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Determinants of Risk Behaviour: Three Laboratory Experiments on Peer Effects, Group Identity and Incentive Schemes

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DECLARATION PAGE

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The third chapter is a joint work with prof. Antonio Filippin. The research idea originates from the findings of the second chapter. We equally contributed to the definition of the design and the writing of the paper while I am responsible for the writing of the code of the software for the experiment and the preparation of the final data. The paper has been presented at the French Experimental Economics Association (ASFEE) conference, Cergy 2016; the International Meeting on

Experimental and Behavioral Social Sciences (IMEBESS), Rome, 2016; the World Meeting of the Economic Science Association (ESA), Jerusalem, 2016; and the Southern Europe Experimental Team's Meeting (SEET), Cagliari (Italy), 2017. From this chapter we obtained the working paper circulating as: Filippin, A., and Gioia, F. (2017). Competition and Subsequent Risk-Taking Behaviour: Heterogeneity across Gender and Outcomes, IZA Discussion Paper No. 10792.

The three chapters have not been submitted for any other degree or professional qualification.

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ABSTRACT

Risk is inherent in many social and economic decisions, such as the choice of pathway in secondary school, the choice of major at university, job decisions, health-related behaviour, marriage, parenthood, migration and the allocation of financial assets. Investigating the determinants of attitudes towards risk is therefore essential to fully understand how people make such decisions. Recent research has shown that individual risk attitudes are not immutable personality traits, but are influenced by external factors with the potential to change them in more or less enduring ways, such as the characteristics of the environment, emotional states, life experiences such as poverty, job loss or violence, and social relationships.

This thesis studies external factors that play a role in shaping risk attitudes. Specifically, it focuses on two important environmental factors: social relationships and the incentive structure that individuals face (e.g., competition or teamwork).

It is composed of three chapters. Each chapter of the thesis presents the results of a different laboratory experiment, in which individual risk behaviour is always measured using the Bomb Risk Elicitation Task - BRET (Crosetto and Filippin, 2013). This task asks participants to choose how many boxes to collect out of 100, knowing that 99 boxes contain £0.10 while one contains a bomb, but without knowing in which box the bomb is located. They can therefore choose their preferred lottery among 100 lotteries whose outcomes and probabilities are fully described only by one parameter, i.e., the number of collected boxes. Earnings increase linearly with the number of boxes collected, but they are all lost if the bomb lies in one of the collected boxes. In the first two chapters, risk behaviour is measured both before and

after the treatment manipulation, and feedback on the peers' ex-ante risk behaviour is used as a channel to study peer influence on the subjects' ex-post risk behaviour.

The first two chapters provide new evidence that individual risk behaviour is influenced by the risk behaviour of the peer group and offer one explanation for why peer effects are not always present and vary in intensity. This is due to the fact that individuals are more influenced by those peers with whom they feel more bonded. Specifically, in the first chapter I study how group identity (that is, the portion of an individual's self-concept derived from the sense of belonging to the social group) affects peer effects on risk behaviour. I induce different levels of group identity through different matching protocols (random or based on individual painting preferences) and the possibility of interacting with group members via an online chat in a group task. I find that subjects are affected by their peers when taking decisions and that a stronger group identity amplifies the influence of peers: painting preferences matching significantly reduces the heterogeneity of risk behaviour compared with random matching. On the other hand, introducing a group task has no significant effect on behaviour, possibly because this interaction does not always contribute to enhancing group identity.

The second chapter digs deeper into this evidence by investigating the role of the incentive structure that characterizes the individuals' environment. Since the first chapter shows that peer effects vary in intensity, I hypothesize that different types of incentive schemes may have different effects on peer relationships and, therefore, affect peer effects on risk behaviour. Using a real effort task, which consists of recognizing the value and the country of origin of a random sequence of Euro coins, I compare piece-rate compensation first with a cooperation-based and then with a competition-based incentive scheme. I find that competition significantly reduces attachment to peers and more than halves peer influence on risk behaviour compared with piece-rate compensation, despite the fact that the latter effect is not statistically significant. Such findings suggest that, when designing and evaluating an optimal compensation scheme, it may be important to also consider how peer effects on subsequent risk behaviour will in turn affect future decisions involving risk. For example, in research and development, competition may improve the results of current projects, but risk attitudes will shape the types of future projects that are attempted.

