schemes exert similar influences on productivity in both age groups. While we do not find a significant age difference in competitiveness and reject the age-related predictions of the Social Production Functions Theory, we replicate the gender difference in competitiveness found in the literature. Social incentives in men have an at least as strong or even stronger effect on performance than increased monetary incentives. Women do not show an increase in performance with social incentives.

JEL classifications: C72, C91, J10, J33

Keywords: aging, competition, Social Production Functions, experiment, incentives

Introduction

The effect of incentives on human behaviours is a topic that is highly relevant within the field of economics. With the rise of behavioural economics, the differential effects of monetary and non-monetary incentives have become the focus of many research projects. Even though there have been many experimental and theoretical papers on the issue (e.g. Fehr and Falk, 2002), a central topic that has received significantly less attention is ageing. This topic is however of policy relevance: In many countries, there is presently a debate on increasing the retirement age to balance the accounts of pension systems. In France, the retirement age will be increased stepwise from the current 60 years to 62 years by 2018; in Germany, it has recently been raised to 67 years. In light of these changes, it is especially important to understand whether older workers can be incentivized with the same incentives as younger workers. With the tools of experimental economics, investigating this question in a controlled setting has become straightforward. In the current study, we therefore experimentally investigate the effects of both social and monetary incentive schemes on effort provision of younger and older adults.

The few experimental studies that have looked at effects of older age on economic decision-making did not find large effects (e.g. Kovalchik et al., 2005; Charness and Villeval, 2007; McConnell, 2013). Research in cognitive psychology however has shown the existence of age effects in decision-making, but in general, the findings are less than conclusive. Some studies found that older subjects were more risk averse than younger subjects, while others found no significant effects (Carstensen and Hartel, 2006; Mata et al., 2011). It has also been shown that older and younger adults follow different goals in decision-making, e.g. the former are more motivated to keep a positive affective state (e.g. Carstensen et al, 1999; Mather, 2006), and that competitiveness evolves non-linearly over the life-span (Mayr et al., 2012).

Though we could draw on many theories to make predictions as to how ageing should influence the reaction to different incentive schemes, we decided to use a theory that has recently been developed by sociologists and which has not found its way into the economic literature on incentives for structuring our arguments: The Social Production Functions theory (hereafter SPF; Ormel, Lindenberg, Steverink and Verbrugge, 1999). It is a theory of motivation that posits a hierarchy of universal needs, instrumental goals and resources, in its behavioural predictions. According to its authors, it is based on economic, sociological and psychological insights (Steverink, Lindenberg and Ormel, 1998). The "economic" reasoning within the theory consists of agents optimising well-being within constraints. This does not imply "homo-economicus" like unbiased behaviours, but rather suggest that even bounded-rational agents will still try to optimize well-being. In contrast to many other concepts of motivations, SPF includes a theory of goals. More specifically, rather than universal goals, people are assumed to select and to substitute fulfilment of one goal with fulfilment of another. SPF thereby

assumes a hierarchy of goals from universal goals on the top to instrumental goals that are used to fulfil the universal goals. The universal goals can be categorized into fulfilling basic physical needs and fulfilling social needs, which all agents try to achieve. By this, SPF addresses the question that economic models assuming optimization usually do not answer: "Optimizing what?" (see Steverink, Lindenberg and Ormel, 1998). The name "Social Production Functions" derives from the way the model describes how goals are related. As Steverink et al. put it "Status (as a goal) can be 'produced' by occupying a certain position…." (p. 449). SPF also allows for diversity in how goals are reached and which production functions people use.[1]

In this paper, the focus will be mainly on the fulfilment of social goals/needs, assuming that the basic needs (e.g. sleep, eating) of the agents are sufficiently fulfilled. In contrast to the older and more widely known, but also heavily criticized theory of Maslow (1943), SPF assumes that needs must be at least minimally fulfilled to achieve well-being. However, low fulfilment of one need can be substituted by high fulfilment of another need. Instrumental goals and resources are the instruments by which needs can be fulfilled. The three basic social needs, of which the latter two are the focus of our research, are the need for affection (e.g. love, relationships), the need for behavioural confirmation (e.g. doing the "right" thing in the eyes of relevant others), and the need for status (e.g. being treated with respect).

Although various field studies could be (but are not) linked to SPF theory (e.g. Ashraf, Bandiera and Jack, 2012; Gneezy and Rustichini, 2000), the only other laboratory experiment on reactions to incentives related to SPF theory was conducted by Heyman and Ariely (2004). According to these authors, standard economic models usually assume that employees are motivated by money or similar financial incentives. Not accounting for efforts that are undertaken without prospected monetary rewards is one of the shortfalls of these models. Heyman and Ariely (2004) address this problem by introducing, aside from the monetary market, a social market. When combining both incentive schemes, monetary incentives inhibit the additional beneficial effects of social incentives on effort provision that can be observed when providing social incentives alone. Their model, however, was only validated with younger adults and based on SPF-SA theory, there are reasons to assume that older people might be motivated by other means than younger people and that (additional) social incentives might be highly efficient motivators for older subjects.[2] Furthermore, within the context of work, monetary rewards are always present, but can be – in the form of a salary – less salient than either an additional monetary bonus or social incentives.

[1] Although SPF theory may have numerous flaws when scrutinized in an economic light, it provides a useful vehicle for developing and testing our hypotheses. The reader should keep in mind that other theories can provide similar predictions on behaviours, and that SPF is but one of them. It is especially useful in our context as its extension SPF-SA theory makes precise predictions about changes occurring with age that no other theory makes.

[2] SPF-SA theory is an extension of SPF-theory focusing on changes with age in the way goals are set. « SA » stands for « successful aging ».

Another issue that also has been largely neglected in the literature is whether the effects of ageing on decision-making are gender-specific (but, see Kryspin-Exner, Lamplmayr, and Felnhofer, 2011). Though SPF theory makes no gender-specific predictions, it has been shown in the context of economic experiments on the reaction to incentives that men and women react differently to incentive schemes (e.g. Niederle and Vesterlund, 2007). We therefore also analyse gender differences in our study.

