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Does confidence predict out-of-domain effort?*

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Abstract

Predicting worker's effort is important in many different areas, but is often difficult. Using a laboratory experiment, we test the hypothesis that confidence, i.e. the person-specific beliefs about her abilities, can be used as a generic proxy to predict future effort provision. We measure confidence in the domain of financial knowledge in three different ways (self-assessed knowledge, probability-based confidence, and incentive-compatible confidence) and find a positive relation with actual effort provision in an unrelated domain. Additional analysis shows that the findings are independent of a person's traits such as gender, age, and nationality.

JEL Classification G11, J22

Keywords: Real-effort task, financial literacy, overconfidence

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1 Introduction

In many situations, principals need to predict how much effort agents will provide in the future, which is both useful and difficult. Accurately predicting future effort is useful because it allows to make informed decisions. For example, when taking the decision to hire an inexperienced assistant fresh out of college, a financial manager would benefit from being able to predict *ex ante* how much effort and diligence this potential assistant will put into the assigned work; other examples include promotion decisions, the choice of a spouse, and voting for a politician. Furthermore, predicting future effort is difficult because the information on which the prediction relies is often only weakly related to the domain in which future effort is to be provided. In case of hiring the assistant, one can use average grades or grades in a specific subject (Salas-Velasco (2007)), which however may be noisy. Ideally, one would rely on a proxy that is easy to administer but nevertheless predictive of future effort provision across different domains.

One candidate for such a proxy is confidence in one's abilities, which has been recognized as playing a key role in future effort provision in the same domain. Indeed, the psychology literature considers self-confidence (or self-efficacy, an individual's belief in his or her ability to succeed in a specific task) as the most important factor in forming high performance expectations and in the propensity to work hard to meet those expectations (see for example, Stajkovic and Luthans (1998), Bandura (1982)). People mostly abstain from activities that they believe require abilities they lack but they undertake those where they believe to possess the necessary skills and knowledge. Therefore, when challenged with a certain task, individuals who consider themselves competent in the task domain work harder and persist longer in face of unfavourable outcomes than those who consider themselves amateurs. Stajkovic and Luthans (1998) provide a meta-analysis of psychology and management studies, which investigate the relation between confidence in a certain domain (or specific self-efficacy) and effort-related performance in the same domain. They document a

significant positive relationship between specific self-efficacy and individuals' effort-related performance, with the relationship being stronger for simple tasks and tasks completed in the laboratory rather than in the field.

Also the recent economics literature investigates potential positive spillover effects of self-confidence on effort provision (Campbell et al. (2011), Gervais et al. (2011), Gervais and Goldstein (2007), Falk et al. (2006), Compte and Postlewaite (2004), Bénabou and Tirole (2002)). For example, Bénabou and Tirole (2002) demonstrate that high confidence in one's abilities improves welfare for individuals with time-inconsistent preferences (e.g., hyperbolic discounting) or lack of will power. In their model, the current self strongly prefers a highly self-confident version of future selves because higher confidence helps to resist the tendency to stop working too quickly. Falk et al. (2006) confirm this intuition and show that individuals with low confidence about their abilities abandon costly search much earlier than those with high confidence. Gervais and Goldstein (2007) study a model of a firm where the marginal productivity of individuals' efforts is amplified by other team members' efforts. In their model, the presence of an optimistic agent, who overestimates his marginal productivity and applies excessive effort, results in higher effort provision by his team members and a Pareto-improvement for the whole team. However, to the best of our knowledge, none of the previous studies has tested for a predictive relation of confidence with future effort provision in different domains. For example, would a CFO's confidence in her financial knowledge also predict her effort and diligence in compiling timely and accurate accounting forms required for auditing of the firm? In this study, we use a laboratory experiment to investigate whether individuals' beliefs about their proficiency in the financial domain predict effort and diligence in a real-effort task.

Our paper contributes to the existing literature in three main ways. Most importantly, we demonstrate that confidence in one's ability in one domain can spillover into a different domain, which results in a predictive relation between confidence and effort provision across domains. We measure individuals' confidence in their fi-

nancial knowledge as their beliefs about their performance in a financial knowledge questionnaire[1] and employ three different confidence measures: self-assessed number of questions answered correctly, average probability assigned by a subject that her answers are correct, and an incentive-compatible confidence measure. Although the first two measures could be regarded as "cheap talk" due to their non-incentivized nature, we do find that subjects with higher confidence in their financial knowledge as measured by means of all three confidence measures work more intensively in our real-effort task.

Our results suggest that individuals' self-confidence can be used as a reliable signal to predict future effort provision in various domains. In many real-life situations (e.g., hiring an employee, choosing a partner, etc.), decision-makers usually have a limited set of signals with different accuracy. They therefore tend to base their out-of-domain prediction of effort provision on signals that could be misleading. For example, a person's physical attractiveness or beauty is commonly used in a wide variety of areas, from choosing a partner to hiring an employee. While the evidence for a positive correlation between attractiveness and intelligence is mixed (see Jackson et al. (1995) and Langlois et al. (2000) for a meta-analysis), physically attractive people are viewed as better colleagues and workers: they are hired sooner, receive promotions more quickly, and are paid more than their less-attractive coworkers (Hamermesh (2011)). Even in the domain of political elections, where attractiveness is not on the list of required professional skills, facial appearance of candidates is a powerful predictor of the election outcomes (Todorov et al. (2005))

More reliable signals of future effort provision can be difficult to obtain. For example, when hiring new workers, employers frequently rely on recommendation letters from a previous work place or some objective performance measures (e.g. sales, customer satisfaction, etc.) to infer workers' future effort provision and proficiency

[1]We use a questionnaire on financial knowledge rather than on general knowledge because the majority of our subjects are students with majors in Business or Economics.

in certain areas (Aamodt et al. (1993)). However, these measures are not readily available for fresh out of college graduates with no job experience (Velasco (2012)) or workers previously employed in a different occupation. Our study suggests that an individual's self-confidence could be a good compromise in many of these situations: it is directly related to future effort provision and it is easy to obtain. Note that in our experiment even questionnaire-elicited and non-incentivized measures of confidence predict future effort. Such a measure is a useful tool and it can be easily administered via a simple form before or during an interview.

