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Self-selection into teamwork: A theoretical and experimental analysis

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We analyze self-selection decisions regarding teamwork both theoretically and empirically. While we focus on individual talent, we also investigate the effects of team tasks, individual teamwork skills, and expectations concerning the talent and teamwork skills of potential teammates as further determinants in the self-selection process. Putting our hypotheses derived from a basic self-selection model in dialogue with original data from a real-task laboratory experiment, we are able to show that it is the less talented who find teamwork appealing but that individual teamwork skills and expectations concerning the talent of potential teammates might compensate for this adverse effect.

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I. Introduction

In organizational practice, teamwork is increasingly widespread (see e.g., Barrick et al. 1998: 377; Lindbeck and Snower 2000: 354; Osterman 2000: 186). At the same time, team incentives have developed into an important component of organizational reward systems. When a position needs to be filled, “teamwork” and “team incentives” are frequently used as catchwords in an attempt to attract the attention of potential employees to the advertised vacancy. The question of whether these catchwords are really apt to attract the highly talented, or whether they instead attract the not so able has hardly been analyzed in spite of its obvious practical relevance. Furthermore, potential compensating factors such as the nature of the task to be performed, an individual’s teamwork skills, and his expectations concerning the talent and teamwork skills of potential teammates have not been considered in the literature thus far. This is despite the fact that these factors will clearly affect self-selection decisions between working individually or working on a team.

We are the first to model the process of self-selection between the option of working individually and that of working on a team in a way that allows us to analyze not only the effect of a person’s talent on the self-selection decision but also the effect of task type, a person’s capacity for teamwork, and his expectations regarding potential teammates. Empirically, we present original data from a real-task laboratory experiment in which we let participants choose between individual work and teamwork, and in which we also collect data on their personal characteristics and expectations, shedding light on the suitability of our model.

Regarding the influence of a person’s talent on the sorting decision, we find (both theoretically and empirically) that it is the less talented who are attracted by teamwork and team incentives instead of the highly talented. Because team output depends on the team members’ talents, this negative selectivity effect should be taken into consideration when forming teams and asking people to join voluntarily. Concerning the type of (team) task to be performed, we focus on differing degrees of required interaction and distinguish between additive tasks (with a low degree of required interaction) and compensatory tasks (those with a high degree of interaction required). Unlike with our theoretical results, we find no empirically significant effect of the type of task to be performed on the sorting decision. However, we find strong and positive effects of: (1) a person’s capacity for teamwork, (2) his extraversion as a measure of the non-pecuniary benefit he derives from teamwork, and (3) his expectations regarding potential teammates on his likelihood of joining a team. These effects

might (at least in part) compensate for the effect of talent on the sorting decision such that, in the end, those working on a team are not necessarily less talented than those who choose to work individually.

Concerning related *theoretical* work, no article has yet focused on modeling the sorting decision regarding individual work versus teamwork. Hence, we refer to the general class of self-selection models and use these for the analysis of our research question. Existing models of self-selection, however, have not yet taken into account other factors besides the talent or (at a maximum) the social skills of the decision-maker. Other potential compensating factors for the effect of talent on the self-selection process have been widely ignored so far. In terms of the theoretical approach chosen, our analysis is closest to the work of Grossman (2004). Based on worker self-selection into industrial sectors characterized by either team production or individual production, Grossman (2004) seeks to explain international trade. In his model, the sorting decision between individual work and teamwork is based solely on the talent of employees. He finds that more talented employees are more likely to choose the sector with individual production. However, he does not allow for compensating factors like teamwork skills or task type. Also, unlike in our model, in his model there is no “real” team production in the sense of two employees on the same hierarchical level working together on the same task and being (equally) compensated on the basis of their joint output. Instead, Grossman’s “team” consists of one worker who earns a fixed wage and one manager who receives the residual. Because this set-up does not correspond to the typical team structure we are interested in, it needs to be fundamentally adapted in order to answer our research question.

Furthermore, the articles by Breton, St-Amour, and Vencatachellum (1998, 2003), Eaton and Hollis (2003), and Amann and Gall (2006), even though they do not directly deal with sorting into teams, shed light on issues that are related to our research question: Breton et al. (1998, 2003) rely on reputation effects in a two-generation model to explain why good employees only work with other good employees and refrain from working in teams when their potential teammates are not “good” enough. Eaton and Hollis (2003) are interested in how the reward structure of individual projects and team projects influences an employee’s decision to share an idea for teamwork with a partner or to work alone. They find that team projects need to be over-rewarded; otherwise, an inefficient amount of teamwork is realized. Amann and Gall (2006) apply a model of (voluntary) matching to analyze which students—in terms of talent—chose to study with others (i.e., in groups) instead of studying individually. They find that only average persons select teamwork and that individuals from the top or the bottom of the

talent distribution work alone. Regarding the impact of an employee's talent level on the sorting decision between individual work and teamwork, Breton et al. (1998, 2003) and Amann and Gall (2006) each seem to suggest that highly talented employees are less likely to work on a team. They completely disregard the impact of potential compensating factors.

Concerning the *empirical* literature, it can be said that the perspective on the effect of talent on the decision to join a team is less unified: while Kocher, Strauß, and Sutter (2006) observe that more highly talented individuals are less likely to sort into teams, Königstein and Ruchala (2007), as well as Hamilton, Nickerson, and Owan (2003), find the opposite to hold true. The results of Kocher et al. (2006) and Königstein and Ruchala (2007) are based on laboratory data, whereas the evidence by Hamilton et al. (2003) was gathered in a field experiment. Kocher et al. (2006) use a beauty-contest game to analyze if participants self-select into team decision-making or individual decision-making. They find a tendency among individuals with better decision-making in the first round to sort into individual decision-making. Königstein and Ruchala (2007) conducted an experiment in which participants who were pre-assigned either high or low productivity had to select a group task or an individual task. They find that the highly productive are more likely to choose the group task, perhaps because the experimenters exogenously set productivity in the group task to be generally higher than in the individual task, with the productivity differential larger for the high-productivity types. However, in a field study analyzing the transition from individual piece rates to team piece rates in a garment plant, Hamilton et al. (2003) also find that employees with above-average productivity were the first to voluntarily switch from individual piece rates to team piece rates.

Concerning determinants of the self-selection process other than a person's individual talent, there is hardly any literature as yet. Boschini and Sjögren (2007) consider gender as a potential determinant of the self-selection process and find women to be empirically less likely to join a (co-author) team than men. Considering sociability and using survey data, Krueger and Schkade (2008) show that the gregarious and sociable individuals systematically sort themselves into jobs that offer more interaction with coworkers.

In summary, there is hardly any theoretical literature dealing directly with worker self-selection into teams, and theoretical research has mainly focused on the presumably adverse effect of talent on the decision to sort into a team, leaving out any potential compensating factors. At the same time, the empirical evidence regarding the question of whether it is the less talented who sort into teams is ambiguous, and empirical evidence regarding the effects

of personal characteristics other than talent is scarce. Our article adds to the literature on a theoretical level by explicitly modeling the decision between working individually or working on a team, accounting for factors such as task type and further personal characteristics in addition to talent. Empirically we contribute to the literature by generating experimental data on the self-selection decision that is not distorted by experimenters' predefinitions regarding productivity in individual work or teamwork. Furthermore, and most importantly, by collecting data regarding factors that might potentially compensate for the effect of talent (such as teamwork skills or task type) and by controlling for these factors, we are able to show if there is really an adverse effect of talent on the sorting decision.

The remainder of the article is structured as follows: Section II introduces a model of self-selection for teamwork versus individual work and derive testable implications regarding the effects of: (1) talent, (2) task type, (3) capacity for teamwork, (4) expectations regarding the talent and capacity for teamwork of potential teammates, and (5) any potential non-pecuniary benefits of working on a team. In section III, the theoretical implications are put in dialogue with original experimental data. Section IV concludes.

II. A Model of Self-Selection into Teams

Before going into the details of the model, we need to define what we mean by “working on a team” vs. “working individually”. In our analysis, *working individually* refers to working on a given task without having to cooperate with colleagues to fulfill that task. The output of an employee working individually is assumed to be fully observable and to therefore serve as a basis for remuneration. In contrast, employees *working on a team* are required to interact with their teammates. Their individual output is assumed to be non-verifiable such that it cannot serve as a basis for compensation. Therefore, if an employer wants to create incentives for employees working on a team, he must pay them based on team output.

Because the degree of required interaction in a team context might influence a person's decision to work on a team rather than individually, we further distinguish between two different kinds of (team) tasks: “additive teamwork” on the one hand and “compensatory teamwork” on the other (see Steiner 1972 for a seminal classification of team tasks, Barrick et al. 1998: 379). In analyzing the self-selection decision, we distinguish between a situation in which an individual can decide between working individually and working on a team to complete an additive task or complete a compensatory task. While *additive tasks* are assumed to be separable into individually manageable subtasks such that team output is the sum of

individual amounts of output (see section II.A, Steiner 1972: 33), in *compensatory teamwork*, team members literally have to complete their task together (see also Milgrom and Roberts 1990: 516). In compensatory teamwork, hence, the delegation of subtasks to individual team members is not an option, and team output is determined by the average of individual amounts of output (see Steiner 1972: 34). Concerning the required interaction between team members, additive tasks demand relatively little interaction because once the subtasks have been delegated, each team member can work independently. A real-life example of such an additive task is the joint preparation of an image brochure with different authors each concentrating on a specific task but also crosschecking the others' writing and adding references into their texts. While the amount of required interaction in an additive task is negligible, teams confronted with a compensatory task truly need to constantly interact to accomplish that task. A real-life example is that of product development teams, which typically face compensatory tasks: in product development teams, there are representatives from different operating functions, such as production, marketing, and purchasing. To develop an innovative, realizable, and at the same time profitable product, all of them need to work together and interact intensively.