Theoretical framework and predictions

"Social production functions-successful ageing" theory or *SPF-SA* (Steverink & Lindenberg, 2006; Steverink et al., 1998) is one of the most comprehensive motivation theories that explicitly considers age effects. It is an extension of "SPF" (Ormel, Lindenberg, Steverink, & Verbrugge, 1999), accounting for the motivational changes that occur with ageing. The SPF-SA theory posits that there are age-related changes in the availability of resources for needs satisfaction, with affection relatively more "age proof" than the two others as it depends less on performance. Two main processes guide these changes:

- A patterned change in the availability of resources for the satisfaction of the three social needs over the life span: status satisfaction is the most difficult to maintain, followed by behavioural confirmation. Satisfaction of the need for affection is the easiest to maintain in relation to the two other needs.
- A process of compensation and substitution regarding social need satisfaction over the life course. Behavioural confirmation and affection are substitutes of and compensate for declines in status need satisfaction, and affection need satisfaction also compensates and substitutes for the decline in behavioural confirmation need satisfaction. (Steverink & Lindenberg, 2006, p. 283)

Hence, one can extrapolate from SPF-SA theory that the relative prices of the three social needs are changing with age. That is, older adults should focus more on affection need satisfaction, while younger adults should rather focus on behavioural confirmation and status-need fulfilment. This in turn leads to the prediction that different incentives might motivate younger and older subjects. More specifically, as tournament incentives ("competition") focus on status need satisfaction, they might motivate older subjects less than either piece rate incentives (behavioural confirmation & physical needs) or any kind of "social" incentives (e.g., doing something because it is important for someone else – behavioural confirmation or affection).

Concerning status need satisfaction, older adults might prefer not to participate in tournaments as they assume that status confirmation will be difficult for them. If however, they assume that they are in a situation where it is rather easy for them to fulfil their need of status confirmation, they might in fact

choose competitive incentives over other incentives, especially when competing with other older subjects, as in our experiment.

It is important to note that SPF-SA theory is not the only theory that can yield testable predictions about age-related changes in motivation. In fact, it is possible that an economic life-cycle model with credit constraints can produce age-related changes in the desire for social vs. monetary rewards. The predictions of such a model would be similar to those produced by SPF-SA. In our view, the mechanism proposed by SPF-SA is however intuitively appealing and produces detailed predictions for an experiment that go beyond what a life–cycle model would predict. To give an example, based on SPF-SA we can predict differences between those older subjects that have a high opinion about their own relative ability in the experimental task and those that have low task-related self-esteem. We therefore focus on SPF-SA in the formulation of our hypotheses.

We use an experimental design that has originally been developed by Niederle & Versterlund (2007), who studied gender differences in the reaction to incentives. In this experiment, subjects earn money by solving real-effort tasks (summing up two-digit numbers). Performances in the task are incentivized by different incentive (piece rate, tournament) mechanism. Subjects are also allowed to choose the incentive mechanism they prefer the most. We added a fifth round to the original four rounds of the Niederle and Vesterlund experiment to investigate the motivational effects of additional "social" versus "monetary-only" incentives. We test the effects of social need satisfaction with an emphasis on status (achieve more than others) and behavioural confirmation (doing things well, being useful). The need for affection (feeling that you are liked, empathized with, etc.) plays a less important role in our set-up. In the "social" treatment, behavioural confirmation is the most prominent need that can be satisfied, as the experimenter asks subjects to *make a last effort* (i.e. doing things well) *because it is very important for the success of the study* (i.e. being useful). The competition treatment, and to some extent also the choice treatment, has a rather strong status satisfaction dimension, as participants here have the possibility to achieve more than others. Piece rate performance is less related to social needs, as the focus is on individual monetary gains, thus, physical need satisfaction. At the end of the game, participants retrospectively made an incentivized guess about their performance in the competition round and filled in a short demographic questionnaire.

Niederle & Vesterlund reported significant gender differences in choice of incentives. Women are less willing to enter a competition than men, such that – based on performance – too few women, but too many men enter the competition. By now many papers replicate findings of the earlier studies with different age and cultural groups (e.g., Gneezy & Rustichini, 2004, Gneezy et al, 2008, Dreber et al., 2009), but in terms of age groups they all focus on younger rather than older subjects – usually children or teens.

Hypotheses

In this study, we want to test four major hypotheses. First, we hypothesize that there are behavioural differences in preferences for competitive settings (H1): Those younger and older subjects who believe that they are performing well relative to their peers should take the opportunity for status-need fulfilment. Next, we explore age differences in performance under different incentive schemes, namely under competition (H2a) and social incentives (H2b) and expect an increase in effort (as measured by correct responses on a mathematical task) from a piece-rate incentive scheme to a competitive or social incentive scheme for both age groups, although this increase can be of different magnitude in the two groups as SPF-SA states that older adults react differently from young adults to the social dimension of incentive schemes. Hypothesis 3 posits that, because of the non-linear evolution of competitiveness over the life span, older subjects will compete too little based on their actual performance. Finally, we test whether the gender differences reported in the literature for younger subjects also hold for older subjects (H4). We therefore test if older women compete too little compared to older men and if older men compete too much.

Methods

Subjects

We invited a sample of people older than 58 (N = 45, 24 women, 21 men) to the experimental laboratory (AWI Lab, Heidelberg University, Germany), and a comparison sample of 40 students (mean age 24 years, 24 women, 16 men). All participants received a show-up fee of 3€ and an additional payment according to their performance (0.5€/correct answer if paid in the piece-rate treatment, 2€/correct answer for the winner out of four competing subjects in the competition treatment, and 1€/correct answer if paid for the high monetary-incentive treatment). Participants only interacted with their own age group.