Our second contribution concerns a positive relation between exaggerated confidence, i.e. overconfidence, and effort provision. For instance, CEOs can be too self-confident and many negative effects of their overconfidence have been documented in the literature.[2] To disentangle ability from overconfidence, we investigate whether overconfidence could be detrimental for effort provision. We measure overconfidence in two different ways. Our first measure is *overestimation* (or *optimism*) which describes a situation where subjects estimate their ability, achievements, level of control, or probability of success to be higher than they actually are. Our second overconfidence measure is *better-than-average* (aka *overplacement*) and it captures cases when subjects believe that they are better than others (Moore and Healy (2008)). We find that overconfidence, both in terms of overestimation and better-than-average measures, positively predicts effort provision.

Our results are helpful to interpret the beneficial effects of confidence and moderate overconfidence for social signalling and leadership (Burks et al. (2013), Reuben et al. (2012), Gervais et al. (2011)). Being a successful leader requires a non-trivial effort in multiple unrelated domains (e.g. coordinating workload, motivating team members to work at their full potential, creating positive atmosphere, etc.). In this case, high confidence in one's ability in one domain can be used as a signal of future

[2]See, for example, Deshmukh et al. (2013), Schrand and Zechman (2012), Malmendier et al. (2011), Malmendier and Tate (2008), Malmendier and Tate (2005), Hayward and Hambrick (1997).

commitment and high effort provision in multiple other domains. Indeed, Gervais et al. (2011) theoretically predict that CEOs with higher confidence in their ability to create firm value are preferred by boards of directors because they are committed to exert more effort to resolve uncertainty about future firm projects than their less confident counterparts. Campbell et al. (2011) show that boards of directors are more likely to retain moderately overconfident CEOs than their diffident or highly overconfident peers. Furthermore, high confidence is important and beneficial in pursuing new ideas (Hirshleifer et al. (2012), Galasso and Simcoe (2011), Simon and Houghton (2003)) and in implementing entrepreneureal projects (Hayward et al. (2010), Hayward et al. (2006)), where both failure rates and uncertainty about future outcomes are acutely high. Thus, both innovation and entrepreneurship require substantial effort in various areas of expertise, which can be supported by high confidence in a somewhat different area.

Our third contribution is methodological. We show that both self-assessed and incentive-compatible confidence measures are positively correlated and are good predictors of individuals' effort choice. In psychology, self-confidence (or self-efficacy) is typically measured by means of directly asking people to state their degree of confidence in their ability to perform a certain task with no incentives to assess their ability correctly (see Bandura (2006) for a detailed guide on self-efficacy scales). We follow this tradition and ask participants to state their beliefs about their performance in the financial knowledge questionnaire both in terms of the self-assessed number of correct answers and in terms of the probability that their answers are correct. By contrast, the economics literature generally emphasizes the importance of incentive-compatible measures. For example, several papers on CEO overconfidence use personal managerial investments, specifically net purchases of their company stock, their stock-option holdings, and the timing of option exercises, as a proxy for managerial confidence.[3]

[3]A non-exhaustive list includes Huang and Kisgen (2013), Deshmukh et al. (2013), Schrand and Zechman (2012), Hirshleifer et al. (2012), Galasso and Simcoe (2011), Campbell et al. (2011), Billett and Qian (2008) and Malmendier and Tate (2005).

Our incentive-compatible confidence measure is in line with this tradition. By design, the participants are monetarily worse-off by overstating or understating their financial knowledge and only receive positive payoff when they hold unbiased beliefs about their proficiency in the financial domain. In our task, both measures of confidence, self-assessed and incentivized, are positively correlated with future effort provision. Moreover, we show that our non-incentivized measures of confidence can be used as a valid approximation of the incentivized measure. This result is important because in many field situations, self-assessed confidence measures are easier and cheaper to administer than incentive-compatible ones.

The remainder of the paper proceeds as follows. Section 2 details the experimental design. The results are provided in Section 3. Section 4 concludes.

2 Experimental Design

The experiment consists of two parts. In the first part, we assess subjects' knowledge and self-confidence in the financial domain. In the second part, subjects choose how much to work in a real-effort decoding task, where their monetary reward depends only on their effort level. In this task, effort as such and its output have little intrinsic value and provide no feedback about subjects' ability.

2.1 Measures of Skill and Confidence

Subjects answer 20 financial knowledge questions[4] by choosing between two alternatives (see Appendix A). At the end of the experiment, but before providing any feedback, we ask subjects how many out of 20 questions they think they answered correctly. The exact question is "You were asked to answer 20 financial knowledge questions. For how many of these questions do you think you gave the correct answer?

[4]Among others, our questions include those proposed by Van Rooij, Lusardi and Alessie (2011). We also include three questions from the cognitive reflection task by Frederick (2005).

(State a number between 0 and 20.)" The self-assessed number of correct answers or Confidence_CA is our first measure of the subjects' confidence in their financial knowledge.