A. Model Assumptions

In the literature, a sorting decision is generally captured via a comparison of the expected levels of utility gained from the various alternatives (see for example Kosfeld and von Siemens 2007: 9). The decision-maker, as a rational being, will choose the alternative that grants the highest level of expected utility (see for example Lazear 2005: 653; Boschini and Sjögren 2007: 327). As is typical for self-selection models (see for example Dohmen and Falk 2006), we focus on the decision-makers' optimal decisions *given* a pre-described situation and do not derive a general equilibrium solution.

Like Grossman (2004), we assume that there are enough job vacancies of each type (vacancies for jobs working individually and for jobs working on a team) that any given individual has the option of choosing to work individually or on a team. As in Grossman (2004: 215), individuals are assumed to be risk-neutral¹ and heterogeneous concerning their

¹ In reality, of course, a typical employee will display risk aversion. Intuitively, however, it is not clear how much the assumption of risk aversion would change our results. On the one hand, joining a team might be favorable from a risk perspective because it would entail the opportunity for diversification, but on the other hand, it would expose the employee to additional risk that he does not face when working individually: the risk of being grouped together with teammates of low ability and/or who have a low capacity for teamwork. Interestingly, the two effects seem to cancel out: not only do our theoretical results remain qualitatively

talent.

Following the typical structure of self-selection models, a given individual bases his sorting decision on the utility expected from working on a team or individually. We assume that the expected utility of a given potential employee depends on (1) the income he expects to gain from working on a team or individually (which in turn will depend on the production function in question—i.e., the type of task to be performed) and (2) any non-pecuniary benefits from working alone or on a team (see Hamilton et al. 2003: 467, 469, 473; Kosfeld and von Siemens 2007: 8; Boschini and Sjögren 2007: 329 for non-pecuniary benefits of teamwork).

As a utility function for a risk-neutral individual, we use the simplest possible utility function of the following form:

$$u(Y, N) = Y + N \quad (1)$$

where Y represents the income and N the non-pecuniary benefits of working on a team. While we simply plug the non-pecuniary benefit² N as a variable into the utility function, income Y is modeled using a reward function $Y(\cdot)$ and a production function $f(\cdot)$. Specifically, we presume that the reward function takes the following form:

$$Y_j(\cdot) = fix_j + var_j \cdot f_j(\cdot) \quad \text{for } j \in \{I, A, C\} \quad (2)$$

where fix_j is a fixed payment and var_j is a variable payment based on individual output or, in case of teamwork, team output, $f_j(\cdot)$. The index j implies that, depending on whether we are considering income derived from working individually ($j=I$), income from working on a team with an additive task ($j=A$) or income from working on a team with a compensatory task ($j=C$), the parameters of the reward function can take different values.

The $1/n$ –remuneration typically applied in team contexts is reproduced in our model by

$$var_j = \frac{\alpha_j}{n} \quad \text{for } j \in \{I, A, C\}$$

Essentially, the output-based payment consists of a variable pay component α_j (with $\alpha_j \in]0,1]$) divided by the number of team members n .³

Because the variable pay component is based on output, we also need to specify the production function $f_j(\cdot)$. In our model, the specific form of the production function will depend on whether the employee works individually, on a team with an additive task or on a

unchanged if risk aversion is assumed, but additionally, from an empirical perspective, the decision to work individually or on a team is not affected by risk aversion.

² N is assumed to be a random variable with a normal distribution and a strictly positive expectation. When an individual is working individually, N is set to zero because N represents the non-pecuniary utility one gains from working in a team as compared to working individually.

³ In the case of individual work, this definition of the variable wage component also applies with the number of

team with a compensatory task.

For the sake of simplicity, we assume that the output of an individual working individually is given by:

$$f_I(\cdot) = q_n + \varepsilon_n + \eta \quad (3)$$

where q_n stands for the decision-maker's talent (or quality), ε_n is an individual error term (e.g., his health condition), and η is a common error term that represents a factor like the overall economic situation. Hence, like Lazear (2005), we abstract from an individual's effort choice. Interestingly, we are able to show that teamwork is less attractive to the highly talented even though we abstract from the potential problem of free-riding.

The variables of the decision-maker carry the index n because the decision-maker is always taken to be the n^{th} team member. Accordingly, q_i is the talent of team member i , and ε_i is the individual error term of team member i .

We assume that an individual knows his own talent q_n but neither the realization of his error terms nor the talents and realized error terms of his potential teammates (see Cooper, Dyck, and Frohlich 1992: 484). Thus, q_i , ε_i and η are assumed to be random variables. To simplify the calculations, the random variables are set up to be normally and independently distributed (see Breton et al. 2003: 879 for the same assumption),⁴ and each variable is identically distributed for all team members (see Irlenbusch and Ruchala 2008: 146). The expectations of the error terms are zero ($E[\varepsilon_i]=0$, $E[\eta]=0$), and the expected talent of teammate i is assumed to be strictly positive ($E[q_i]>0$).

When a person is working on a team, individual output is basically modeled as in equation (3). However, we introduce *capacity for teamwork* τ_i as an ability that is not directly task-related but is more like a social ability and therefore only influences output when one is working on a team (see Stevens and Campion 1999: 209, Hamilton et al. 2003: 467, Morgeson, Reider, and Campion 2005: 585). Capacity for teamwork is defined here as the ability to apply one's task-related abilities to what the team has to accomplish (see Miller 2001: 751; Scarnati 2001: 6). Therefore, we multiplicatively link talent and capacity for teamwork leading to the following individual output from work on a team: $(\tau_n + \delta_n) \cdot (q_n + \varepsilon_n) + \eta$, where τ_n is the capacity for teamwork that is known to the decision-maker, and δ_n is the decision-maker's error term regarding his own capacity for teamwork when

team members set to $n=1$.

⁴ For simplicity's sake, it is also presumed that the random variables and the non-pecuniary benefit of working on a team, N , are not correlated.

working on an unknown team. While τ_n is a non-stochastic variable,⁵ δ_n is a random variable with an expectation of zero ($E[\delta_n]=0$) that is assumed to be independent of all the other random terms in the model.

The two kinds of team tasks mentioned above—additive and compensatory—are accounted for by different production functions (see Steiner 1972: 16). The team production function for an *additive task* is modeled through an additive production function of the form

$$f_A(\cdot) = (\tau_n + \delta_n)(q_n + \varepsilon_n) + \sum_{i=1}^{n-1} ((\tau_i + \delta_i)(q_i + \varepsilon_i)) + n \cdot \eta$$

where $(\tau_i + \delta_i) \cdot (q_i + \varepsilon_i) + \eta$ is the uncertain output of team member i . The team output in teams with an additive task thus equals the sum of n individual outputs, with n being the team size.

For work on a team with a *compensatory task*, we let that team's production function take the shape of a Cobb-Douglas production function:

$$f_C(\cdot) = ((\tau_n + \delta_n)(q_n + \varepsilon_n))^{\frac{1}{n}} \cdot \prod_{i=1}^{n-1} ((\tau_i + \delta_i)(q_i + \varepsilon_i))^{\frac{1}{n}} + \eta.$$

By setting the exponent of each factor in the production function equal to $1/n$, we implicitly assume that each team member is equally important to the team's output (for an equivalent assumption, see Chiang and Wainwright 2005: 388). As a result, for the compensatory task, the team output equals the geometric mean of individual outputs.⁶

When looking at the two team production functions above, one sees that the degree of interaction between team members is higher in the Cobb-Douglas production function, where team members' outputs are linked multiplicatively such that the output of one team member influences the output of another team member.

B. Expected Utilities

Based on the model's assumptions, we can now calculate the expected utilities of working individually and working on a team with either an additive or a compensatory task. Through a comparison of the expected utility levels, in the next step, the sorting decision for a given

⁵ However, τ_i is unknown to the decision-maker and is therefore stochastic. We assume a normal distribution with $E[\tau_i] \in]0; 2]$ such that a person's expected capacity for teamwork can be so high that the team might profit from this capacity ($E[\tau_i] > 1$), but at the same time so low that it might be detrimental to team output ($E[\tau_i] < 1$).

⁶ This interpretation has to be distinguished from that of Kremer (1993) who also uses a Cobb-Douglas production function but where the factors that represent workers enter into the function with an exponent of one. Given this specification, combined with the fact that factors representing workers can only take values within the interval of $[0, 1]$, in Kremer's world it is the "weakest link" that dominates team output.

individual can be derived.

We calculate the *expected utility of working individually* by plugging the individual production function (3) into the reward function (2), inserting the latter into the utility function (1), and calculating the expectation for the resulting term:

$$E[u(Y_I)] = E[fix_I + var_I \cdot (q_n + \varepsilon_n + \eta)].$$

This equation translates into

$$E[u(Y_I)] = fix_I + var_I \cdot q_n.$$

Analogously, we calculate the *expected utility of working on a team with an additive task* for an arbitrary individual with talent q_n (see appendix A):

$$\begin{aligned} E[u(Y_A, N)] &= E \left[fix_A + var_A \cdot \left((\tau_n + \delta_n) \cdot (q_n + \varepsilon_n) + \sum_{i=1}^{n-1} ((\tau_i + \delta_i) \cdot (q_i + \varepsilon_i)) + n \cdot \eta \right) + N \right] \\ &= fix_A + var_A \cdot (\tau_n \cdot q_n + (n-1) \cdot E[\tau_i] \cdot E[q_i]) + E[N]. \end{aligned}$$