The third chapter restricts the attention to competition and enquires whether this type of incentive scheme has a direct effect on risk-taking behaviour, beyond any social comparison, and whether its impact on subsequent risk behaviour is heterogeneous according to gender. Risk behaviour is measured after the performance of a real effort task, consisting of recognizing the value and country of origin of Euro coins, incentivized either as a tournament with fixed rewards or as a random draw with the same monetary payoffs. The data show that competition does not significantly affect subsequent risk-taking behaviour when considering the full sample. However, there is a positive relationship between competition and risk aversion for males, who become significantly more risk-averse after losing a competition than after randomly earning the same low payoff. In contrast, males do not become more risk-seeking after winning the tournament, while the average risk-taking behaviour of females is unaffected by tournament participation and outcomes. The reaction of males to negative outcomes might be driven by intrinsic motives, such as emotions or a shift in the locus of control from internal to external.

Overall, the evidence presented here shows that risk attitudes are not immutable but may be shaped by external factors. Of particular importance is the role played by the risk behaviour of peers, which begins to emerge even when bonds are weak and becomes stronger as the social link intensifies. Any policy that aims to change risk attitudes (or that does so indirectly) will thus see its effects spread to the target subjects' peers, and may amplify its success if the peer group is chosen wisely. Changing the characteristics of the subjects' environment by introducing competition weakens their attachment to the competing peers and may attenuate peer effects on risk behaviour. In addition, competition per se has no impact on subsequent risk behaviour, except for males who become more risk-averse after losing.

LAY SUMMARY

Over their life course, people make many social and economic decisions influenced by their risk attitudes, such as choice of career, university degree course, study and work effort, marriage, parenthood, migration, smoking, drug and alcohol use, criminal activity and the allocation of financial assets. Knowing what influences risk attitudes is therefore essential for a full understanding of how people make such decisions. Recent research has shown that individual risk attitudes are shaped at least partly by external factors, such as the characteristics of their environment like family structure or their classroom's gender composition, emotional states, life experiences like poverty, job loss or violence, and social relationships.

The thesis contributes to our understanding of what influences risk attitudes by studying when and how they may be modified by the behaviour of individuals physically or socially near to a subject. It also examines whether an incentive scheme used to improve subjects' performance may affect their risk attitudes, either directly or through a change in social relationships.

It is composed of three chapters, each one presenting the results of a different laboratory experiment.

The first two chapters are based on the consideration that humans are by nature social creatures and that their social relationships influence their behaviour and choices. They study whether an individual's social network is also capable of changing their risk behaviour, and provide new evidence that individual risk behaviour is influenced by the risk behaviour of the person's peer group. They also offer one explanation for why peer effects are not always present and vary in intensity. This is due to the fact that individuals are more influenced by peers with whom they feel more bonded. Specifically, in the first chapter I study how group identity (that is, the portion of an individual's self-concept derived from the sense of belonging to the social group) affects peer effects on risk behaviour; I find that individuals' feelings of attachment to the various peers with whom they interact differ in intensity, and this is reflected in the extent to which their risk behaviour is influenced by that of their peers: a stronger group identity amplifies peer effects. The second chapter expands on this research, suggesting that economic interventions, such as the implementation of incentive schemes aimed at increasing performance, may alter peer relationships and thus vary the extent to which individuals are influenced by their peers. It compares piece-rate compensation with a cooperation-based and with a competition-based incentive schemes, showing that competition significantly reduces attachment to peers and more than halves peer influence on risk behaviour when compared with piece-rate compensation; however, the latter effect is not statistically significant. Such findings suggest that the strength of social relationships is an important determinant of the intensity of peer influence on individual behaviour. Additionally, when designing and evaluating an optimal compensation scheme, it may be important to also consider the possible change in peer attachment, and how peer effects on subsequent risk behaviour will in turn affect future decisions involving risk. For example, in research and development, incentivizing performance using competition may improve the results of current projects, but decisions made on the types of future projects to be attempted are influenced by risk attitudes; thus, the role of peers may be important.

The third chapter restricts the attention to competition, and enquires whether such an incentive, widely used in education and in the labour market to improve performance, may in itself shape risk behaviour, beyond any social comparison, and whether its impact on subsequent risk behaviour is heterogeneous according to gender. It shows that competition does not significantly affect subsequent risk-taking behaviour when considering the full sample. However, there is a positive relationship between competition and risk aversion in males, who become more risk-averse after losing in the competitive environment.