When answering the financial knowledge questionnaire, subjects also assign a probability that the chosen answer is correct. The probability is restricted to vary between 50% and 100% because there are only two alternative answers for each question. We use the average probability assigned by a subject to her answers being correct as an additional, probability-based confidence measure, Confidence_PB. Both Confidence_CA and Confidence_PB measures reflect subjects' beliefs about their proficiency in the finance domain and are widely used in the psychology literature. We also follow the economics literature and employ an incentive-compatible confidence measure, described in the next section.

Incentivized Confidence Measure

Once subjects finish the questionnaire, their knowledge or skill level in the financial domain is determined according to Table 1. The skill level increases in the number of correct answers and varies from 1 to 5.[5] Subjects do not know their performance in the financial knowledge questionnaire but they are shown Table 1 that enables them to form a belief about the number of correct answers they gave and about their corresponding skill level.

[Insert Table 1 about here]

We elicit subjects' beliefs about their skill level by asking them to choose an effort level (in an unrelated real-effort task; see below) that corresponds to their perceived performance in the financial knowledge questionnaire. If they choose the effort level that corresponds to their performance in the questionnaire, they obtain a reward,

[5]The number of correct answers required for a certain skill level is defined in a pilot study such that the proportion of subjects in each skill group is approximately the same. None of the subjects from the pilot study participated in the subsequent main experiment.

otherwise they obtain nothing. As illustrated in Panel A of Table 2, to receive a reward of 1350 cents, a subject with skill level 1 should choose the 20% effort level, a subject with skill level 2 should choose the 40% effort level, etc. Otherwise subjects receive zero. By design, subjects are worse-off by overstating or understating their skill level in the financial domain and only receive a positive payoff when they hold unbiased beliefs about their proficiency. We call the chosen effort level Confidence_IC measure to denote the fact that it is an incentive-compatible confidence measure.

[Insert Table 2 about here]

To guarantee that all the subjects face identical incentives to assess their actual financial knowledge level correctly, all of them have to perform the same real-effort task at the same difficulty level of 60% (see below). To make sure that subjects understand the task and reward structure, they are asked five comprehension questions about the task and the reward table. Subjects are not allowed to start the experiment until they answer all the questions correctly.

2.2 Effort Provision

If confidence is useful as a predictor of real-effort provision in a different domain then we should find that subjects with higher confidence in their financial knowledge are more likely to choose higher effort levels in our real-effort task (see the detailed description below) that is onerous and unrelated to the financial domain.

Real-Effort Task

After providing an incentive-compatible confidence measure, the subjects perform a real-effort task: they choose how much effort they want to exert by selecting an effort level in an incentivized decoding task. All subjects need to decode a list of 30 long numbers and partition them into several different groups (see Appendix B). Subjects can choose different effort levels corresponding to the number of groups from which

to decode. The lowest effort level of 20% corresponds to a list of 30 long numbers to be classified into two groups whereas in the highest effort level of 100% subjects need to decode a list of 30 long numbers and categorize them into 10 groups. The subjects' reward increases with effort level from 1030 cents for the lowest effort level to 1450 cents for the highest effort level and it is independent of their skill level[6] (see Panel B of Table 2 for the reward structure).

Irrespective of effort level, all subjects have the same amount of time (150s)[7] to complete the task. Importantly and in strong contrast to the incentivized confidence measure, the incentives in this task are entirely independent of financial knowledge.[8] Thus, irrespective of their skill, subjects decide whether to exert more or less effort for more or less pay. Again, awareness of these facts is ascertained with control questions.

Decoding lists of numbers into groups is tedious, demands concentration, and does not require any specific prior knowledge. The nature of the task guarantees that subjects do not choose higher effort levels because they enjoy performing the task or because they assign any intrinsic value to the completed work (Gneezy et al. (2011)). Also, the task does not require any specific expertise, ensuring that subjects are equally capable doing it. These specific task characteristics enable us to make sure that the subjects' internal motivation to perform the task is low and they face non-trivial costs of mental effort, which are approximately the same across different subjects. Thus, in the real-effort task, the subjects' effort should be only driven by monetary reward and by their desire to provide effort.

[6]We provide all the subjects with identical monetary incentives to select effort levels because we want to focus on the effects of subjective confidence on effort provision rather than on the effects of incentives *per se*. Our incentive scheme is similar to a piece-rate one apart from the fact that it pays a decreasing rate for each next piece of work done.

[7]The time constraint is rigid in the sense that subjects cannot gain more time by performing the task faster and they are penalized for exceeding the time limit. To insure deliberate choices, subjects are familiarized with different difficulty levels before making their choices. Moreover, they cannot proceed until they perform the task 100% correctly.

[8]To balance cognitive load between choosing real effort level and estimating their skill level, we use the same real-effort task to obtain the incentivized confidence measure and to measure subjects' effort provision.

3 Results

Ninety students have participated in a 75-minutes long laboratory experiment, coded in Z-tree (Fischbacher (2007)) at the CentERLab of Tilburg University, the Netherlands. The average participant was 22 years old; there were 42 women; and 71 participants had majors in Business and Economics. The average earnings constituted about 13 Euros (or about $17 at the time of the experiment).

3.1 Financial Knowledge and Confidence

Table 3 reports subject performance in the financial knowledge questionnaire and their confidence in their performance. On average, the subjects answer 66.5% of the questions correctly (as measured by the variable Financial Knowledge), which correspond to 14.1 out of 20 questions. However, they believe that they have answered 70.5% of questions correctly according to our Confidence_CA measure, i.e. the number of correct answers reported by the subjects in the final questionnaire divided by 20. The mean (median) difference between Confidence_CA and Financial Knowledge is 4.0% (0.0%) and it is significantly different from zero at the 1% (5%) significance level.[9] So, as one might have expected, the participants of our experiment are not only confident in their financial abilities, they are overconfident.[10]

The subjects' confidence in their financial knowledge is even higher according to our probability-based confidence measure. According to the Confidence_PB measure, the subjects believe that on average they have answered 84.5% questions correctly. The mean and median difference between Confidence_PB and Financial Knowledge are 18.0% and 15.6% respectively and both are significantly different from zero at the

[9]For the null hypothesis that the median is zero, we perform Wilcoxon signed rank test, which assumes that the difference is an ordinal variable. The test shows that the median value is statistically different from zero, because the subjects overstate their performance to a greater degree than the degree to which they understate it.