Given the multiplicative form of the Cobb-Douglas production function, deriving the *expected utility of working on a team with a compensatory task* is more difficult. Via approximation (see appendix A), we obtain the following:

$$\begin{aligned} E \left[fix_C + var_C \cdot \left(((\tau_n + \delta_n) \cdot (q_n + \varepsilon_n))^{\frac{1}{n}} \cdot \prod_{i=1}^{n-1} ((\tau_i + \delta_i) \cdot (q_i + \varepsilon_i))^{\frac{1}{n}} + n \cdot \eta \right) + N \right] \\ = fix_C + var_C \cdot \tau_n^{\frac{1}{n}} \\ \cdot \left(1 + \frac{\sigma_{\delta_n} \sqrt{2}}{\sqrt{\pi n} \tau_n} + \frac{\left(\frac{1}{n} - 1\right) \sigma_{\delta_n}^2}{2n \tau_n^2} + \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_{\delta_n}^3}{3\sqrt{\pi n} \tau_n^3} \right) \cdot q_n^{\frac{1}{n}} \\ \cdot \left(1 + \frac{\sigma_{\varepsilon_n} \sqrt{2}}{\sqrt{\pi n} q_n} + \frac{\left(\frac{1}{n} - 1\right) \sigma_{\varepsilon_n}^2}{2n q_n^2} + \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_{\varepsilon_n}^3}{3\sqrt{\pi n} q_n^3} \right) \\ \cdot \left(E[\tau_i]^{\frac{1}{n}} \cdot \left(1 + \frac{\sigma_{\tau_i + \delta_n} \sqrt{2}}{\sqrt{\pi n} E[\tau_i]} + \frac{\left(\frac{1}{n} - 1\right) \sigma_{\tau_i + \delta_n}^2}{2n E[\tau_i]^2} + \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_{\tau_i + \delta_n}^3}{3\sqrt{\pi n} E[\tau_i]^3} \right) \right. \\ \cdot E[q_i]^{\frac{1}{n}} \\ \cdot \left. \left(1 + \frac{\sigma_{q_i + \varepsilon_i} \sqrt{2}}{\sqrt{\pi n} E[q_i]} + \frac{\left(\frac{1}{n} - 1\right) \sigma_{q_i + \varepsilon_i}^2}{2n E[q_i]^2} + \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_{q_i + \varepsilon_i}^3}{3\sqrt{\pi n} E[q_i]^3} \right) \right)^{n-1} \\ + E[N]. \end{aligned}$$

C. Implications: The Sorting Decision

Given the general form of the expected utility of working individually, on a team with an additive task or a compensatory task, we can now compare the expected utility for any individual—i.e., any values of the personal variables in the model, such as talent, capacity for teamwork, and non-pecuniary benefits—and deduce the individual's self-selection decision. In a first step, we look at whether (all other things being equal) more talented individuals tend to select teamwork or individual work. The model result gives us a preliminary indication of whether it is indeed the less talented who sort into teams.

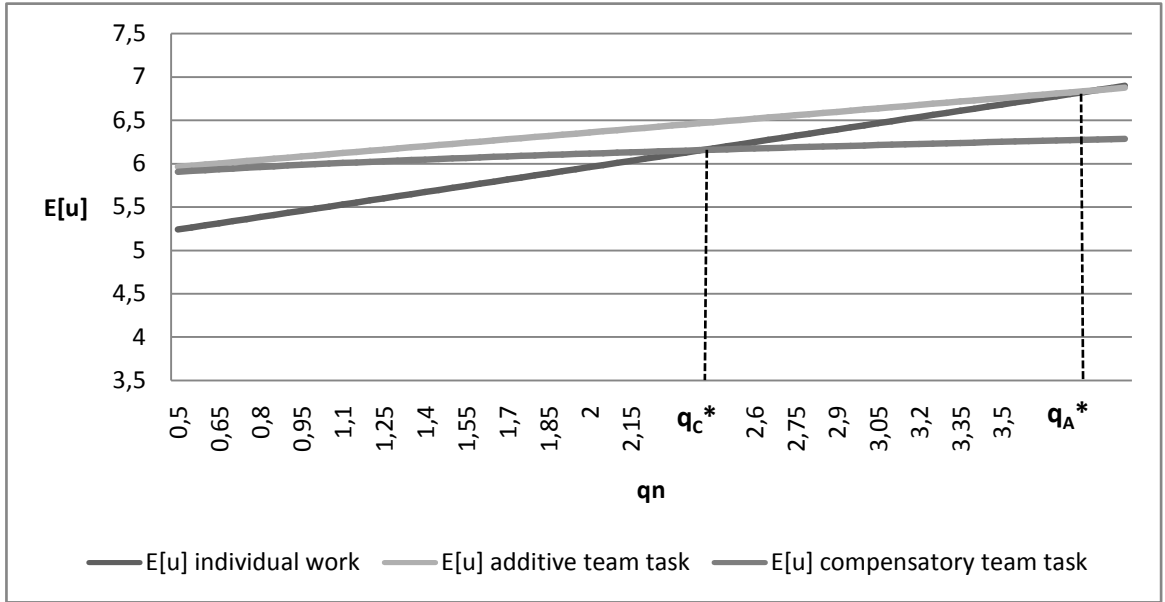


Fig. 1. – Expected Utilities for Different Values of q_n

By making equal the expected utility of working individually and that of working on a team (with either an additive or a compensatory task) and solving for the talent of the decision maker q_n , we calculate the critical talent level q^* of the individual considered.⁷ This critical talent level indicates the level of talent at which the individual will not have a preference regarding working individually versus working on a team. Figure 1 shows the expected utility for different values of talent q_n and the critical talent levels q^* for comparing working individually with working on a team with an additive task (q_A^*), and with working on a team with a compensatory task (q_C^*).⁸

⁷ It should be noted that there is only a closed form solution for the critical talent level given an additive task. For the compensatory task, the results must be simulated, and the critical talent level must be determined graphically (see figure 1). The parameter values used for the simulation are as follows: $fix_{I,A,C} = 5$; $\alpha_{I,A,C} = 0.48$; $n = 2$; $r = 0.1$; $\tau_{n,A} = 1.1$; $\tau_{n,C} = 1.2$; $E[\tau_i] = 1.5$; $E[q_i]_A = 0.53$; $E[q_i]_C = 0.47$; $E[N]_A = 0.64$; $E[N]_C = 0.68$; $Var(\varepsilon_i) = 0.01$; $Var(\delta_i) = 0.01$; $Var(\tau_i) = 0.08$; $Var(q_i) = 0.02$.

⁸ Note that we only look at sorting between working individually and working on a team, not between different task types.

From figure 1, it is obvious that if an individual has a talent q_n over and above the particular critical talent level, the individual will ceteris paribus choose to work individually rather than on a team because his expected utility from working individually will exceed that from working on a team.⁹ This observation leads us to the following hypothesis:

Hypothesis 1: *The lower a person's talent, the more likely he will be to select teamwork.*

While *Hypothesis 1* mirrors the theoretical results in the literature (especially Grossman 2004), additional potential determinants that might influence the sorting decision and hence might compensate for the adverse effect of talent have not been considered in the literature so far. In the following, we look at task type, capacity for teamwork, expectations regarding potential teammates, and non-pecuniary benefits of teamwork as potential further determinants of the self-selection decision.

Figure 1 shows that the critical talent level for the additive team task is higher than that for the compensatory team task given the same reward parameters. This relationship between the two critical talent levels translates into a higher probability of working on a team when given an additive task, which leads us to hypothesize as follows:

Hypothesis 2: *Faced with an additive task, an employee is more likely to choose teamwork than when faced with a compensatory task.*

In addition to answering the question of who is attracted to team incentives in terms of employee talent and which is the more attractive (team) task for employees with different talent levels, the model also allows us to look at the effects that the other model parameters have on the sorting decision. One way to calculate these effects on the sorting decision is to first determine the critical talent level—i.e., the talent level that makes an individual indifferent to the choice between working individually and working on an additive or a compensatory team—and then to differentiate this critical talent level with respect to the model parameters considered. If the derivative is greater than zero, an increase in the parameter in question will ceteris paribus raise the critical talent level and thereby increase the probability that the individual being considered will select teamwork. In terms of figure 1, an increase in the expected utility level of either form of teamwork is equal to a shift of the

⁹ Here we abstract from a possible process of adverse selection due to decision makers' downward adjustment of their expectation regarding the talent of potential teammates $E[q_i]$. Accounting for a process of downward adjustment will typically strengthen our theoretical result that individuals joining a team will in general be of lower ability than those who choose to work individually.

critical talent level to the right, which results in more values for q_n lying below the critical talent level. In essence, the probability of an individual's displaying a level of talent below his individual critical talent level increases.

Table 1 displays the results that we obtain by differentiating the critical talent levels q_A^* and q_C^* with respect to the four model parameters capturing personal characteristics (other than talent) and individual expectations concerning potential teammates. The two columns on the right hold a “+”, if the derivation of the critical talent level with respect to the considered model parameter is positive—i.e., a higher value of the parameter leads ceteris paribus to a higher probability of an individual's selecting teamwork.¹⁰ The results are valuable if one wants to know what kind of employee decides to work on a team and which factors could potentially compensate for a negative effect of talent on sorting into teams.

Table 1
Derivations of Critical Talent Levels with Respect to Model Parameters x

model parameter x	$\frac{\partial q_A^*}{\partial x} > 0$	$\frac{\partial q_C^*}{\partial x} > 0$
τ_n : capacity for teamwork	+	+
$E[q_i]$: expected talent of potential teammates	+	+
$E[\tau_i]$: expected capacity for teamwork of potential teammates	+	+
$E[N]$: expected non-pecuniary benefit from working on a team	+	+

We first look at the effect of capacity for teamwork on the sorting decision. Because capacity for teamwork is only of use when one is working on a team, the positive derivative displayed in table 1, which implies that a person with a higher capacity for teamwork is more likely to select teamwork, is intuitively plausible.