The task

Subjects had to carry out a real-effort task, consisting of the addition of five two-digit numbers. We mainly followed the set-up by Niederle and Vesterlund (2007). At the start of the experiment, subjects were informed that the experiment consisted of five rounds, and that one of these rounds would be chosen at random for payment. The first four parts of the experiment consisted of the same mathematical task that had to be performed under different incentives, while the fifth part consisted of a retrospective decision:

In the first round, subjects performed the task with a piece rate payment scheme. In the second round, a competitive incentive scheme was introduced. In this trial, subjects earned an amount of money four times higher than in the piece rate scheme if they were the best out of a randomly matched group of

four. The other subjects earned nothing. In the third round, subjects could decide whether to be paid in a piece rate or in a competitive incentive scheme. In the final round, subjects played the task with a modified piece rate payment scheme: roughly half of the participants played the game with increased monetary incentives; the other half of the participants played the game with social incentives in addition to the piece rate payment scheme of the first round. To investigate the motivational effects of social incentives, anterior to the fourth round, the experimenter read aloud a text asking participants to make a last effort and to try to answer as many questions as possible.[3]. He stressed that it would be very important for the experimenter that subjects try really hard. In the terminology of SPF-theory, performance in the tournament treatment is related to status need satisfaction, while performance in the "social" treatment (and to a lesser extent in piece rate, which is in general less based on social need satisfaction as it is an individual performance task) is related to behavioural confirmation. Subjects were paid as in the standard Piece Rate condition. In the high monetary incentives treatment, subjects were paid twice the price of the standard piece rate payment for each correct answer. Additionally, participants could decide retrospectively whether to be paid in the piece rate or in the competitive incentive scheme for round one in order to distinguish between preferences for competitive pay as opposed to preferences for having to perform in a competitive settings. We closely followed the procedures by Niederle and Vesterlund (2007). Based on the literature, we hypothesize a difference in choice of competitive incentives between age as well as between gender groups.

Results

1) Regression models

In a first step, we report regressions that predict the choice to compete and the performance of participants. In the subsequent sections, the results are complemented by pair-wise comparisons.

As summarized in table 1, we find that gender to be a robust predictor of competitiveness (choice to compete) (all $p < .1$). However, neither age nor the interaction between age group and gender, has significant effects on competitiveness (to ease interpretation of the coefficients, table A1 in the appendix contains the same regressions as linear probability models). Women are less likely to compete, a result that also holds when controlling for absolute and believed performance. On the other hand, age and actual performance (as measured by performance on the piece rate trial and by the increase in correct responses from the piece rate to the competition trial) do not have a significant effect on the likelihood of entering a competition.

[3] All sessions were conducted by the same experimenter (A.S.).

Table 1: Predictors of choice to compete

Factor	Model 1	Model 2	Model 3	Model 4	Model 5
Older age	-.310	-.127	-.221	-.695	-.056
	(.469)	(.489)	(1.235)	-1.550	(.497)
Female	-1.290**	-1.201*	-1.162*	-1.345ˣ	-1.130*
	(.469)	(.479)	(.484)	(.702)	(.487)
Piece Rate Performance		.085			.061
		(.054)			(.055)
Impr. comp. – piece rate		-.016			
		(.086)			
Self-ranking			-.627ˣ	-.615*	-.497ˣ
			(.646)	(.305)	(.318)
Older age*female				.355	
				(.968)	
Older age*self-ranking			.035		
			(.614)		
Constant	1.740*	.661	2.653*	2.920*	1.686
	(.809)	(-1.061)	(1.164)	(-1.280)	(-1.254)
R^2	.124	.166	.183	.185	.201

Logistic regressions. Dependent variable: choice to compete. Standard errors in parentheses.

ˣp < .1 *p < .05 **p < .01 N = 85

The second factor that significantly influences willingness to compete is self-ranking. Participants who are more confident about their relative performances (as measured by self-ranking) are more likely to compete than participants who are less confident ($p < .1$). Based on SPF-SA, we expect that those older adults who believe themselves to be performing well relative to their peers (thus those who rank themselves high compared to their group) should take the opportunity for status-need fulfilment and vice versa for those older adults that rank themselves low. In younger adults, this effect should be more prominent. The interaction effect between age and self-ranking, is however not significant.

In the following, we report regressions on the number of correctly solved problems, as a proxy for performance, in each of the treatments (table 2).

Table 2: Predictors of performance for each condition

	Piece rate		Competition		Choice		Final	
Factor	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Older age	-.248*	-.285	-.245*	.000	-.270*	-.079	-.212*	.184
	(.022)	(.424)	(.024)	(.999)	(.011)	(.688)	(.050)	(.496)
Female	-.160	-.173	-.112	.034	-.130	-.047	-.112	.081
	(.135)	(.275)	(.297)	(.707)	(.236)	(.604)	(.296)	(.476)
Older age *		.040		-.044		.002		-.226
Female		(.931)		(.836)		(.992)		(.389)
Piece rate				.829***		.820***		.729***
performance				(<.001)		(<.001)		(<.001)
Choice to					.165	.011		
compete					(.134)	(.868)		
Social							.201×	.064
							(.062)	(.573)
Older age *								.009
Social								(.946)
Constant	13.883***	14.083***	14.596***	2.568	14.669***	4.621*	15.662***	3.511
	(<.001)	(<.001)	(<.001)	(.155)	(<.001)	(.021)	(<.001)	(.152)
R^2	.082	.082	.069	.701	.130	.726	.092	.565

Linear regressions. Dependent variables: number of correctly solved problems. Standardized regression coefficients β; significance levels in parentheses. N = 85. ×p < .1 *p < .05 ***p < .001

In summary age, but not gender of participants, influences performance in all four incentive schemes. When controlling for baseline-performance (measured by performance on the initial piece-rate trial), the effect of age disappears, which is likely caused by the strong relationship between age and performance.

In the first regression model of performance on the final incentive scheme, we introduced the nature of incentives (social or increased monetary) as the regressor. It appears that the nature of the incentives with marginal significance explains performance on the final trial, with a stronger effect for social compared to increased monetary incentives.