[10]For example, in their summary of the micro foundations of behavioural finance, De Bondt and Thaler (1994) state that 'perhaps the most robust finding in the psychology of judgment is that people are overconfident' (p. 389).

1% significance level.

[Insert Table 3 about here]

It could be argued that giving a higher score for the first two measures is free and simply makes subjects feel better about themselves. However, providing strong incentives for the subjects to correctly assess their skill level does not remove their overconfidence as shown by our third confidence measure, Confidence_IC. We compare the subjects' actual skill level and their incentive-compatible beliefs about their skill level in Table 3. On average, the subjects achieve a skill level of 2.5 (out of 5) and there is approximately the same number of subjects in each skill level group. The subjects believe that their average skill level is 3.0 according to the Confidence_IC measure, which is significantly higher than 2.5 ($t = 3.56$, $p < 0.001$); the medians of Skill and Confidence_IC are also significantly different from each other ($z = 6.47$, $p < 0.001$). Note that the subjects receive zero monetary reward if they are too optimistic or too pessimistic about their skill level. Thus, even though the subjects are provided with substantial monetary incentives to assess their skill level objectively, they continue being over-optimistic about their financial knowledge.

3.2 Effort Provision

To measure effort provision, we ask subjects to choose an effort level between 1 and 5 in terms of a difficulty level of our decoding task. Subjects know that higher monetary reward is attainable only by committing to a higher effort level and is not affected by the their financial knowledge or skill level. According to Table 3, the subjects' average effort choice is equal to 3.8 and it is significantly below 5 ($t = 11.16$, $p < 0.001$), indicating that subjective effort cost is non-trivial in our experimental task. Most importantly, even though the real-effort task is completely unrelated to financial knowledge, the Effort variable is positively correlated with Confidence_CA, Confidence_PB, and Confidence_IC measures (see Panel B, Table 3).

It is worth noting that the subjects' effort choice is not affected by their actual knowledge in the financial domain: both the Financial Knowledge and Skill measures are not correlated with the Effort variable. Thus, subjective confidence or the subject's beliefs about their financial skills rather than their actual financial skills are predictive of effort provision. Note also that the Confidence_PB measure is determined before the subjects make any effort choice decision and even before they are explicitly asked to form a belief about their skill level (see below for the relation between confidence measures).

[Insert Figure 1 about here]

To confirm further that confidence increases effort provision, we compare effort choices between the subjects with low and high confidence levels (within bottom and top terciles). According to Figure 1, the subjects with high confidence choose to work more than those with low confidence. The difference in effort levels is significant at the 10% significance level for all three confidence measures: for the Confidence_CA measure the t-statistic is equal to 2.40, with a p-value of 0.02; for Confidence_PB, $t = 1.99$ ($p = 0.05$); for Confidence_IC, $t = 1.93$ ($p = 0.06$).

3.3 Multivariate Analysis

In this section we explore the relationship between confidence and effort choice in a multivariate setting. The dependent variable is Effort, i.e. the subjects' choice of effort level in the real-effort task. The explanatory variables include different confidence measures, the subjects' actual skill level, and their personal characteristics. The results are reported in Table 4.

In model (1), we use Confidence_CA as the only explanatory variable to predict the subjects' effort choice in our real-effort task. We find that the subjects with higher confidence in their financial knowledge work harder in the unrelated domain of decoding. In model (2) we add the actual subjects' skill level and their personal

characteristics as additional explanatory variables.[11] Among the personal characteristics that we control for are: gender (a dummy variable equal to 1 for female subjects; 0 otherwise), age (in years), nationality[12] (a dummy variable for subjects who indicate that they grew up in the People's Republic of China; 0 otherwise), and study major (a dummy variable equal to 1 for subjects with majors in Business or Economics; 0 otherwise). None of the additional controls[13] seem to explain the subjective effort choice in a persistent and significant manner. Most importantly, the coefficient for Confidence remains unchanged.

[Insert Table 4 about here]

In models (3) and (4), we use Confidence_PB and Confidence_IC as alternative measures of the subjects' confidence in their financial knowledge. According to both models, the two measures of confidence are positively related to the subjects' effort choice; also both measures are significant in regression models with no controls. Thus, irrespective of the specific measure used, confidence in financial knowledge predicts effort provision in a task that is unrelated to this knowledge.

Finally, we identify the relative importance of non-incentivized confidence and actual knowledge in the subjects' choice for the incentive-compatible measure, Confidence_IC. We therefore regress Confidence_IC (i.e. the self-assessed skill level elicited in an incentive-compatible manner) on the non-incentivized confidence measures, actual skill level, and the subjects' characteristics; see models (5) and (6). If the subjects have accurate beliefs about their financial knowledge, then the coefficient for Skill

[11]Despite a positive and significant correlation between the variables Confidence_CA and Skill, there is no multicollinearity problem in model (2); the average VIF is only 1.17.

[12]Several studies point out that in comparison with many Western cultures, the Chinese culture emphasizes the importance of effort and persistence in achieving goals (Leung (2010), Chen and Uttal (1988))For example, according to Chen and Uttal (1988), while "innate ability may determine the rate at which one acquires new knowledge, the ultimate level of achievement is attained through effort."