***Hypothesis 3:** The greater a person's teamwork skills, the more likely he will be to select teamwork.*

When having to decide whether to work on a team or alone, one can also take into account how “good” one's coworkers are because their talent influences team output to a great extent. According to table 1, working with “better” teammates is more attractive than working with average or below-average coworkers (see also Boschini and Sjögren 2007: 326). Hence,

¹⁰ However, for the compensatory task, a closed form for the critical talent level cannot be determined. Therefore, we simulated the results using reasonable parameter combinations that we gained from our experiment. The formally derived results for the additive critical talent level are unambiguous as long as

hypothesis 4 reads as follows:

Hypothesis 4: *The greater a person's expectation of his potential teammates' talent, the more likely he will be to select teamwork.*

The same argumentation holds when one considers the capacity for teamwork of one's potential coworkers. If these individuals are expected to have a greater capacity for teamwork, team output will also be higher. Therefore, in accordance to the “+” in table 1, we pose the following hypothesis:

Hypothesis 5: *The higher a person's expectations regarding his potential teammates' capacity for teamwork, the more likely he will be to select teamwork.*

The non-pecuniary benefit of working on a team also plays a role in the sorting decision. The “+” in table 1 for the expected non-pecuniary benefit $E[N]$ translates into a higher probability of choosing teamwork for high values of $E[N]$ because that means that one enjoys working with others. The corresponding hypothesis is:

Hypothesis 6: *The greater a person's expected non-pecuniary benefit from working on a team, the more likely he will be select teamwork.*

In the following section, we present empirical evidence from a real-task experiment to test the derived hypotheses.

III. Self-Selection into Teams: Experimental Evidence

A. Experimental Design and Procedures

To test the above-mentioned hypotheses, we conducted a real-task experiment in which participants had to decide whether they wanted to answer a quiz individually or in teams given that they would be paid according to their individual output when working individually and receive compensation based on an equal share of the team output when working on teams. Participants were recruited via a university-wide email: 99 students from different faculties, predominantly economics and business administration (N=17), German language and literature (N=10), psychology (N=9), educational science (N=7), and rhetoric (N=7) participated. Every student attended one of three sessions that lasted about one hour. Average pay was €8.94. In two of the three sessions, students were required to work on a compensatory task, and in the remaining session, students were assigned a task of an additive nature. The *additive task* was mapped by confronting participants with mathematical

$var_{C,A} \cdot \tau_n < var_I$ and for the derivation after τ_n as long as $fix_A - fix_I \geq 0$.

statements such as: " $4 \times 33 = 112 \rightarrow$ True or False?" This approach was chosen because only one kind of ability and, moreover, ability at only a rather basic level (basic mathematics) was needed to solve the problems. Therefore, each team member in principle should have been able to answer most of the questions (see Steiner 1972: 33). On this basis, if teamwork was chosen, participants were in a position to divide the statements among the team members and let each team member judge the validity of the statements individually.

In order to simulate a *compensatory task*, we confronted participants with a broad spectrum of knowledge-based statements that were not as easily dividable among team members because every statement required different kinds of abilities and different knowledge, so that the best chance of maximizing the number of correct answers was to jointly judge the statements.¹¹ An example of such a knowledge-based statement is: "Donald Duck is an only child. \rightarrow True or False?"¹²

Each session was structured as follows:

1. **Instructions:** Students received written instructions (see appendix B) on the procedure of the experiment and the compensation details. If there were any questions, they were answered in front of the whole group.
2. **First task-processing phase (seven minutes):** According to the particular treatment, participants were given 29 (compensatory task) or 40 (additive task) statements that they had to judge individually as "true" or "false". If they answered correctly, they received one point; if they answered incorrectly, one point was subtracted.¹³ Even though there was no general compensation for points earned during this first task-processing phase, participants knew that at the end of the experiment, three randomly drawn participants would also be paid for points earned during that phase (see step 7: "Compensation" for payment details).
3. **Sorting decision:** Immediately after the first task-processing phase, students were asked how they wanted to work in the second task-processing phase, in which they knew they would be confronted with exactly the same statements as in the first task-processing phase, plus an equal number of additional statements at the same level of difficulty.

¹¹ This mapping of the compensatory task focuses on the interdependence of team members as its main characteristic. However, the Cobb-Douglas production function (see section II.A) is not exactly captured by the experimental setting because the team output in the experiment would not necessarily be zero if one of the team members did not contribute to team output.

¹² The knowledge-based statements were taken from the parlor game "Cranium".

¹³ However, if a person received a negative number of total points, the sum was set to zero.

Knowing that they would be rewarded for the points they earned in the second phase, participants were asked to decide between (1) working individually, (2) working on a team with one other person or (3) working on a team with three other people.¹⁴

4. **Questionnaire 1:** While we randomly matched participants who had opted for teamwork, all participants had to fill out a questionnaire regarding their assessment of their own talent and their capacity for teamwork as well as their expectations regarding the talent and capacity for teamwork of their potential teammates (for these questions, see appendix B). As a measure of the non-pecuniary benefits (N) of working on a team, the items of the Neo-Five-Factor Inventory by Borkenau and Ostendorf (1993) concerning extraversion were also added to the questionnaire.
5. **Second task-processing phase (15 minutes):** Again, according to the particular treatment, participants received 58 (compensatory task) or 80 (additive task) statements when working individually. When they were working on a team, the amount of statements for the team remained at 58 for the compensatory task but increased by 80 per team member for the additive task to allow for the division of tasks among team members. Furthermore, it is in the nature of additive tasks that teams produce a higher *quantity* than do individuals, but it is typical of compensatory tasks that teams can improve the *quality* of the outcome over that achieved by individuals, while the quantity remains the same. As in the first task processing phase, students had to judge the statements as “true” or “false” and received one point per correct answer while losing one point for each incorrect answer.
6. **Questionnaire 2:** While the answers from the second phase were analyzed and points were calculated, participants completed a second questionnaire regarding their risk attitude and personal data—e.g., data regarding gender or age (questions see appendix B).
7. **Compensation:** Students received a participation reward of €5.00 plus variable pay depending on the points earned in the second task-processing phase. When an individual was working on a team, the points the team earned were divided by the number of team members, and each team member was rewarded according to his share of points. For the additive task, students received €0.12 per point, and for the compensatory task, they received €0.30 per point. This was because fewer statements were given and thus, fewer

¹⁴ In this article, however, we do not discuss the decision-making process involved in sorting people into teams of different sizes. In our sample, only fourteen people chose to work in the large, four-person team; thus, our sample size was too small for an analysis of team size.

points were possible.¹⁵

B. Results

Descriptives and Univariate Statistics

Hypothesis 1 refers to the impact of a person's talent on his sorting decision. Talent in the experiment was measured (1) by the points earned in the first task-processing phase as an objective measure and (2) via a self-assessment following the first task-processing phase. As to the self-assessment, participants were asked to estimate the amount of points they had achieved in the first task-processing phase. While for the sorting decision, the latter, subjective measure of talent should be pivotal, employers will of course be interested in the former—i.e., objective talent. However, in our data, the actual points earned and the self-assessment by participants were strongly and positively correlated at the one-percent significance level ($r=0.5$). In what follows, we concentrate on the subjective self-assessment of talent by participants because the decision to work either individually or on a team will essentially be formed by what people believe they can accomplish individually or on a team and not as much by their “true” and potentially unknown talent.

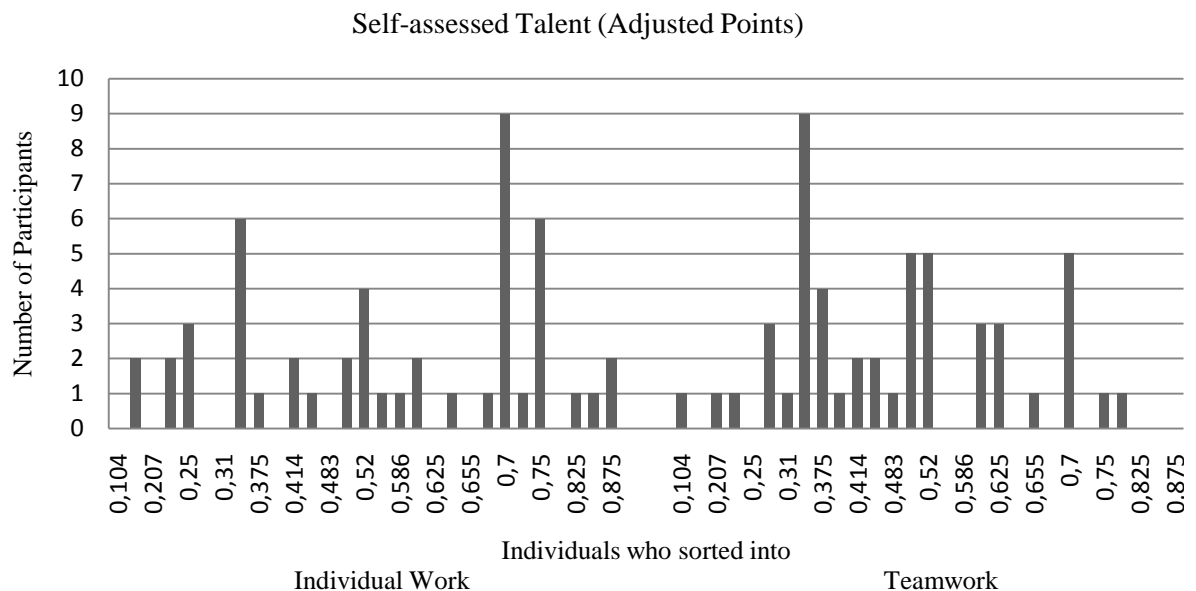


Fig. 2. – Decision Maker's Self-assessed Talent by Sorting Decision

Figure 2 shows the self-assessment of talent for those participants who chose to work individually (left) and for those who chose to work on a team (right). A Mann-Whitney U test shows that the distributions of self-assessed talent are significantly different at the five-

¹⁵ Recall that the participants could not choose between task types because the task type was predetermined in each session beforehand.

percent level between those participants who chose individual work and those who chose teamwork. In support of hypothesis 1, a t-test shows at a five-percent significance level that participants who chose individual work (rightfully) believe that they have received more points in the first phase than those who chose teamwork.