Pairwise comparisons

2) Age differences in the selection into competition

We then investigated the age differences in the choice of competitive incentives. We do not find a general age difference in choice: 42.5% of older adults and 37.8% of young adults chose to compete in round 3 ($\chi^2 = 0.197$; $p = 0.657$).[4]

Table 3: Age differences in competitiveness

Group	Choice	Frequency	%
Young	Piece rate	23	57.5
	Competition	17	42.5
	Total	40	100
Older	Piece rate	28	62.2
	Competition	17	37.8
	Total	45	100

We thus confirm the results of the regression and show that there is no significant age difference in competitiveness, i.e., older subjects are no less proneto search for status relative to younger subjects.
To interpret this effect, it is important to know whether there is an age difference in performance in any of the incentive conditions or in improvement between piece rate and competition. Following SPF-SA theory we assume that those subjects (young and old) that can expect ~~to be able~~ to achieve status (i.e., win) by entering a competition should enter, whilst those who do not expect to do so should focus on other instrumental goals. Over- or under-entry into the tournament (based on real probabilities of winning with the realized performance; cf. Table 6 in the next section)[5] can be interpreted as over- respectively under-confidence, as entry is strongly correlated with beliefs.

3) Age difference in performance
    a. reaction to competitive incentives

Table 4 and figure 1 confirm that there are age differences in performance in all conditions: in the piece rate incentive scheme ($t_{(83)} = 2.221$, $p = 0.029$)[6], in the competitive incentive scheme ($t_{(83)} =$

[4] We report Pearson's χ^2 values with an asymptotic two-sided significance level.
[5] In line with the procedure reported in the original Niederle & Vesterlund (2005) paper, we determine whether someone "should" enter using the following simulation technique: We draw 10,000 groups of four for any given performance level, using our sample with replacement. We then calculate the frequency of winning with this performance level. We repeat that 100 times and report the average of these winning frequencies (see Niederle & Vesterlund, 2005 and 2007).
[6] T-tests always report two-sided significance levels. Because of unequal group sizes and a relatively small sample, we also applied Monte-Carlo (MC) simulations (1 Mio. random samples) to check for the robustness of

2.232, p = 0.028), in the choice incentive scheme ($t_{(83)}$ = 2.549, p = 0.013); and marginally in the social or increased piece rate incentive scheme ($t_{(83)}$ = 1.877, p = 0.064). However, there is no age difference in improvement from one to another condition: younger and older subjects do improve performance and do it equally (improvement piece rate and competition - $t_{(83)}$ = 0.111, p = 0.912, improvement between piece rate and final phase $t_{(83)}$ = 0.412, p = 0.682).[7]

Table 4: Age differences in performance

Condition	Mean young (SD)	Mean older (SD)	$t_{(83)}$-value	p-value	Hedge's g[8]
Piece rate	11.35(5.19)	9.02(4.47)	2.221	0.029	0.479
Competition	12.78(5.07)	10.38(4.83)	2.232	0.028	0.481
Choice	13.25(5.56)	10.49(4.41)	2.549	0.013	0.549
Monetary/Social	12.88(4.97)	10.87(4.88)	1.877	0.064	0.405
Impr. comp. - piece rate	1.43(2.70)	1.36(3.04)	0.111	0.912	0.024
Impr. soc./monet. – piece rate	1.53(3.48)	1.84(3.65)	0.412	0.682	-0.086

N young adults: 40; N older adults: 45

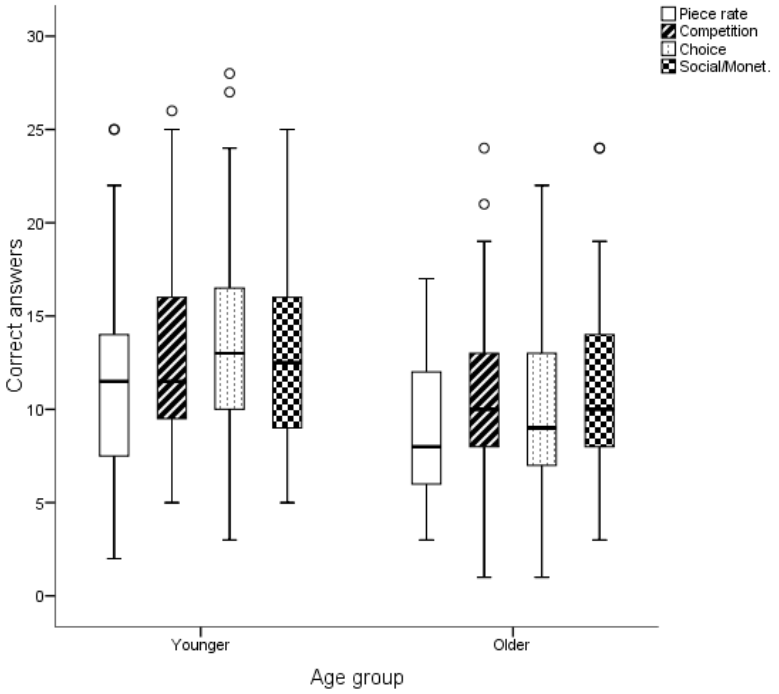

Figure 1: Box-plots of trial performance by age group.

our results. If significance levels largely deviate from results that are significant in the t-test, we report the MC significance level in a footnote.

[7] Table A2 in the Appendix contains a more detailed analysis of these results by taking the gender component into account.

[8] In accordance with Cohen's (1988) thumb rule, we classify the size of an effect as small if its value is around 0.20, as medium if g is around 0.50, and as large if the effect size is around 0.80.

We now investigate whether participants choosing to compete in the choice trial differ in performance from participants that chose the piece rate. Participants also ranked their own performance in competition in a subsequent step and we can test for differences in beliefs about performance in the competition treatment. We expect participants choosing to compete to perform better and to rank themselves higher than participants choosing the piece rate incentive scheme. In a first step we show data for both age groups together, and subsequently we will split groups by age.