[13]We also measure subjects' risk aversion via the Holt and Laury (2002) task and cognitive reflection score (CRS) via questions by Frederick (2005). Both risk aversion and CRS are insignificant and do not affect our main result.

should be equal to 1 and the variable Skill should be the only one to explain the subjects' self-assessed skill level.[14] However, we find that in model (5) the coefficient for Skill is not significant and in model (6) it is significantly below 1 (F-statistic = 73.22, p-value = 0.000). Note that in both models Confidence_CA and Confidence_PB are positively and significantly related to Confidence_IC. These results suggest that non-incentivized measures of confidence can be a valid approximation of incentivized measures.

3.4 Overconfidence and Effort

The previous literature shows that too much confidence (i.e. overconfidence) could be detrimental for individual decision making.[15] In our case, there may be limits to the beneficial effects of confidence on real effort provision. We therefore investigate whether subjects' effort choice is affected by their overconfidence. Following the standard definition (see for example, Moore and Healy (2008)), we capture overconfidence as the difference between the subjects' beliefs about their financial knowledge (i.e. confidence) and their actual knowledge. In particular, we measure overconfidence in four different ways. Overconfidence_CA is the difference between the number of correct answers a subject believes she gave (i.e. Confidence_CA) and the actual number of correct answers, in percentage points. Overconfidence_PB is the difference between the probability-based confidence measure (i.e. Confidence_PB) and the actual number of correct answers, in percentage points. Overconfidence_IC is the difference between the subjects' incentive-compatible skill level (i.e. Confidence_IC) and their actual skill level. Finally, Better-than-Average is a dummy variable, equal to 1 for those subjects

[14]Note that a stable bias in beliefs (e.g. all subjects believe that they gave two correct answers more than they actually did) also should make the Skill variable a powerful predictor of the subjects' self-assessed skill level.

[15]The detrimental effects of overconfidence range from value-destroying decisions of CEOs (Deshmukh et al. (2013), Schrand and Zechman (2012), Malmendier and Tate (2008), Hayward and Hambrick (1997)) and poor decision quality of VCs (Zacharakis and Shepherd (2001)) to poor investor performance (Grinblatt and Keloharju (2009), Barber and Odean (2001)).

who believe that their performance in the financial knowledge questionnaire is higher than the performance of others; 0 otherwise. We regress the subjects' effort choice level on different overconfidence measures, their actual skill level, and their personal characteristics. The results are reported in Table 5.

[Insert Table 5 about here]

We find that three out of four overconfidence measures are positively and significantly related to the subjects' effort choice. Overconfidence_CA and Better-than-Average have the highest explanatory power in terms of adjusted R-squared (see models (1) and (4)). So, not only the degree to which subjects overestimate their ability relative to their actual ability but also relative to the ability of others can positively affect their propensity to exert effort in our real-effort task.

4 Conclusion

Our data extend the notion that self-confidence is considered as a valuable individual trait. Our findings suggest that high confidence in one domain (financial knowledge) is predictive of real-effort provision in a completely different domain (piece-meal decoding of a list of numbers). Thus, subjects with high confidence in their financial proficiency tend to work more than their peers with low confidence in an unrelated tedious task. In our experiment, we employ three different measures of confidence: self-assessed number of correct answers in the financial knowledge questionnaire, the average probability that given answers are correct, and an incentive-compatible confidence measure. Each of the three measures is positively related to the subjects' real effort. Our results are robust when controlling for a set of subjects characteristics, including gender, age, nationality, study major, risk-aversion, and cognitive reflection score. In conclusion, the present study may provide leads for investigating whether simple confidence measures could be used as predictors of real-effort provision in different settings.

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A Financial Knowledge Questionnaire

The appendix presents twenty financial knowledge questions with two alternative answers each; the correct answer is in bold.

1. Inflation may create problems in many ways. Which group would have the greatest problem during periods of high inflation that last several years? **(i) Older people living on fixed retirement income;** (ii) Young working couples with children and a mortgage.

2. If interest rates rise, what will typically happen to bond prices? **(i) Fall;** (ii) Rise.

3. Buying a single company's stock usually provides (i) a safer return than a stock mutual fund; **(ii) a riskier return than a stock mutual fund.**

4. Justin just found a job with a take-home pay of €2,000 per month. He must pay €800 for rent and €200 for groceries each month. He also spends €200 per month on transportation. If he budgets €100 each month for clothing, €150 for restaurants and €250 for everything else, how long will it take him to accumulate savings of €900. (Assume no interest rate payment on savings). **(i) 3 months;** (ii) 5 months.

5. A young person with $100,000 to invest should hold riskier financial investment than an older person with $100,000 to invest. **(i) True;** (ii) False.

6. In investor wants to buy a house but does not have sufficient funds. He invests in a risky project and his investment (including the returns) doubles in size every quarter. If it takes 48 quarters to reach the necessary funds to purchase the house, how many quarters would it take to have sufficient funds to purchase half of the house? (i) 24 quarters; **(ii) 47 quarters.**

7. Scott and Eric are young men. Each has a good credit history. They work at the same company and make approximately the same salary. Scott has borrowed €6,000 to take a foreign vacation. Eric has borrowed €6,000 to buy a car. Who is likely to pay the lowest finance charge? **(i) Eric will pay less because the car is collateral for the loan;** (ii) They will both pay the same because consumer credits have the same interest rate.

8. Elena started her pension program at age 20 and put in €2,000 each year for 15 years. Rebecca started her pension program at age 35 and put in €2,000 each year for 30 years. If they both get 6% per year on their investments, who will have more money at age 65? **(i) Elena;** (ii) Rebecca.