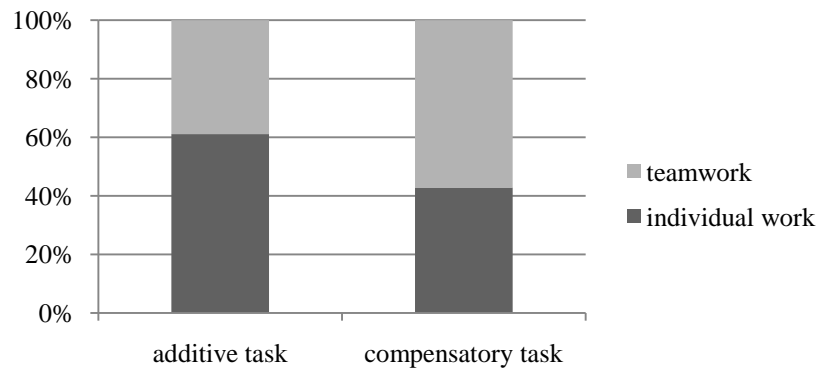


Fig. 3. – Sorting Decision by Task Type

Hypothesis 2 proposes that an individual is more likely to choose teamwork when faced with an additive task than when faced with a compensatory task. However, when looking at the empirical data displayed in figure 3, the opposite seems to be true: When confronted with an additive task, 39 percent of the participants chose teamwork, and 57 percent chose to work on a team when being confronted with a compensatory task.

Concerning *hypothesis 3*, every participant was asked to judge his own capacity for teamwork on a seven point Likert scale from low (=1) to high (=7) (in questionnaire 1). Figure 4 shows the self-assessment of capacity for teamwork for participants who sorted into individual work (left) and teamwork (right). We ran a t-test to compare the mean capacity for teamwork between those individuals who decided to work individually and those who opted for teamwork. Supporting *hypothesis 3*, at a one-percent significance level, participants who decided for individual work assessed themselves to have a lower capacity for teamwork than those who decided for teamwork. Accordingly, a Mann-Whitney U test also allows us to reject the hypothesis of equal distributions of capacity for teamwork at the five-percent level.

Apart from a person's own talent and capacity for teamwork, potential teammates' talent and capacity for teamwork is expected to influence an individual's sorting decision (*hypotheses 4 and 5*). Figure 5 illustrates how participants who sorted into individual work (left) or teamwork (right) evaluate their potential teammates in terms of talent (points achieved during the first phase). Again, we use a t-test and a Mann-Whitney U test to analyze whether there

are significant differences in expectations concerning potential teammates for those who decide in favor of teamwork versus those who decide against it.

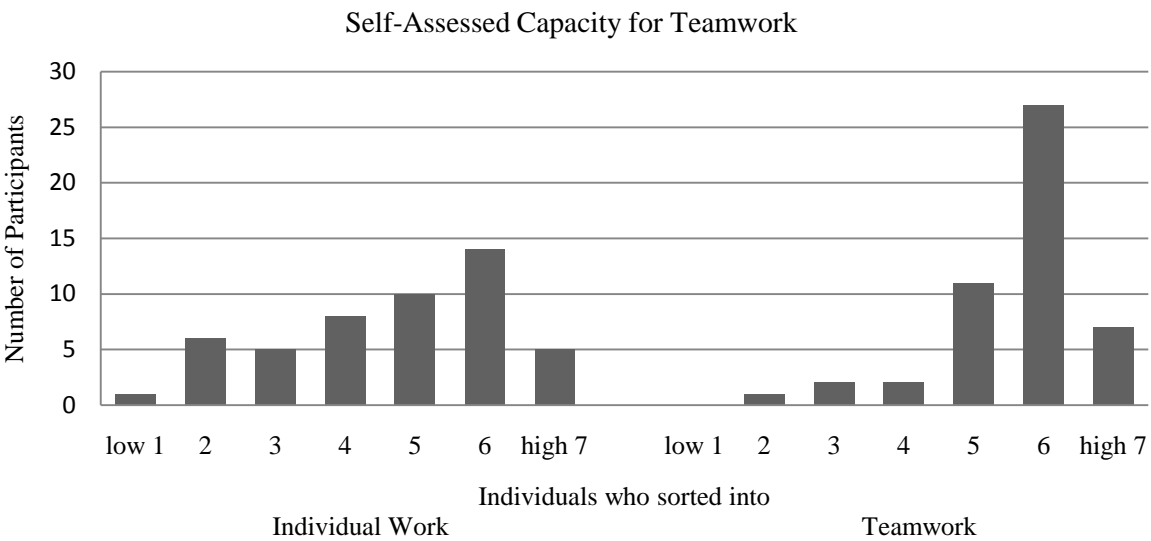


Fig. 4. – Decision Maker’s Self-assessed Capacity for Teamwork by Sorting Decision

We find that, contrary to our expectations (*hypothesis 4*), there is no significant difference between those who decided for individual work and those who opted for teamwork regarding their assessment of potential teammates’ talent.

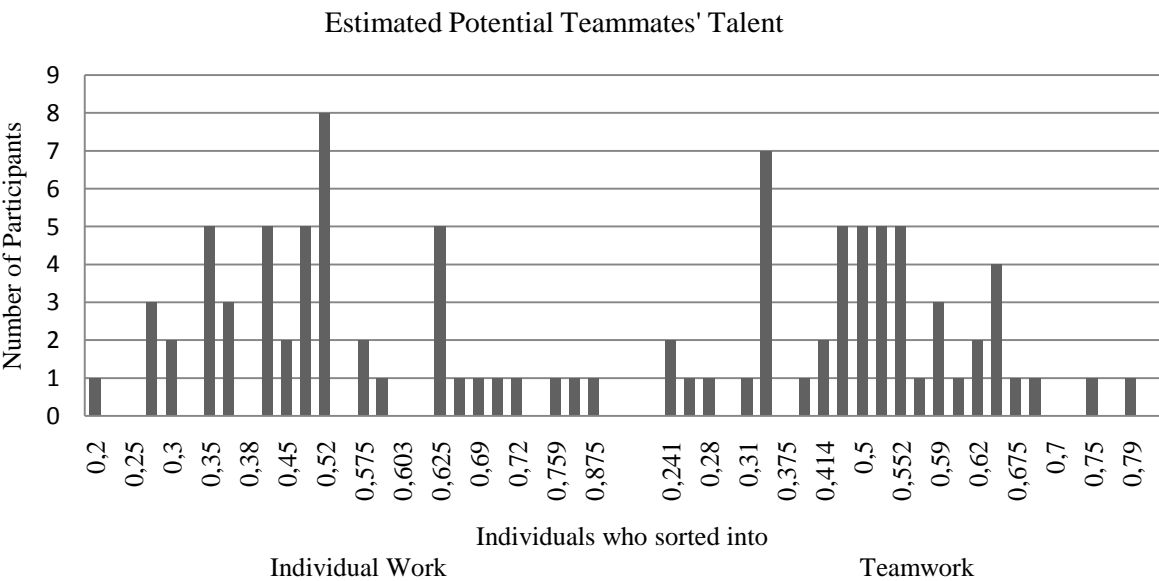


Fig. 5 – Estimated Potential Teammates’ Talent by Sorting Decision

Concerning the impact of the estimated capacity for teamwork of potential teammates on the sorting decision (*hypothesis 5*), using a t-test, we again do not find a difference between individuals who chose individual work and those that opted for teamwork. However, a Mann-Whitney U test implies a different distribution at the ten-percent significance level. Figure 6 displays the empirical results for participants who selected individual work (left) and teamwork (right).

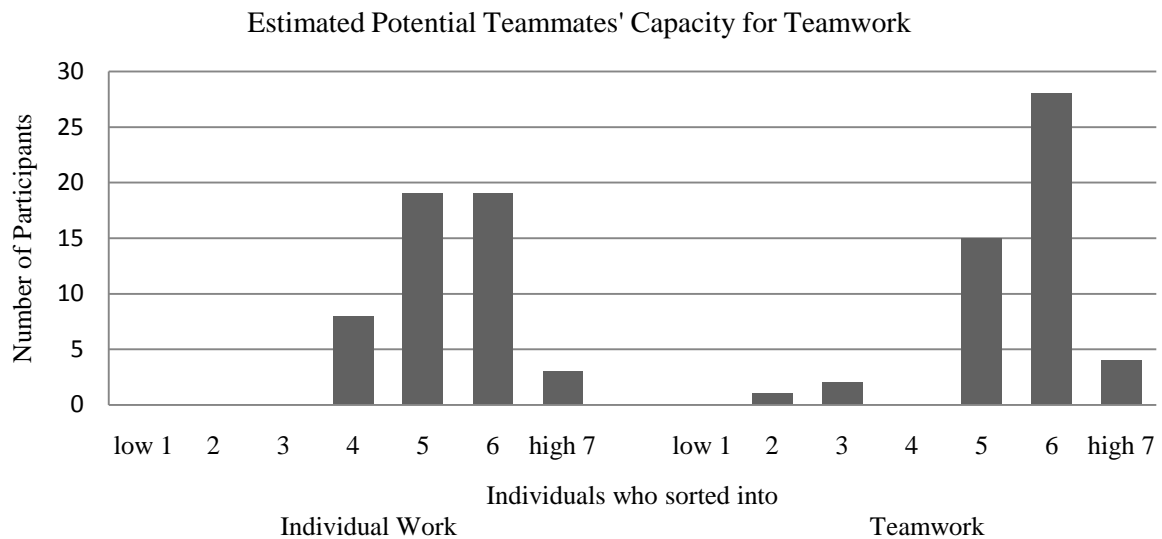


Fig. 6. – Estimated Potential Teammates' Capacity for Teamwork by Sorting Decision

Hypothesis 6 claims that the higher a person's expected non-pecuniary benefits from working on a team, the more likely he will be to sort into teamwork. We measured the non-pecuniary benefits a person gains from working on a team by means of the personality trait of extraversion because extraversion is a measure of sociability (see Borkenau and Ostendorf 1993: 28; Morgeson et al. 2005: 588). We concluded that a social person would enjoy being with other people and therefore would reap significant non-pecuniary benefits from working on a team. Extraversion was measured using the items of the NEO-Five-Factor Inventory by Borkenau and Ostendorf (1993). Figure 7 displays the empirical distributions of extraversion for participants who selected individual work (left) and teamwork (right). Supporting *hypothesis 6*, a t-test shows that at the one-percent significance level, people who selected teamwork have a higher level of extraversion than do those who chose individual work. This result is supported by a Mann-Whitney U test.