Table 5 shows performance in the three first treatments (piece rate, competition, choice), the level of improvement from piece rate to competition, and subject's self-ranking. With the exception of those instances concerning improvement from piece rate to competition, subjects choosing to compete perform better than subjects who choose the piece rate.[9] In the piece rate treatment, competitive subjects submitted on average 11.50 correct answers in five minutes, compared to 9.20 correct answers in the non-competitive group ($t_{(83)} = 2.154$, $p = 0.034$). The effect goes in the same direction for the competition treatment (not significant, $t_{(83)} = 1.626$, $p = 0.108$) and the choice treatment ($t_{(83)} = 2.024$, $p = 0.046$, see figure 2).[10] Subjects who choose to compete do not differ significantly from subjects who choose the piece rate incentive scheme with respect to improvement from the piece rate treatment to the competition treatment ($t_{(83)} = 0.786$, $p = 0.434$).

There is a significant difference in subject's self-ranking, with competitive subjects ranking themselves as significantly better than subjects who chose a non-competitive incentive scheme ($t_{(83)} = 2.546$, $p = 0.014$).

Table 5: Performance differences and competitiveness

Condition	Mean piece rate	Mean comp.	$t_{(83)}$-value	p-value	Hedge's g
Piece rate	9.20(4.47)	11.50(5.32)	2.154	0.034	-0.472
Competition	10.78(4.87)	12.59(5.21)	1.626	0.108	-0.358
Choice	10.88(4.39)	13.15(5.91)	2.024	0.046	-0.445
Impr. comp. – piece rate	1.59(2.74)	1.09(3.06)	0.786	0.434	0.173
Rank	2.14(0.80)	1.68(0.84)	2.546	0.014	0.559

N piece rate: 51; N competition: 34

[9] For reasons of text fluency, we classify hereafter subjects that choose to compete as competitive, and subjects that chose the piece rate incentive scheme as noncompetitive. We are aware that by attributing the predicate "noncompetitive" to the participants we do not necessarily describe participants' personality, but rather their preferences on the current task.

[10] MC significance: 0.110

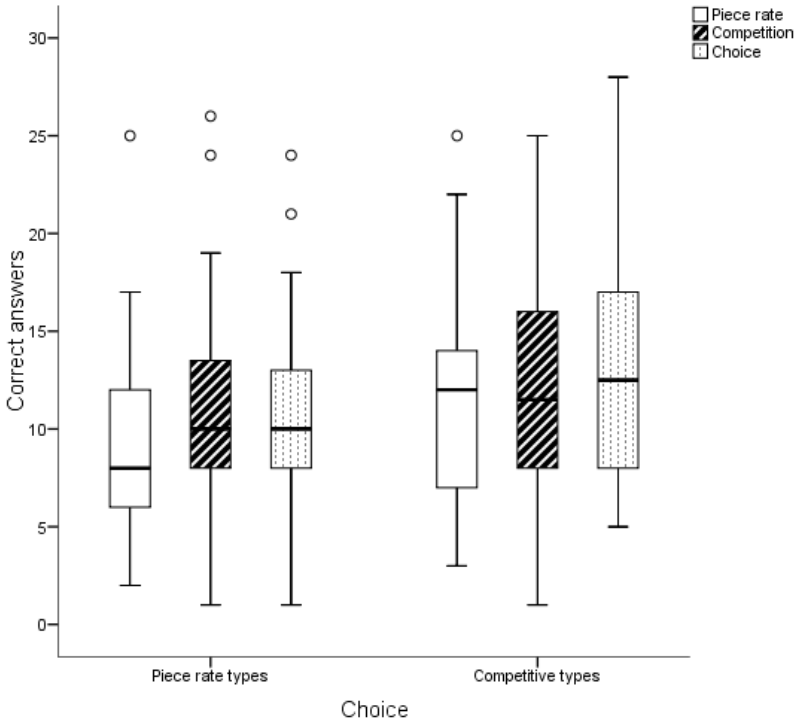

Figure 2: Box-plots of trial performance by competitiveness (the same figure separated by age group can be found in the appendix, Figure A1).

When focusing on age effects, the difference between participants who chose the piece rate incentive scheme and those who chose the competitive incentive scheme only holds for younger subjects (table A3 and figure A1 in the appendix). Those younger subjects who choose to compete perform better in piece rate trials (marginally significant, $t_{(38)} = 1.639$, $p = 0.055$), in competition trials (marginally significant, $t_{(38)} = 1.598$, $p = 0.059$), and in choice trials ($t_{(38)} = 1.819$, $p = 0.039$). They do not improve more from the piece rate trial to the competition trial than the other group ($t_{(38)} = 0.143$, $p = 0.444$), but they rank themselves higher (marginally significant, $t_{(38)} = 1.546$, $p = 0.065$).

Older subjects who choose to compete differ from those who choose the piece rate in none of the performance measures, but in self-ranking ($t_{(43)} = 1.941$, $p = 0.030$).

In summary, we find a general difference in most of the performance measures (all except improvement) between subjects choosing to compete and those preferring piece rate incentives. When looking at age differences, the general difference only holds for younger subjects; older subjects differ in self-ranking and in none of the other measures (replicating the finding of Charness and Villeval, 2007 and confirming our prediction based on SPF-SA theory that mainly those who believe they can reach status goals by doing so should choose competition).

We further see that there are no differences in over- or under-entry into competition between older and younger subjects, thus older adults are not significantly different in over- or under-confidence when having the choice to enter a tournament (table 6; for gender differences within each age group, see table A4a and A4b in the Appendix).

Table 6 : Over- and under-entry : Both age-groups

	Calculation based on tournament performance		Calculation based on choice performance	
	Young	Older	Young	Older
Under-entry				
Number of subjects who should enter	18	18	22	19
Of those how many do not enter	8	10	0	0
Average expected cost of under-entry	24.75	22.65		
	$X^2 = .444$ p = .505			
Over-entry				
Number of subjects who should not enter	22	27	18	26
Of those how many do enter	7	9	6	8
Average expected cost of over-entry	4.5	3.83	4.25	3.75
	$X^2 = .013$ p = .910		$X^2 = .032$ p = .858	

b. differences in the reaction to "social" incentives

Based on SPF-SA theory, we hypothesized that older subjects should react more strongly to "social" than to monetary incentives. When directly comparing social to increased monetary incentives, it turns out that social incentives have a slightly stronger effect on productivity (see table 2). On average, subjects solve 12.77 problems in the social incentives group, but only 10.83 problems in the monetary incentives group (marginally significant, $t_{(83)} = 2.025$, p = 0.074). This effect has the same magnitude in younger and older subjects.