9. Employees should have the majority of their retirement funds in their current employers stock. (i) True; **(ii) False.**

10. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? **(i) 5 minutes;** (ii) 100 minutes.

11. It is possible for investors to be diversified even if they invest all their money in one mutual fund. **(i) True;** (ii) False.

12. You should rather have $5,000 or a Euro cent doubled every day for a month? (i) True; **(ii) False**.

13. Yolanda has three credit cards and she owes €500 on each of them. The interest rates are 7% for card A, 9% for card B and 8% for card C. If Yolanda has €1,000 to pay some of her debt, which cards should she pay if she wants to minimize future interest payments? **(i) €500 to card B and €500 to card C;** (ii) €333 to card A and €334 to card B and €333 to card C.

14. How do income taxes affect the income that people have to spend? (i) They decrease spendable income in deflationary times and increase spendable income in inflationary times. **(ii) They decrease the amount of goods and services that can be purchased.**

15. A bat and a ball cost 1.10 Euro in total. The bat cost 1 Euro more than the ball. How much does the ball cost? (i) 0.10 Euro; **(ii) 0.05 Euro.**

16. At takeovers, the bidding firm usually pays a large premium to the target firm. Therefore, upon announcement, the target firm's share price increases substantially as it anticipates the premium to be paid in the takeover. Hence, if you own shares of a target firm (before the announcement), you will very likely make a large profit if you sell them after the announcement. **(i) True;** (ii) False.

17. You invest €1000 in a project and the discount factor is 10%. The return is expected to be €1100 in year 1 and €1200 in year 2 (when the project ends). The net present value is approximately: **(i) €1000;** (ii) €1300.

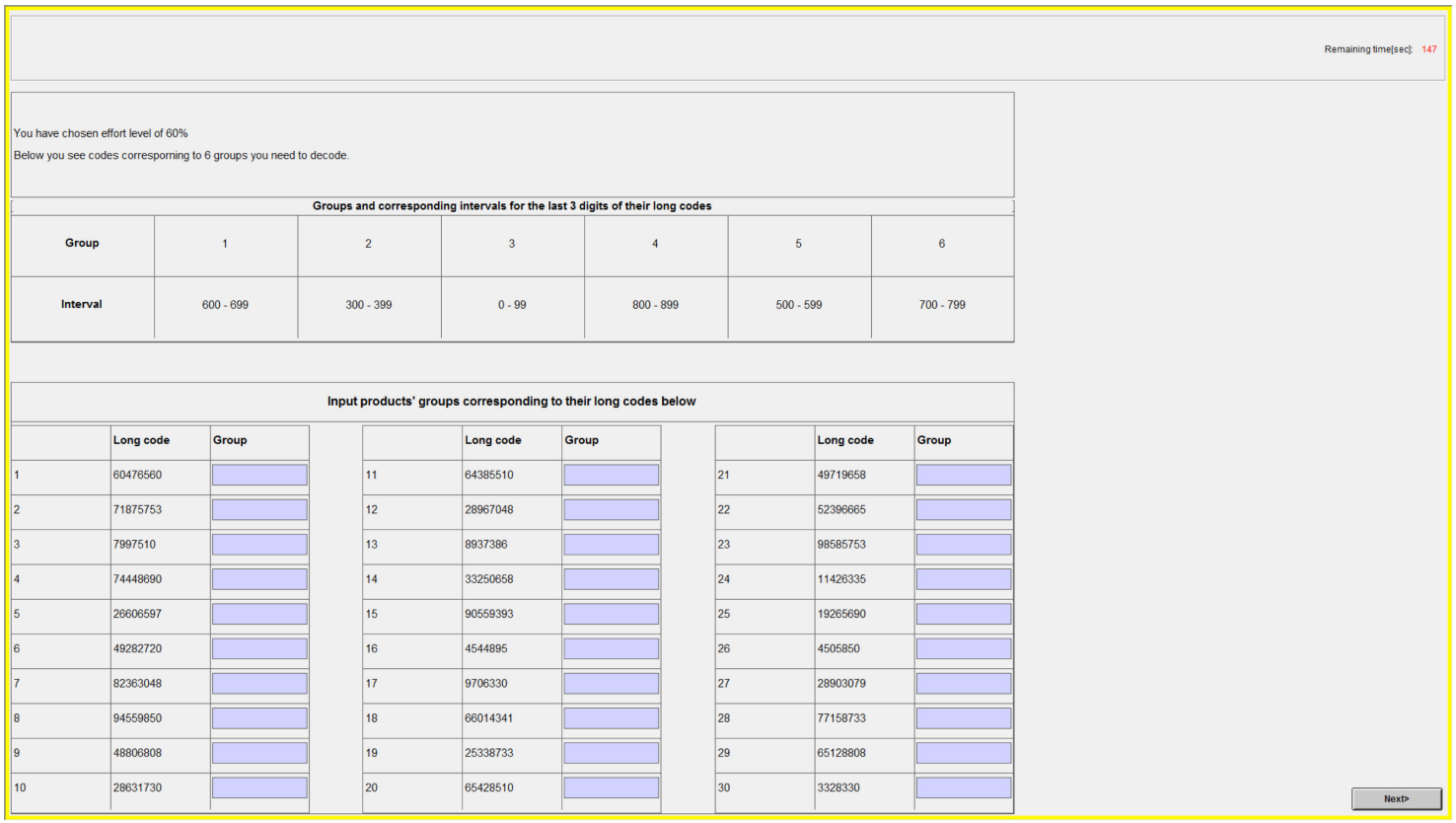
18. If you have to sell one of your stocks, you should sell one which has gone up in price rather than one which has gone down. (i) True; **(ii) False.**

19. To do well in the stock market, you should buy and sell your stocks often. (i)True; **(ii) False.**

20. The cost of capital of the average listed firm consists is about **(i) 10%;** (ii) 20%.

B The Decoding Task

The screen shot demonstrates a task for effort level of 60%, which corresponds to decoding of 30 product codes into 6 different product groups, based on their last three digits.