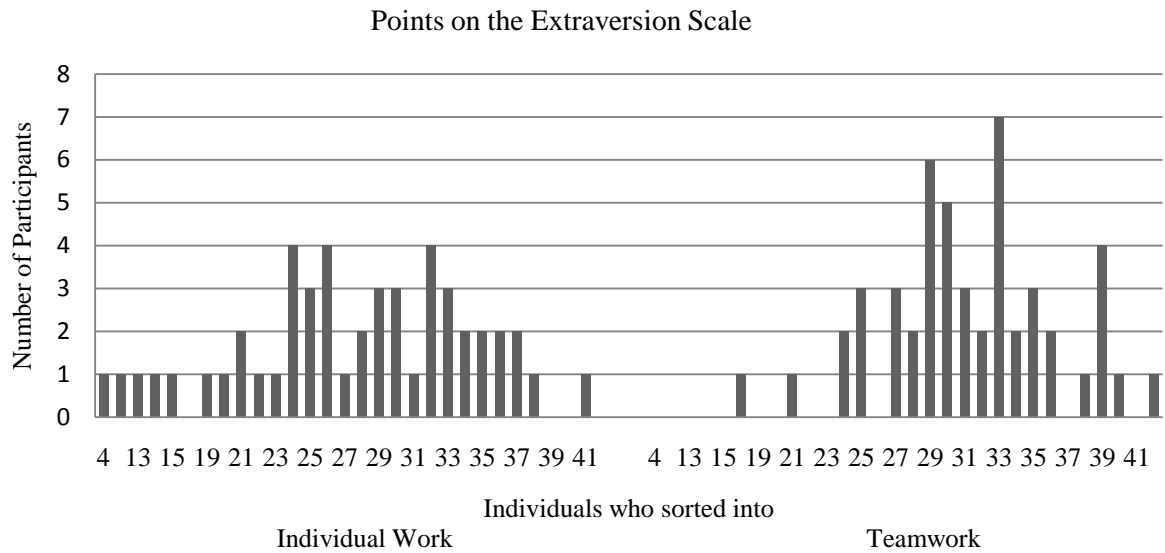


Fig. 7. – Decision Maker’s Extraversion by Sorting Decision

Logistic Regression Results

To test the validity of our hypotheses, we ran a logistic regression with the dependent variable “opting for teamwork”, which takes the value of zero if the person chooses to work individually and the value of one if he self-selects into teamwork. Apart from the discussed variables (e.g., talent, capacity for teamwork, task type), we also control for risk attitude¹⁶, nationality, age, and gender. To avoid problems of multi-collinearity, extraversion is not included as an explanatory variable because a correlation check shows a high positive correlation of 0.63 with another explanatory variable (self-assessed capacity for teamwork) that is significant at the one-percent level. Hence, hypothesis 6 cannot be tested in the logistic regression. Table 2 shows the results of our analysis. As goodness of fit measures, the probability for obtaining the same empirical observations without any relation of the explanatory variables to the dependent variable is low (at 0.0002), and the likelihood ratio of 31.69 substantially exceeds the X^2 reference value of 23.59, given nine degrees of freedom and a significance level α of 0.005.

Table 2 displays the estimated marginal effects of the parameters. A positive marginal effect signifies that (at the significance level given) an individual with a higher corresponding parameter has a higher probability of choosing teamwork.

¹⁶ Risk attitude was measured using a standard lottery question (for examples, see Dohmen et al. 2005: 33).

Table 2
The Marginal Effects on Sorting into Teams

Sorting Decision (1 = teamwork)	dy/dx
Self-assessed Talent: q_n	-1.56*** (0.55)
Task Type (1= additive, 2=compensatory)	0.14 (0.14)
Capacity for teamwork: τ_n	0.14*** (0.05)
Talent of potential teammates: $E[q_i]$	1.79*** (0.68)
Capacity for teamwork of potential teammates: $E[\tau_i]$	0.00 (0.07)
Risk-proclivity	-0.00 (0.02)
German (0=no, 1=yes)	0.39*** (0.14)
Age	0.02 (0.02)
Gender (0 = female, 1= male)	-0.10 (0.14)
Observations: 98	
LR $\chi^2(9) = 31.69$	
Prob > $\chi^2 = 0.0002$	
Pseudo R^2 : 0.23	

NOTE. – Standard errors are in parentheses.

* p-values <0.1.

** p-values <0.05.

*** p-values < 0.01.

Supporting *hypothesis 1*, the empirically estimated marginal effect for a person's self-assessed talent level is -1.56, implying that a person with a higher talent level (as measured by the amount of points that the individual expects to have earned in the first task-processing phase) is less likely to choose teamwork. If a person estimates his talent to be one point higher, the likelihood of his selecting teamwork decreases by 0.04 for the additive task and by 0.05 for the compensatory task.¹⁷ The marginal effect is significant at the one-percent level.

¹⁷ Concerning the marginal effects of -0.04 and -0.05, it is necessary to recall that self-assessed talent is measured as the expected number of points earned in the first task-processing phase. Because (depending on task type) the maximum number of possible points varied, self-assessed talent was normalized via the maximum number of possible points, and thus, the displayed marginal effects need to be divided by 40 (the maximum for the additive task) and 29 (the maximum for the compensatory task), respectively.

We find no significant effect of task type on the sorting decision. Thus, contrary to *hypothesis 2*, our data do not imply that teamwork is more attractive under an additive task.

Concerning *hypotheses 3* and *4*, both the coefficient of the talent of potential teammates and the coefficient of an individual's teamwork skills are significant at the one-percent level. As supposed in *hypotheses 3* and *4*, both variables have a positive coefficient, which translates into a higher probability of choosing teamwork for individuals with a higher capacity for teamwork and/or with higher expectations about potential teammates' talent. If a person judges his capacity for teamwork to be one point higher on the seven-point Likert scale, the probability that he will choose teamwork rises by 0.14; if his expectations regarding potential teammates' talent increase by one point, the likelihood of his choosing teamwork increases by 0.05 (additive teamwork) or by 0.06 (compensatory teamwork).¹⁸

The coefficient for the expectation about teammates' capacity for teamwork (*hypothesis 5*) is not significant. Apparently, when deciding whether to work on a team or individually, unlike as predicted by *hypothesis 5*, participants did not take into account whether they considered their potential teammates to be team players. One reason for this result could be that participants did not judge capacity for teamwork to be a productive factor; rather, it was seen as a factor increasing the utility of teamwork for the person in question (i.e., one's own capacity for teamwork would influence the sorting decision but not the one regarding potential teammates). Furthermore, this result might also be explained by the low variance in expectations about teammates' capacity for teamwork (see figure 6).

Concerning the control variables, we can see that once we control for self-assessed talent, individual capacity for teamwork, and expectations regarding the talent and teamwork skills of potential teammates, a person's risk attitude, gender, and age do not affect the sorting decision. However, nationality ("being a German: yes or no") is highly significantly correlated with the probability of opting for teamwork. All else being equal, non-Germans are less likely to choose teamwork than are Germans. Because the non-Germans in our sample were taken from such culturally different countries as Bulgaria, China, Colombia, Japan, Poland, and Russia, we conclude that this is not a culture effect but only a language effect: participants knew that, when selecting teamwork, they would have to interact with other people in German and might have preferred to work individually because of poor language skills (basic skills, however, were assured).

¹⁸ To calculate these marginal effects, the same considerations and calculations were applied as with self-

IV. Conclusions

This article sheds light on the trade-off between implementing teamwork (and team-based compensation) and recruiting the best employees. Without explicitly modeling the self-selection process, the theoretical literature reaches a consensus regarding a negative effect of talent on sorting into teams. However, the empirical results presented in the literature so far are inconsistent. One reason for the contrary empirical results could be that additional factors, like task type or capacity for teamwork, have not been accounted for in the studies in question. With our experimental design, we set out to remedy this shortcoming of the literature and attempt to provide firms with some guidance as to what kind of employee (when confronted with what kind of task) will select teamwork. We analytically show that employees of above-average talent will generally be discouraged from applying for a job offering teamwork (i.e., selecting a team) because they will fear that they may earn less than they otherwise could. However, this negative effect of talent might in practice be compensated for—e.g., by the positive effects of capacity for teamwork or other personal characteristics.

Essentially, the data support our hypotheses regarding a negative correlation between self-assessed talent and the probability of choosing teamwork, a positive correlation between self-assessed teamwork skills and the probability of choosing teamwork, and a positive correlation between the expected talent of potential teammates and the probability of choosing teamwork. Contrary to what was theoretically expected, we find neither a significant correlation between task type and self-selection into teamwork nor a significant correlation between the expected capacity for teamwork of potential teammates and the probability of one's choosing teamwork for oneself. Thus, we do find the theoretically predicted negative relation between talent and the likelihood of sorting into teams, and we also uncover the significant influence of other personal characteristics that could, at least in principle, compensate for the effect of talent: a highly talented employee might choose to join a team due to a high capacity for teamwork or to high expectations regarding the talent and/or capacity for teamwork of potential teammates. Based on our results, when mandating teamwork and at the same time aiming to attract above-average employees, employers should attempt to raise potential employees' expectations about potential teammates' level of talent by, for example, building up a general reputation for attracting high-quality personnel.