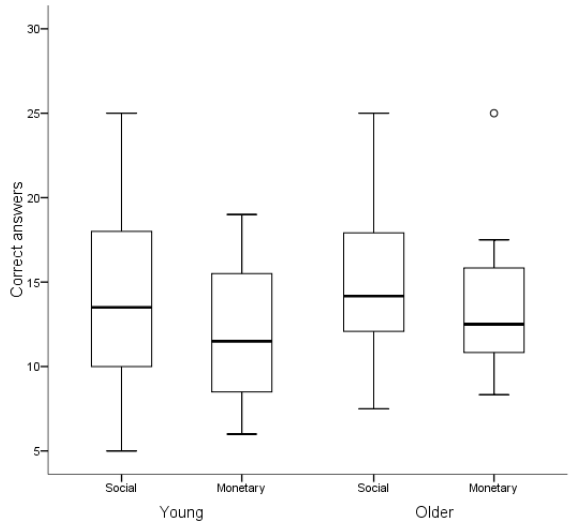

Figure 3: Box-plots of performance in the social vs. monetray round, divided by treatment and age group.

4) Gender differences

An effect well known in the literature (Müller & Schwieren, 2011; Niederle & Vesterlund, 2007) is a gender difference in the choice of competitive incentive schemes. We can test whether this holds not only for young women, but also for older women. Whereas 56.8% of men choose to compete in round 3, only 27.1% of women do so ($\chi^2 = 7.666$, $p = 0.006$). If we split the sample by age groups, this effect still holds: 29.2% of younger women choose the competitive incentive scheme, compared to 62.5% in men ($\chi^2 = 4.365$; $p = 0.037$). This effect is marginally significant in older adults: 52.4% of older men choose to compete, compared to 25% of older women ($\chi^2 = 3.572$, $p = 0.059$).

Table 7: Gender differences in competitiveness

Group		Choice	Frequency	%
Male		Piece rate	16	43.2
		Competition	21	56.8
		Total	37	100
Female		Piece rate	35	72.9
		Competition	13	27.1
		Total	48	100
Older	Male	Piece rate	10	47.6
		Competition	11	52.4
		Total	21	100
Young	Male	Piece rate	6	37.5
		Competition	10	62.5
		Total	16	100
Older	Female	Piece rate	18	75
		Competition	6	25
		Total	24	100
Young	Female	Piece rate	17	70.8
		Competition	7	29.2
		Total	24	100

Discussion

The main aim of this experiment was to explore age differences in the reaction to incentives, based on predictions of SPF-SA theory. To achieve this goal, subjects participated in a real-effort task with four incentive schemes: piece rate, tournament, choice between piece rate and tournament, and social or

increased monetary incentives. On the whole, we replicated most of the effects previously known in the literature, and answered our main research questions.

More specifically, with respect to age and gender differences, we found that:
Concerning performance, older subjects generally perform worse in all conditions than younger subjects. This effect supposedly is due to age differences in cognitive domains such as processing speed (Salthouse & Madden, 2008) and fluid intelligence (Bugg et al., 2006). Younger and older subjects do however not differ in the increase in performance between the conditions. This shows that even though overall performance of older subjects on this task may be worse than that of younger subjects, the effect of conditions points in the same direction for both age groups (i.e. the difference in performance between the competition treatment and the piece rate treatment does not differ significantly between age groups). When controlling for gender and the interaction of gender and age, the significant age effect disappears (driven by a change in standard errors; the coefficient increases in size). Performance increases from the piece rate to all subsequent trials (and not between any of the subsequent trials). Subjects seem to be equally motivated to perform well by competitive incentives and by piece rate settings with increased performance incentives, and slightly more by social incentives. As predicted by SPF-SA theory, and unlike Heyman and Ariely (2004), adding social incentives to the monetary rewards seems to have a stronger effect on effort provision than monetary incentives alone. The performance-increasing effect of increased monetary incentives or additional social incentives seems to have a similar strength as a competitive environment, as we do not find significant increases in effort provision from the competition trial to the final trial with monetary or with social incentives. Unlike the predictions of SPF-SA theory, we do not observe that the magnitude of the difference between social and increased monetary incentives changes with age.

Unlike the common stereotype that older adults "are less willing to learn, and implicitly less interested in working hard and competing" (Charness and Villeval, 2007), in the setting of our experiment we do not find decreased competitiveness, either in men or in women. We replicate the gender difference in competitiveness found in the literature (Müller and Schwieren, 2011; Niederle and Vesterlund, 2007): women enter a tournament less often than men. This effect holds for both age groups. The two factors that explain the most of this variance of tournament entry are the gender of participants and self-ranking. Participants who are more confident about their relative performance are more likely to compete than participants who are less confident, which is in line with SPF-predictions. Interestingly, with older subjects, we do not observe a significant difference in performance between those that chose to compete and those that chose a piece rate incentive scheme, but well a difference in beliefs about actual performance. This suggests that, though beliefs have a relatively high likelihood of being wrong, those subjects who believe that they are able to fulfil their status goal will try to attain it. Furthermore, women are less likely to compete (a result that also holds when controlling for absolute

and believed performance) and age per se does not have a significant effect on the likelihood to enter a competition. We do not observe any general age-effects on under- or over-entry into competition. Instead, given their actual performance, too many young men enter into competition, and too many older women do not. At the same time, there is no significant over-entry by older men, nor is there a significant under-entry in young women.[11] The design of our study however does not allow us to fully control for confounds such as risk preferences, wealth or other correlates that can also change with age and may be partly explaining the observed effects. Changing risk preferences in particular might be a strong confound, which we can only partially control for by taking participants' beliefs into account. A risk loving participant would try to enter a competition even when believing that the odds of winning are too low to reach the higher expected value, whereas a risk neutral or averse participant would try to avoid the competitive setting when beliefs of winning are low. Another confound that might be of interest for explaining the observed differences can be the physiological changes (hormones, brain activity) that occur with ageing. Although the effects of hormones on behaviour in an ageing context are not well researched (e.g. Huffmeijer, van IJzendoorn and Bakermans-Kranenburg, 2012), it has been shown that hormones play a crucial role in competitive settings (Apicella et al., 2011; Buckert et al., 2014) and that their concentrations change with age (Crilly, Francis and Nordin, 1981). Also, it has been shown that the activation of brain structures underlying risk preferences changes with age (e.g. Lee, Leung, Fox, Gao and Chan, 2008), and that some of the regions involved in preferences for competitive settings overlap with "risk-regions" (in young adults; Decety, Jackson, Sommerville, Chaminade and Meltzoff, 2004). Though speculative, it might therefore be that age differences in preferences for competitive settings have a considerable amount of underlying physiological changes.