Remaining time[sec]: 147

You have chosen effort level of 60%

Below you see codes corresponing to 6 groups you need to decode.

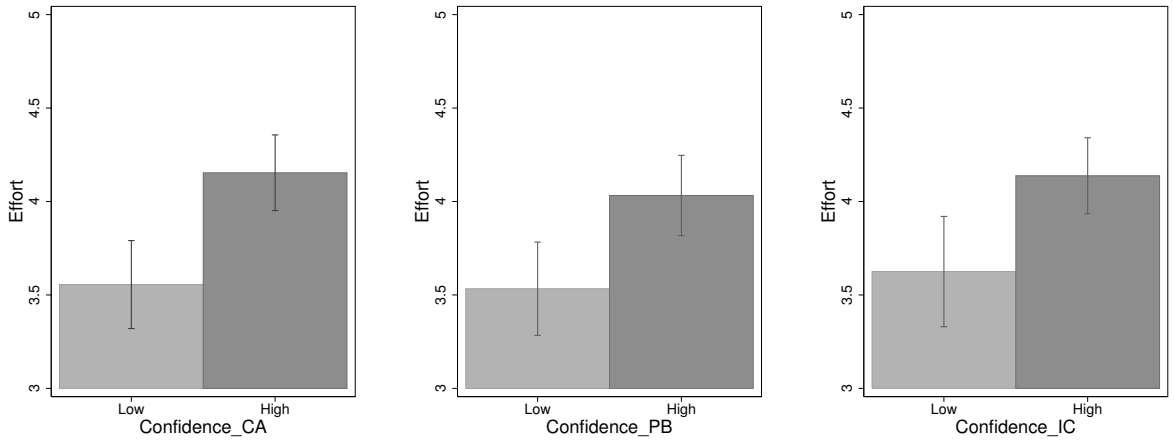
Groups and corresponding intervals for the last 3 digits of their long codes

Group	1	2	3	4	5	6
Interval	600 - 699	300 - 399	0 - 99	800 - 899	500 - 599	700 - 799

Input products' groups corresponding to their long codes below

	Long code	Group		Long code	Group		Long code	Group
1	60476560		11	64385510		21	49719658	
2	71875753		12	28967048		22	52396665	
3	7997510		13	8937386		23	98585753	
4	74448690		14	33250658		24	11426335	
5	26606597		15	90559393		25	19265690	
6	49282720		16	4544895		26	4505850	
7	82363048		17	9706330		27	28903079	
8	94559850		18	66014341		28	77158733	
9	48806808		19	25338733		29	65128808	
10	28631730		20	65428510		30	3328330	

Next>



(1a) (1b) (1c)

Figure 1

Effort and Confidence

The figure presents the average effort choice for the subjects with low and high confidence levels; vertical bars depict average effort levels and vertical lines represent 10% standard errors. **Effort** is the subjects' effort level, exerted in the experimental real-effort task. Three different confidence measures are employed. 1a, **Confidence_CA** is a number of correct answers a subject believes she gave divided by 20, as reported in the final questionnaire. 1b, **Confidence_PB** is the average probability a subject assigns to her answers being correct across 20 financial knowledge questions. 1c, **Confidence_IC** is the subjects' self-assessed skill level, elicited in an incentive-compatible manner.

Table 1

Number of Correct Answers and Skill Level

Number of correct answers	11 or less	12 or 13	14 or 15	16 or 17	18 or more
Skill level	1	2	3	4	5

Table 2

Reward Values for the Incentivized Confidence and Effort Provision Tasks

Panel A: Incentivized Confidence					
Effort level	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
20%	1350	0	0	0	0
40%	0	1350	0	0	0
60%	0	0	1350	0	0
80%	0	0	0	1350	0
100%	0	0	0	0	1350
Panel B: Effort Provision					
20%	1030	1030	1030	1030	1030
40%	1190	1190	1190	1190	1190
60%	1350	1350	1350	1350	1350
80%	1400	1400	1400	1400	1400
100%	1450	1450	1450	1450	1450

Notes: To earn a positive reward in the Incentivized Confidence task, subjects must choose an effort level corresponding to their actual skill; otherwise reward is zero. However, they need to perform the decoding task of effort level of 60% irrespective of the effort level chosen. In the Effort Provision task, subjects' reward depends only on their chosen effort level.

Table 3

Financial Knowledge, Confidence, and Effort

Panel A. Summary statistics

Variable	Mean	Median	Sd	Min	Max
Financial Knowledge, %	66.5	65.0	13.6	40.0	95.0
Confidence_CA, %	70.5***	70.0**	11.1	50.0	95.0
Confidence_PB, %	84.5***	86.4***	8.2	64.5	100.0
Skill	2.5	2.0	1.2	1.0	5.0
Confidence_IC	3.0***	3.0***	1.1	1.0	5.0
Effort	3.8***	4.0***	1.0	2.0	5.0

Panel B. Correlations

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Confidence_CA	-					
(2) Confidence_PB	0.57***	-				
(3) Confidence_IC	0.70***	0.47***	-			
(4) Financial Knowledge	0.43***	0.18*	0.30***	-		
(5) Skill	0.41***	0.19*	0.30***	0.96***	-	
(6) Effort	0.27***	0.24**	0.20*	0.07	0.04	-