Overall, the research conducted shows that risk attitudes are not immutable but may be shaped by external factors. The inborn social nature of humans renders highly important the role played by the risk behaviour of peers, which already begins to emerge when bonds are weak and which becomes stronger as the social link intensifies. Any policy that aims to modify risk attitudes (or that does so indirectly) will thus spread its effects to the peers of the target subject, and may amplify its success if the peer group is chosen wisely. Changes in the characteristics of subjects' environment may change peer relationships. For example, the implementation of incentive schemes aimed at improving performance by introducing competition weakens subjects' attachment to their competing peers and may attenuate peer effects on risk behaviour. The choice of such an incentive should therefore consider the spillover effect coming from a weaker peer attachment. However, competition does not exert a direct impact on subsequent risk behaviour, except in males who become more risk-averse when they lose.

INTRODUCTION [1]

Risk is at play in many social and economic decisions, such as the choice of pathway in secondary school, the choice of major at university, job decisions, career advancements, health, marriage, parenthood, migration, eating habits, decisions around smoking, drug and alcohol use, criminal activity and the allocation of financial assets (Alexander et al., 2001; Fergusson et al., 2002; Saks and Shore, 2005; Belzil and Leonardi, 2007; Clark and Lohéac, 2007; Schmidt, 2008; Caner and Okten, 2010; Jaeger et al., 2010; Light and Ahn, 2010; Spivey, 2010; De Paola and Gioia, 2012). Risk attitudes are therefore an economic preference parameter that has attracted a great deal of attention from researchers interested in gaining a deeper understanding of the determinants of such decisions.

Abandoning the traditional view of individual preferences as immutable personality traits (Stigler and Becker, 1977), recent research has in fact shown that individual risk attitudes are not exogenously given, but instead influenced by external factors with the potential to change them in more or less enduring ways. Among such factors are environmental characteristics. For example, Dohmen et al. (2012) show evidence of the role played by family size and birth order on the intergenerational transmission of risk attitudes, with firstborn children and children with fewer siblings being more strongly influenced by their parents. Additionally, Booth and Nolen (2012), in a field study, show that women's risk preferences are influenced by the classroom's gender composition.

[1] The author has received financial support from The Economic and Social Research Council (ESRC) that has awarded her a three-year scholarship for the PhD studies. The views expressed in the thesis are those of the author and do not necessarily reflect those of the institutions she belongs to. The usual disclaimers apply.

Risk attitudes are also influenced by shocks and life experiences such as poverty, job loss or violence. Among others, Eckel et al. (2009) show that Hurricane Katrina evacuees exhibit risk-loving behaviour shortly after the disaster, while an opposite reaction is reported by Cameron and Shah (2015), who instead find that individuals in Indonesian villages that had suffered from a flood or an earthquake exhibit a long-lasting increase in risk aversion. Page et al. (2014) show higher risk-taking behaviour among individuals whose properties were directly affected by the 2011 Australian floods. Instead, Haushofer and Fehr (2014) point out a positive relationship between the psychological consequences of poverty, such as stress and negative affective states, and risk-averse decision-making. Similarly, Hetschko and Preuss (2015) find that job loss, and even the threat of job loss, make people less willing to take risks, although the effects are of a transitory nature. Callen et al. (2014) find a positive relationship between exposure to violence and a preference for certainty.

Another important factor influencing individual decisions in situations involving risk is their emotional state: Conte et al. (2013) show that joviality, sadness, fear and anger instigate risk-seeking behaviour, while Campos-Vazquez and Cuilty (2014) find that risk aversion increases with sadness. Furthermore, Bassi et al. (2013) use a controlled experiment to show that sunshine and good weather increase risk-taking in subjects.

Finally, risk behaviour is influenced by social relationships; several papers (see, among others, Gardner and Steinberg, 2005; Cooper and Rege, 2011; Ahern, Duchin and Shumway, 2013; Bougheas, Nieboer and Sefton, 2013; Balsa, Gandelman and Gonzàles, 2015; Lahno and Serra-Garcia, 2015) show evidence of peer effects on individual decisions involving risk. This last factor proves very important because, as the Greek philosopher Aristotle remarked about 25 centuries ago, "man is by nature a social animal"; he naturally seeks interactions with others for his well-being. He cannot live without the social environment because it is through social interactions that he develops thought, language, culture and personality. Neither can he live in isolation, because he cannot satisfy his mental and physical needs without the cooperation of his peers. His sociality is inborn.