The gender effects cannot be related directly to SPF-SA theory; one would need to add some assumptions about stereotypical gender-appropriateness for striving to reach certain goals. As status seeking through competitive behaviour has not been part of the gender roles of older women, they may be more prone to strive for behavioural confirmation as a substitute, compared to younger women (students) who have been told that status-striving is appropriate for women (and not only men) (Chao and Schor, 1998; Noble, Haytko and Phillips, 2009; Wagner and Berger, 1997). This could also explain why in previous studies (Niederle & Vesterlund, 2007), more over-entry has been found for men than for women, and more under-entry for women, whereas in our study, young women do not exhibit significantly larger under-entry than men, while older women do. This, however, is only speculation and needs to be validated in other experiments.

[11] Speculating about possible reasons for this, one could assume that young men have higher testosterone levels than old men (see Morales, Heaton & Carson, 2000) and due to that, show stronger status-seeking behavior. For women, in addition to a similar effect of testosterone reduction, a cohort-effect could also play a role, in that older women have been socialized in a time where women were not supposed to be competitive, while for young women, especially students, competitiveness is an accepted behavior.

Conclusion

To conclude, older subjects seem to differ in their performance, but not in their reaction to incentives from younger subjects. While the differences are not large, they do show the need to differentiate not only between younger and older adults, but also between men and women. Overall, older women's performance is slightly lower than that of younger women, whereas we do not find this age difference for men. When it comes to social incentives, the motivational effect of social incentives seems to be slightly higher than the motivational effect of monetary incentives, at least for men.

With respect to the SPF-SA theory, in our experiment, we tested the effects of social need satisfaction with an emphasis on status (being taken seriously, achieving more than others) and behavioural confirmation (doing things well, being useful, contribution to a common goal). Even though we do not observe strong differences between age groups in the reaction to status and behavioural confirmation treatments, we observe some increase in performance in both age groups in reaction to social-need-satisfaction conditions relative to the piece-rate treatment, where none of the social needs can be fulfilled. In particular, the social/monetary treatment, in which confounding factors like task familiarity or learning should not play a role, shows that the possibility for behavioural confirmation has a stronger effect on performance than a doubling of the financial incentives. Hence the results of our study suggest that SPF-SA theory does not seem to always be an appropriate theory to differentiate between behaviour of people of different ages. Indeed, it seems that older adults are not different from younger adults in terms of the weight they put on different needs.

As with any experiments, the current study has its limitations. Given that the number of studies in the field of aging and decision-making is still limited, our experiments aim at studying differences between younger and older adults. Therefore, we selected the older subjects in a way that eased comparability with younger subjects. All our older participants were healthy, highly educated and practised a cognitively active lifestyle. We are aware that our results might apply only to a specific group of older adults, and we do not claim to be able to generalize to the entire population of older people. This also limits the size of our participant sample and thereby reduces the statistical power of our tests. We also want to point out that extreme group comparisons such as between younger and older adults may obscure some life-span differences in competitiveness. For example Mayr et al. (2012) find that competitiveness follows a non-linear pattern over the life course, increasing from youth to middle age, and then declining. The aim of our experiment is however to focus on older people as with life expectancies increasing, it is highly probable that retirement age will also increase over the next few decades. For the design of future working environments, it therefore is important to understand the extent to which older adults are willing to compete. A life-span study investigating our research questions would be a very interesting avenue for further research.

In this experiment, we wilfully did not try to rule out cohort effects. All western populations are ageing rapidly, hence there is an immediate need to describe the behaviour of older adults. It is also of great importance to understand how these behavioural differences develop over the life-course, but our first aim was to describe the differences between young and older adults, paving the way for future work where we will try to minimize the impact of cohort effects and to find explanations for these age differences.

More work is necessary to fully understand the implications of our results for workplace design, especially focusing on social incentives. Further experiments should also look at age-mixed settings, as this might be the more relevant setup with respect to real-world workplaces. Predictions especially with respect to how the (perceived) possibility of status confirmation (but also behavioural confirmation) of the elderly differs from our homogeneous set-up should also be tested.

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Appendix

Table A1

Factor	Model 1	Model 2	Model 3	Model 4	Model 5
Older age	-.282	-.053	-.195	-.254	-.064
	(.009)	(.254)	(.440)	(.091)	(.280)
Female	-.180	-.062	-.107	-.148	-.031
	(.089)	(.175)	(.286)	(.304)	(.599)
Piece Rate Performance		.914			.778
		(.000)			(.000)
Impr. comp. – piece rate		-.354			
		(.000)			
Self-ranking			-.381	-.392	-.132
			(.019)	(.000)	(.037)
Older age*female				.071	
				(.690)	
Older age*rank			.019		
			(.949)		
Constant	16.229	2.548	19.189	20.000	6.004
	(.000)	(.000)	(.000)	(.000)	(.000)
R^2	.105	.843	.246	.248	.741

Linear regressions. Dependent variable: choice to compete. Standardized regression coefficients β. Significance levels in parentheses. Please refer to Table 1 for the effects of interest.