Notes: The table presents the summary statistics for the subjects' performance in the financial knowledge questionnaire, their confidence, and effort. **Financial Knowledge** is the actual number of correct answers given by a subject divided by 20 (the total number of questions), expressed in percentage points. **Confidence_CA** is a number of correct answers a subject believes she gave divided by 20, as reported in the final questionnaire. **Confidence_PB** is the average probability a subject assigns to her answers being correct across 20 financial knowledge questions. **Skill** is defined in accordance with Table 1 and equals 1 if a subject gives 11 or less correct answers in the financial knowledge questionnaire, 2 if she gives 12 or 13 correct answers, 3 if 14 or 15, 4 if 16 or 17, and 5 if the subject answers 18, 19, or 20 questions correctly. **Confidence_IC** is the subjects' self-assessed skill level, elicited in an incentive-compatible manner. **Effort** is the subjects' effort level, exerted in the experimental real-effort task.
We test whether means (medians) of Confidence and Confidence_PB are equal to those of Financial Knowledge. We also test whether means (medians) of Confidence_IC and Effort are equal to those of Skill. We perform a standard 2-tailed t-test of null hypothesis the equality of means; we perform Wilcoxon signed rank test for the equality of medians.
* stands for $p < 0.10$, ** for $p < 0.05$, and *** for $p < 0.01$.

Table 4

Impact of Confidence on Subjective Effort Choice

Dependent variable	Effort				Confidence_IC	
Model	(1)	(2)	(3)	(4)	(5)	(6)
Confidence_CA	0.024***	0.026**			0.069***	
	(0.009)	(0.010)			(0.009)	
Confidence_PB			0.025*			0.059***
			(0.014)			(0.014)
Confidence_IC				0.172*	-	-
				(0.100)		
Skill		-0.050	0.020	-0.004	0.012	0.202**
		(0.098)	(0.093)	(0.096)	(0.083)	(0.093)
Female		-0.136	-0.159	-0.206	0.064	-0.025
		(0.209)	(0.213)	(0.210)	(0.177)	(0.213)
Age		-0.005	-0.009	-0.001	0.015	0.009
		(0.034)	(0.035)	(0.035)	(0.029)	(0.035)
Chinese		0.369	0.307	0.406	-0.072	-0.201
		(0.240)	(0.251)	(0.244)	(0.204)	(0.251)
Major in Business		-0.332	-0.315	-0.284	-0.057	0.003
or Economics		(0.256)	(0.261)	(0.260)	(0.217)	(0.261)
Constant	2.141***	2.475***	2.099*	3.583***	-2.172***	-2.617**
	(0.645)	(0.932)	(1.225)	(0.793)	(0.789)	(1.224)
Observations	90	90	90	90	90	90
Adj. R^2	0.065	0.065	0.031	0.027	0.462	0.224

Notes: The table reports the results for OLS regression models for the subjects' effort level choice, models (1)-(4). The dependant variable is **Effort**, the subjects' effort level, exerted in the experimental real-effort task. The main explanatory variables are three different measures of confidence. **Confidence_CA** is a number of correct answers a subject believes she gave divided by 20, as reported in the final questionnaire. **Confidence_PB** is the average probability a subject assigns to her answers being correct across 20 financial knowledge questions. **Confidence_IC** is the subjects' self-assessed skill level, elicited in an incentive-compatible manner.
The table also reports the results for OLS regression models for the subjects' incentive-compatible confidence measure, Confidence_IC, models (5)-(6). The main explanatory variables are non-incentivized measures of confidence, Confidence_CA and Confidence_PB
* stands for $p < 0.10$, ** for $p < 0.05$, and *** for $p < 0.01$. Standard errors are in parentheses.

Table 5

Impact of Overconfidence on Subjective Effort Choice

Variable	(1)	(2)	(3)	(4)
Overconfidence_CA	0.021**			
	(0.010)			
Overconfidence_PB		0.014		
		(0.012)		
Overconfidence_IC			0.172*	
			(0.100)	
Better-than-Average				0.495**
				(0.238)
Skill	0.198	0.181	0.169	0.011
	(0.121)	(0.158)	(0.120)	(0.093)
Female	-0.191	-0.220	-0.206	-0.122
	(0.209)	(0.212)	(0.210)	(0.215)
Age	-0.002	-0.002	-0.001	-0.008
	(0.034)	(0.035)	(0.035)	(0.035)
Chinese	0.373	0.353	0.406	0.341
	(0.244)	(0.253)	(0.244)	(0.245)
Major in Business	-0.285	-0.269	-0.284	-0.356
or Economics	(0.258)	(0.262)	(0.260)	(0.262)
Constant	3.528***	3.400***	3.583***	3.922***
	(0.789)	(0.874)	(0.793)	(0.777)
Observations	90	90	90	90
Adj. R^2	0.041	0.007	0.027	0.042

Notes: The table reports the results for OLS regression models for the subjects' effort level choice. The dependant variable is **Effort**, the subjects' effort level, exerted in the experimental real-effort task.

The main explanatory variables are four different measure of overconfidence. **Overconfidence_CA** is the difference between the number of correct answers a subject believes she gave, Confidence_CA, and the actual number of correct answers in percentage points. **Overconfidence_PB** is the difference between the probability-based confidence measure, Confidence_PB, and the actual number of correct answers in percentage points. **Overconfidence_IC** is the difference between the subjects' self-assessed skill level, Confidence_IC, and their actual skill level. **Better-than-Average** is a dummy variable, equal 1 for those subjects who believe that their performance in the financial knowledge questionnaire is higher than the performance of others; 0 otherwise.

* stands for $p < 0.10$, ** for $p < 0.05$, and *** for $p < 0.01$. Standard errors are in parentheses.