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Appendix A - Calculation of Expected Utilities

Calculation of the expected utility of working on a team with an additive task for a given individual:

$$\begin{aligned} E[u(Y_A, N)] &= E \left[fix_A + var_A \cdot \left((\tau_n + \delta_n) \cdot (q_n + \varepsilon_n) + \sum_{i=1}^{n-1} ((\tau_i + \delta_i) \cdot (q_i + \varepsilon_i)) + n \cdot \varsigma \right) + N \right] \\ &= fix_A + var_A \cdot (\tau_n \cdot q_n + (n-1) \cdot E[\tau_i] \cdot E[q_i]) + E[N]^{19} \end{aligned}$$

Calculation of the expected utility of working on a team with a compensatory task for a given individual:

$$\begin{aligned} E \left[fix_C + var_C \cdot \left(((\tau_n + \delta_n) \cdot (q_n + \varepsilon_n))^{\frac{1}{n}} \cdot \prod_{i=1}^{n-1} ((\tau_i + \delta_i) \cdot (q_i + \varepsilon_i))^{\frac{1}{n}} + \eta \right) + N \right] \\ = fix_C + var_C \cdot E \left[((\tau_n + \delta_n) \cdot (q_n + \varepsilon_n))^{\frac{1}{n}} \right] \cdot E \left[((\tau_i + \delta_i) \cdot (q_i + \varepsilon_i))^{\frac{1}{n}} \right]^{n-1} \\ + E[N] \\ = fix_C + var_C \cdot E \left[(\tau_n + \delta_n)^{\frac{1}{n}} \right] \cdot E \left[(q_n + \varepsilon_n)^{\frac{1}{n}} \right] \\ \cdot \left(E \left[(\tau_i + \delta_i)^{\frac{1}{n}} \right] \cdot E \left[(q_i + \varepsilon_i)^{\frac{1}{n}} \right] \right)^{n-1} + E[N] \end{aligned}$$

Exemplary approximation of the first moment (= expectation) of $(\tau_i + \delta_i)^{\frac{1}{n}}$ given that $Y := (\tau_i + \delta_i) \sim \mathbb{N}(\mu_1 = E[\tau_i], \sigma_1^2 = Var(\tau_i) + Var(\delta_i)^{20})$.

$$\begin{aligned} E \left[(\tau_i + \delta_i)^{\frac{1}{n}} \right] &= E \left[y^{\frac{1}{n}} \right] = \frac{1}{\sqrt{2\pi(Var(\tau_i) + Var(\delta_i))}} \cdot \int_{-\infty}^{\infty} e^{-\frac{(y-E[\tau_i])^2}{2(Var(\tau_i)+Var(\delta_i))}} \cdot y^{\frac{1}{n}} dy \\ &= \frac{1}{\sqrt{2\pi(Var(\tau_i) + Var(\delta_i))}} \cdot 2 \cdot \int_{E[\tau_i]}^{\infty} e^{-\frac{(y-E[\tau_i])^2}{2(Var(\tau_i)+Var(\delta_i))}} \cdot y^{\frac{1}{n}} dy^{21} \end{aligned}$$

¹⁹ Recall that τ_n and q_n are known to the decision maker, while $\tau_i, q_i, \varepsilon_i, \varepsilon_n, \delta_n$ and δ_i are independently distributed random variables. The expectation of $\varepsilon_i, \varepsilon_n, \delta_n$ and δ_i is zero.

²⁰ $Var(\tau_i + \delta_i) = E[(\tau_i + \delta_i)^2] - E[\tau_i + \delta_i]^2 = E[\tau_i^2] + E[\delta_i^2] - E[\tau_i]^2 = Var(\tau_i) + E[\tau_i]^2 + Var(\delta_i) - E[\tau_i]^2 = Var(\tau_i) + Var(\delta_i)$.

²¹ To facilitate calculations, we take twice the integral from $E[\tau_i]$ to ∞ instead of once the integral from $-\infty$ to ∞ (the normal distribution is symmetrical around its maximum).

To calculate $\frac{1}{\sqrt{2\pi\sigma_1^2}} \cdot 2 \cdot \int_{\mu_1}^{\infty} e^{-\frac{(y-\mu_1)^2}{2\sigma_1^2}} \cdot y^{\frac{1}{n}} \cdot dy$ we first substitute $t := \frac{(y-\mu_1)^2}{2\sigma_1^2}$:

$$\begin{aligned} & \frac{1}{\sqrt{2\pi\sigma_1^2}} \cdot 2 \cdot \int_{\mu_1}^{\infty} e^{-\frac{(y-\mu_1)^2}{2\sigma_1^2}} \cdot y^{\frac{1}{n}} \cdot dy \\ &= \frac{1}{\sqrt{2\pi\sigma_1^2}} \cdot 2 \cdot \int_0^{\infty} e^{-t} \cdot \left(\sqrt{t \cdot 2\sigma_1^2} + \mu_1 \right)^{\frac{1}{n}} \cdot \frac{\sigma_1}{\sqrt{2}} \cdot t^{-\frac{1}{2}} \cdot dt^{22} \\ &= \frac{1}{\sqrt{\pi}} \cdot \int_0^{\infty} e^{-t} \cdot t^{-\frac{1}{2}} \cdot \left(\sqrt{t \cdot 2\sigma_1^2} + \mu_1 \right)^{\frac{1}{n}} \cdot dt \end{aligned}$$

We use an approximation of $\left(\sqrt{t \cdot 2\sigma_1^2} + \mu_1 \right)^{\frac{1}{n}} = \mu_1^{\frac{1}{n}} \cdot \left(\frac{\sqrt{t \cdot 2\sigma_1^2}}{\mu_1} + 1 \right)^{\frac{1}{n}}$ to simplify the calculations. A third-degree Taylor approximation of $(1 + \alpha \cdot x)^{\frac{1}{n}}$ around $x_0 = 0$ is as follows: $(1 + \alpha \cdot x)^{\frac{1}{n}} \approx 1 + \frac{1}{n} \cdot \alpha \cdot x + \frac{1}{2n} \cdot \left(\frac{1}{n} - 1 \right) \alpha^2 \cdot x^2 + \frac{1}{6n} \cdot \left(\frac{1}{n} - 1 \right) \cdot \left(\frac{1}{n} - 2 \right) \alpha^3 \cdot x^3$. Because this approximation holds for $x \geq 0$, it also holds for $x = \sqrt{t}$ and $\alpha = \frac{\sqrt{2\sigma_1^2}}{\mu_1}$.

²² $t = \frac{(y-\mu_1)^2}{2\sigma_1^2} \rightarrow y = \sqrt{t \cdot 2\sigma_1^2} + \mu_1$ and $\frac{dy}{dt} = \frac{\sigma_1}{\sqrt{2}} \cdot t^{-\frac{1}{2}} \rightarrow dy = \frac{\sigma_1}{\sqrt{2}} \cdot t^{-\frac{1}{2}} dt$. Substituting the old integral limits into $\frac{(y-\mu_1)^2}{2\sigma_1^2}$ for y yields the new borders of 0 and ∞ .

$$\begin{aligned}
& \frac{1}{\sqrt{\pi}} \cdot \int_0^\infty e^{-t} \cdot t^{-\frac{1}{2}} \cdot \left(\sqrt{t \cdot 2\sigma_1^2 + \mu_1} \right)^{\frac{1}{n}} \cdot dt \\
& \approx \frac{1}{\sqrt{\pi}} \cdot \int_0^\infty e^{-t} \cdot t^{-\frac{1}{2}} \cdot \mu_1^{\frac{1}{n}} \\
& \cdot \left(1 + \frac{\sigma_1 \sqrt{2t}}{n\mu_1} + \frac{\left(\frac{1}{n} - 1\right) \sigma_1^2 \cdot t}{n\mu_1^2} + \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_1^3 \cdot t^{\frac{3}{2}}}{3n\mu_1^3} \right) dt \\
& = \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \int_0^\infty e^{-t} \cdot t^{-\frac{1}{2}} \cdot dt + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\sigma_1 \sqrt{2}}{n\mu_1} \int_0^\infty e^{-t} \cdot t^{-\frac{1}{2}} \cdot t^{\frac{1}{2}} \cdot dt \\
& + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\left(\frac{1}{n} - 1\right) \sigma_1^2}{n\mu_1^2} \int_0^\infty e^{-t} \cdot t^{-\frac{1}{2}} \cdot t \cdot dt \\
& + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_1^3}{3n\mu_1^3} \int_0^\infty e^{-t} \cdot t^{-\frac{1}{2}} \cdot t^{\frac{3}{2}} dt \\
& = \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \Gamma\left(\frac{1}{2}\right) + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\sigma_1 \sqrt{2}}{n\mu_1} \cdot \Gamma(1) + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\left(\frac{1}{n} - 1\right) \sigma_1^2}{n\mu_1^2} \cdot \Gamma\left(\frac{3}{2}\right) \\
& + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_1^3}{3n\mu_1^3} \cdot \Gamma(2) \quad^{23} \\
& = \mu_1^{\frac{1}{n}} + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\sigma_1 \sqrt{2}}{n\mu_1} + \frac{\mu_1^{\frac{1}{n}}}{2} \cdot \frac{\left(\frac{1}{n} - 1\right) \sigma_1^2}{n\mu_1^2} \\
& + \frac{\mu_1^{\frac{1}{n}}}{\sqrt{\pi}} \cdot \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_1^3}{3n\mu_1^3} \quad^{24} \\
& = \mu_1^{\frac{1}{n}} \cdot \left(1 + \frac{\sigma_1 \sqrt{2}}{\sqrt{\pi} n \mu_1} + \frac{\left(\frac{1}{n} - 1\right) \sigma_1^2}{2n\mu_1^2} + \frac{\sqrt{2} \left(\frac{1}{n} - 2\right) \left(\frac{1}{n} - 1\right) \sigma_1^3}{3\sqrt{\pi} n \mu_1^3} \right)
\end{aligned}$$

²³ We deploy the fact that $\Gamma(x) = \int_0^\infty e^{-t} \cdot t^{x-1} dt$.