Individuals physically or socially near to a subject do therefore exert an influence on his behaviour and choices; indeed, research in many fields, including biology, sociology and psychology, has investigated how and why this happens. In recent years, there have also been a sizeable amount of economic studies investigating the existence of peer effects across many settings and for many outcomes. Peer influence has been found to play a key role in academic achievement, choice of college major, workers' productivity, cheating behaviour, social outcomes, such as joining a fraternity, and risky behaviours, such as smoking, driving recklessly or committing a crime (Manski, 1993; Sacerdote, 2001; Zimmerman, 2003; Stinebrickner and Stinebrickner, 2006; Falk and Ichino, 2006; Carrell, Malmstrom and West, 2008; Mas and Moretti, 2009; Imberman, Kugler and Sacerdote, 2012; Falk, Fischbacher and Gächter, 2013).

Despite the large literature on peer effects in socio-economic outcomes, only recently has research started enquiring whether the observed peer effects on final outcomes are indeed the result of peer influence on individual preferences and attitudes which, in turn, affect economic decisions. In fact, along with the cognitive dimension, individual preferences and attitudes, like motivation, patience, risk propensity or perseverance, are important determinants of socio-economic outcomes.[2] Furthermore, certain attitudes have been shown to be more malleable than cognitive abilities over the life cycle and up to later ages (Borghans, et al., 2008). Therefore, studying the extent to which peers exert an influence on individual attitudes provides an important contribution to the optimal design of policy interventions on the economic outcomes affected by such attitudes. For example, it has been shown that

[2] The economic literature typically contrasts cognitive and non-cognitive skills. Cognitive abilities are defined by the American Psychological Association as "the ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning and overcome obstacles by taking thought" (Neisser et al., 1996; Borghans et al., 2008). Non-cognitive abilities are defined as "capabilities related to a person's personality; persisting attributes of human behavior, non-situational, such as self-control, self-discipline, agreeableness, self-esteem and conscientiousness" (Allport, 1937; Thiel and Thomsen, 2011).

more risk-averse individuals are more likely to go into public sector employment (Pfeifer, 2011). A policy intervention that wishes to foster private sector employment would benefit from research into peer influence on individual risk behaviour for two reasons. First, the existence of peer effects on risk behaviour would amplify the effects of the policy intervention, because it would imply that targeting the risk behaviour of a few individuals would generate an effect on private sector employment, not only for the target pool of subjects, but also for their peers. Moreover, the fact that peers have an influence on an individual's risk behaviour, causing individuals to become more risk-seeking when they are surrounded by more risk-seeking peers and vice versa, would imply that a wise choice of target pool may amplify the benefits of the policy intervention.

Thesis outline – The thesis contributes to the existing literature on the determinants of individual risk behaviour, both by providing new evidence on some of the effects already investigated in behavioural economics and by exploring new relationships which suggest directions for future research. It mainly focuses on peer effects on risk behaviour by investigating if, how and, above all, when an individual's risk attitudes are influenced by the behaviour of his peers. In addition, it considers the incentive structure that characterizes the environment to study whether it influences individual risk behaviour, both directly and through changes in peers' relationships.

The thesis is composed of three chapters.

The first two chapters provide new evidence that individual risk behaviour is influenced by the risk behaviour of their peer group, and offer one explanation as to why peer effects are not always present and vary in intensity. This is due to the fact that individuals are more influenced by peers to whom they feel more attached. Some recent evidence suggests that not all peers influence an individual's behaviour, while some peers exert a stronger influence (Vaquera and Kao, 2008; Lomi et al., 2011; Borjas and Doran, 2014; Lin and Weinberg, 2014). The first chapter shows that individuals' feelings of attachment to the various peers with whom they interact differ in intensity, and this is reflected in the extent to which they are influenced by their peers' behaviour. The second chapter digs deeper into this evidence by investigating the role played by the incentive structure characterizing the individuals' environment. Since the first chapter shows that peer effects vary in intensity, I hypothesize that different types of incentive schemes may alter peer relationships and, therefore, vary the extent to which individuals are influenced by their peers. The research conducted shows that, compared with a piece-rate or a cooperation-based incentive, competition attenuates feelings of attachment to peers and peer influence on risk behaviour; however, the latter effect is not significant in statistical terms.