Table A2

Gender	Condition	Mean young (SD)	Mean older (SD)	df	t-value	p-value	Hedge's g
Male	Piece rate	12.38(6.87)	9.81(4.52)	35	1.369	0.180	0.445
	Competition	13.44(6.49)	11.00(4.38)	35	1.363	0.181	0.443
	Choice	14.44(7.08)	11.43(4.52)	35	1.574	0.124	0.511
	Monetary/Social	13.06(4.94)	11.76(4.69)	35	0.745	0.461	0.265
	Impr. comp. – piece rate	1.06(2.35)	1.19(3.17)	35	0.135	0.893	-0.044
	Impr. soc./monet. – piece rate	0.69(3.34)	1.95(4.17)	35	0.994	0.327	-0.321
Female	Piece rate	10.67(3.70)	8.33(4.40)	46	1.988	0.053	0.566
	Competition	12.33(3.94)	9.83(5.22)	46	1.872	0.068	0.532
	Choice	12.46(4.26)	9.67(4.23)	46	2.278	0.027	0.646
	Monetary/Social	12.75(4.35)	10.08(5.00)	46	1.971	0.055	0.560
	Impr. comp. – piece rate	1.67(2.91)	1.50(2.98)	46	0.195	0.846	0.057
	Impr. soc./monet. – piece rate	2.08(3.53)	1.75(3.22)	46	0.342	0.734	0.096

N young male: 16; N older male: 21; N young female: 24; N older female: 24

Table A3

Group	Condition	Mean piece rate	Mean comp.	df	t-value	p-value	Hedge's g
Young	Piece rate	10.22(4.78)	12.88(5.48)	38	1.639	0.055	-0.512
	Competition	11.70(4.66)	14.24(5.37)	38	1.598	0.059	-0.500
	Choice	11.91(4.42)	15.06(6.52)	38	1.819	0.039	-0.571
	Impr. comp. – piece rate	1.48(2.86)	1.35(2.55)	38	0.143	0.444	0.047
	Rank	1.96(0.71)	1.59(0.80)	38	1.546	0.065	0.484
Older	Piece rate	8.36(4.10)	10.12(4.95)	43	1.291	0.102	-0.389
	Competition	10.04(5.00)	10.94(4.63)	43	0.605	0.274	-0.181
	Choice	10.04(4.26)	11.24(4.67)	43	0.883	0.191	-0.266
	Impr. comp. – piece rate	1.67(2.70)	0.82(3.56)	43	0.913	0.183	0.274
	Rank	2.29(0.85)	1.76(0.90)	43	1.941	0.030	0.599

N young piece rate: 23; N young competition: 17; N older piece rate: 28; N older competition: 17.
One-sided t-tests.

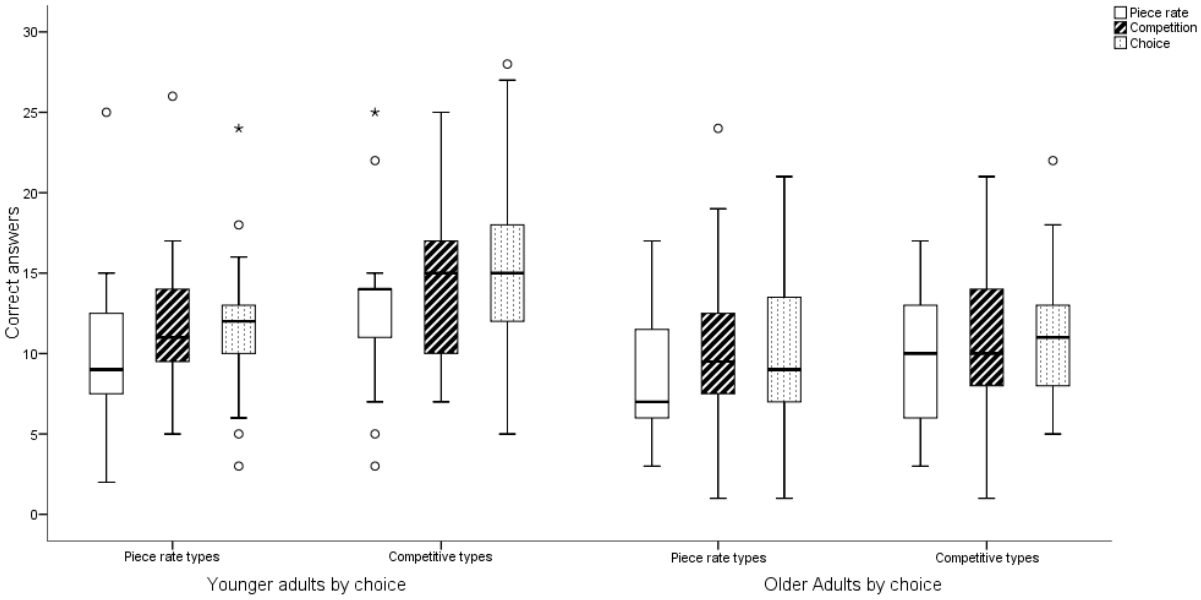

Figure A1: Box-plots of trial performance by competitiveness by age group.

Table A4a : Over- and under-entry : Young Adults

	Calculation based on tournament performance		Calculation based on choice performance	
	Male	Female	Male	Female
Under-entry				
Number of who should enter	7	11	8	14
Of those how many do not enter	3	5	0	0
Average expected cost of under-entry	29.00	22.20		
	$X^2 = .012$ p = .914			
Over-entry				
Number of who should not enter	9	13	8	10
Of those how many do enter	6	1	5	1
Average expected cost of over-entry	4.33	5.50	3.90	6.00
	$X^2 = 8.526$ p = .004		$X^2 = 5.513$ p = .019	

Table A4b : Over- and under-entry : Older Adults

	Calculation based on tournament performance		Calculation based on choice performance	
	Male	Female	Male	Female
Under-entry				
Number of who should enter	11	7	10	9
Of those how many do not enter	4	6	0	0
Average expected cost of under-entry	20.25	24.25		
	$X^2 = 4.219$ p = .040			
Over-entry				
Number of who should not enter	10	17	11	15
Of those how many do enter	4	5	4	4
Average expected cost of over-entry	3.50	4.10	3.75	3.75
	$X^2 = .318$ p = .573		$X^2 = .280$ p = .597	