²⁴ With $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$, $\Gamma(1) = 1$, $\Gamma\left(\frac{3}{2}\right) = \frac{\sqrt{\pi}}{2}$, $\Gamma(2) = 1$.

We can now substitute the approximation of $\frac{1}{\sqrt{2\pi\sigma_1^2}} \cdot 2 \cdot \int_{\mu_1}^{\infty} e^{-\frac{(y-\mu_1)^2}{2\sigma_1^2}} \cdot y^{\frac{1}{n}} dy = \frac{1}{\sqrt{\pi}} \cdot \int_0^{\infty} e^{-t} \cdot$

$t^{-\frac{1}{2}} \cdot \left(\sqrt{t \cdot 2\sigma_1^2} + \mu_1\right)^{\frac{1}{n}} \cdot dt$ into the equation for $E\left[Y_n^{\frac{1}{n}}\right]$

$$\begin{aligned} E\left[Y_n^{\frac{1}{n}}\right] &= \frac{1}{\sqrt{2\pi\sigma_1^2}} \cdot 2 \cdot \int_{\mu_1}^{\infty} e^{-\frac{(y-\mu_1)^2}{2\sigma_1^2}} \cdot y^{\frac{1}{n}} dy \\ &\approx \mu_1^{\frac{1}{n}} \cdot \left(1 + \frac{\sigma_1\sqrt{2}}{\sqrt{\pi}n\mu_1} + \frac{\left(\frac{1}{n}-1\right)\sigma_1^2}{2n\mu_1^2} + \frac{\sqrt{2}\left(\frac{1}{n}-2\right)\left(\frac{1}{n}-1\right)\sigma_1^3}{3\sqrt{\pi}n\mu_1^3}\right) \end{aligned}$$

Given this exemplary approximation of $E\left[(\tau_i + \delta_i)^{\frac{1}{n}}\right]$, we obtain the following as the expected utility of working on a team with a compensatory task:

$$\begin{aligned} &E\left[fix_c + var_c \cdot \left((\tau_n + \delta_n) \cdot (q_n + \varepsilon_n)\right)^{\frac{1}{n}} \cdot \prod_{i=1}^{n-1} \left((\tau_i + \delta_i) \cdot (q_i + \varepsilon_i)\right)^{\frac{1}{n}} + \eta\right] + N \\ &= fix_c + var_c \cdot E\left[(\tau_n + \delta_n)^{\frac{1}{n}}\right] \cdot E\left[(q_n + \varepsilon_n)^{\frac{1}{n}}\right] \cdot \left(E\left[(\tau_i + \delta_i)^{\frac{1}{n}}\right] \cdot E\left[(q_i + \varepsilon_i)^{\frac{1}{n}}\right]\right)^{n-1} \\ &\quad + E[N] \\ &= fix_c + var_c \cdot \tau_n^{\frac{1}{n}} \cdot \left(1 + \frac{\sigma_{\delta_n}\sqrt{2}}{\sqrt{\pi}n\tau_n} + \frac{\left(\frac{1}{n}-1\right)\sigma_{\delta_n}^2}{2n\tau_n^2} + \frac{\sqrt{2}\left(\frac{1}{n}-2\right)\left(\frac{1}{n}-1\right)\sigma_{\delta_n}^3}{3\sqrt{\pi}n\tau_n^3}\right) \cdot q_n^{\frac{1}{n}} \\ &\quad \cdot \left(1 + \frac{\sigma_{\varepsilon_n}\sqrt{2}}{\sqrt{\pi}nq_n} + \frac{\left(\frac{1}{n}-1\right)\sigma_{\varepsilon_n}^2}{2nq_n^2} + \frac{\sqrt{2}\left(\frac{1}{n}-2\right)\left(\frac{1}{n}-1\right)\sigma_{\varepsilon_n}^3}{3\sqrt{\pi}nq_n^3}\right) \\ &\quad \cdot \left(E[\tau_i]^{\frac{1}{n}} \cdot \left(1 + \frac{\sigma_{\tau_i+\delta_n}\sqrt{2}}{\sqrt{\pi}nE[\tau_i]} + \frac{\left(\frac{1}{n}-1\right)\sigma_{\tau_i+\delta_n}^2}{2nE[\tau_i]^2} + \frac{\sqrt{2}\left(\frac{1}{n}-2\right)\left(\frac{1}{n}-1\right)\sigma_{\tau_i+\delta_n}^3}{3\sqrt{\pi}nE[\tau_i]^3}\right)\right. \\ &\quad \cdot E[q_i]^{\frac{1}{n}} \\ &\quad \cdot \left. \left(1 + \frac{\sigma_{q_i+\varepsilon_i}\sqrt{2}}{\sqrt{\pi}nE[q_i]} + \frac{\left(\frac{1}{n}-1\right)\sigma_{q_i+\varepsilon_i}^2}{2nE[q_i]^2} + \frac{\sqrt{2}\left(\frac{1}{n}-2\right)\left(\frac{1}{n}-1\right)\sigma_{q_i+\varepsilon_i}^3}{3\sqrt{\pi}nE[q_i]^3}\right)\right)^{n-1} \\ &\quad + E[N] \end{aligned}$$

Appendix B – Experiment Instructions and Relevant Questionnaire Questions

Instructions (additive team task)

Welcome to this experiment on “task processing in individual work and teamwork”.

Please carefully read the following information regarding the experiment. You will receive a €5.00 fee for attending. During the experiment you will have the opportunity to add to this amount. The size of the additional monetary amount will depend on your decisions and the decisions of the other participants.

We ask you to refrain from speaking with your neighbors and to switch off your mobile phones. If you have any questions, please raise your hand so that we may help you.

The experiment data will be treated confidentially, and inferences from the data regarding the identity of a given participant will not be possible. To guarantee anonymity, but still be able to match up the data from the different experiment steps, we ask you to create and memorize a personal six-digit identification code. For this code, please choose two letters (e.g., your mother’s initials) and four numbers (e.g., your mother’s date of birth).

Example: Karin Mustermann, born 12.3.1955 → KM1203

Please insert your personal identification code here:

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Procedure of the Experiment:

The experiment consists of two phases in which you will have to solve math tasks.

First phase (7 minutes): You will receive a number of statements that you must classify as “true” or “false”. For each correct answer, you will receive one point (+1); for a wrong answer, one point will be subtracted (-1). The total number of points will be at least zero (i.e., there will be no negative point totals possible). You do not have to check one of the given answers for every statement; however, one of the answers will always be correct. If you do not check one of the possible answers, you will receive zero points for this statement. At the end of the experiment, three participants will be randomly selected. In addition to receiving the payment described below, they will receive 12 cents per point earned in this first phase.

Second phase (15 minutes): Following the first phase, you will have the opportunity to decide whether you would like to keep working individually on the same math tasks and additional tasks of the same kind or if you would like to work on these tasks together with one or three other (randomly drawn) people. Again, you will have to judge, whether in a team or on your own, if each statement given is “true” or “false”. Again, for each correct answer, you will earn one point (+1), and for every wrong answer, one point will be subtracted (-1). If you do not check one of the given solutions, you will receive zero points for the math task in question.

Payoff:

The total number of points earned in the second phase determines the payment for participating in this experiment. In any case, you will receive a €5,00 reward for your participation. Additionally, you will be paid 12 cents for every point earned in the second phase. If you choose to work on the tasks together with one or three other participants, the total number of points for your group will be divided by the number of group members, and every group member will be paid according to his share.

Example:

A group of two persons solved 120 tasks correctly (+120 points) and 20 incorrectly (-20 points); additionally, they did not answer 20 tasks (+ zero points). The total number of points earned will be 100 (+120-20=100). With 12 cents per point, this equals a monetary amount of €12,00 (100 x €0,12=€12,00).

This amount will be equally divided among the two persons in the group so that they receive €6,00 each in addition to the €5,00 reward for participation.

Between the first and second phases, as well as after the second phase, you will be asked to fill out a questionnaire. As soon as you have completed the second questionnaire, you may come to us to collect your payoff. Also, the correct solutions to the problems will then be available.

Thank you for your participation!

You may now begin with the first task-processing phase.

Relevant Questions out of Questionnaire 1 and 2 (additive team task)

- 1. According to your own estimation, how many points did you achieve in the first phase?** 29 points was the maximum of possible points.

Number of points: _____points

- 2. Please estimate – independent of your own preferences – how many points did persons who have a preference for teamwork earn on average in the first phase?** 29 was the maximum number of points possible.

Average number of points: _____points

- 3. Please rate your capacity for teamwork.**

Please check one of the boxes on the scale.

Low capacity
for teamwork

☐ ☐ ☐ ☐ ☐ ☐ ☐

High capacity
for teamwork

- 4. Independent of your own decisions, please rate the average capacity for teamwork of persons with a preference for teamwork.**

Please check one of the boxes on the scale.

Low capacity
for teamwork

☐ ☐ ☐ ☐ ☐ ☐ ☐

High capacity
for teamwork

5. Please imagine that you have won a lottery of 100.000 Euro. Directly after you receive the money, a reputable bank offers you the following financial investment:

You have a chance of doubling your money within two years.

However, there is an equally high risk that you will lose half of the invested money.

You can invest the entirety of the money, invest parts of it, or reject the offer.

Which portion of your lottery winnings would you invest in this risky but potentially profitable financial investment?

The whole amount of 100.000 Euro.....	<input type="checkbox"/>
The amount of 80.000 Euro.....	<input type="checkbox"/>
The amount of 60.000 Euro.....	<input type="checkbox"/>
The amount of 40.000 Euro.....	<input type="checkbox"/>
The amount of 20.000 Euro.....	<input type="checkbox"/>
Nothing; I would reject the offer.....	<input type="checkbox"/>