Just as the research question of the second chapter arose as an extension of the first, the topic of the third chapter follows up on the evidence provided by the second. In fact, the third chapter restricts the attention to competition, the incentive scheme that has been shown to reduce peer influence on risk behaviour, and enquires whether this type of incentive has a direct effect on risk-taking behaviour, beyond any social comparison, and whether its impact on subsequent risk behaviour is heterogeneous according to gender. Therefore, while the second chapter compares different incentive schemes to study the differences in peer influence on risk behaviour, the third chapter looks only at competition, an incentive scheme widely used in education and in the labour market to improve performance. It studies the direct effect of introducing competition on individual risk-taking behaviour in an otherwise equal environment, in which the individuals cannot observe their peers' risk behaviour and so cannot be influenced by them when making decisions involving risk. The contribution of the third chapter is related both to research on factors with the potential to influence individual risk behaviour, and to a recent strand of the literature explaining observed gender inequality that ascribes gender differences in socio-economic outcomes, such as choice of field of study, job profile, occupation or earnings, to gender differences in attitudes and preferences. In particular, women have been shown to be more risk-averse than men (Eckel and Grossman, 2008; Croson and Gneezy, 2009) and to shy away from competition, often performing worse than men in competitive situations (Gneezy et al., 2003; Niederle and Vesterlund, 2007). This evidence has been combined and suggested as an explanation for the observed gender differences in the labour market (Booth and Nolen, 2012). We go one step further by investigating if, once competition has been introduced, its effect on subsequent risk behaviour, and in turn on subsequent decisions involving risk that may affect future productivity, differs according to gender.

Each chapter of the thesis presents the results of a different laboratory experiment, in which individual risk attitudes are always measured using the Bomb Risk Elicitation Task - BRET (Crosetto and Filippin, 2013). This task asks participants to choose how many boxes to collect out of 100, knowing that 99 boxes contain £0.10 while one contains a bomb, but without knowing in which box the bomb is located. They can therefore choose their preferred lottery among the 100 lotteries whose outcomes and probabilities are fully described only by one parameter, i.e., the number of collected boxes. Earnings increase linearly with the number of boxes collected, but they are all lost if the bomb lies in one of the collected boxes.

In both economics and psychology, there are many experimental methods used to elicit risk attitudes (see Charness, Gneezy and Imas, 2013, for a review of the advantages and disadvantages of the most common risk elicitation methods). We use the BRET because of a number of appealing features, such as its short duration; ease of understanding, thanks to the visual representation of the game which illustrates probabilities and outcomes in an intuitive and transparent way; the possibility to precisely measure both risk aversion and risk seeking; and the absence of endogenous reference points.

In the first two chapters, risk behaviour is measured both before and after the treatment manipulation, and feedback on peers' ex-ante risk behaviour is used as a channel to study peer influence on the subject's ex-post risk behaviour.

The **first chapter** (*Peer effects on risk behaviour: the importance of group identity*) investigates whether and to what extent group identity plays a role in peer effects on risk behaviour. Psychologists define group identity as "the portion of an individual's self-concept derived from the sense of belonging to the social group" (Hogg and Vaughan, 2002). Group membership is a ubiquitous feature of social and economic life. However, groups vary enormously, as does people’s attachment to different social groups. In this paper, we hypothesize that the sense of belonging to a social group may affect the realization and magnitude of peer effects.

Different levels of group identity are induced in a laboratory experiment through different matching protocols (Chen and Li, 2009). The lowest level of group identity is represented by a random group assignment, where subjects are randomly matched in pairs. Group identity is enhanced by introducing a group assignment protocol based on individual painting preferences, where individuals are first asked to express their painting preferences by choosing their favourite paintings from a set of five pairs of paintings; they are then matched according to their painting preferences. Finally, the saliency of group identity is increased by letting people interact with fellow group members, after being matched according to their painting preferences, in a group task consisting of their guessing the name of the artists responsible for two more paintings via an online chat application, in order to ask for help from and offer aid to their fellow group members.

We find evidence of peer effects on risk behaviour, and find that they depend on the level of group identity: painting preferences matching significantly reduces the heterogeneity in risk behaviour when compared with random matching (the group’s standard deviation falls by 4.4 boxes collected in the BRET, about 0.54 SD). On the other hand, introducing a group task has no significant effect on behaviour, possibly because interaction does not always contribute to an enhancement of group identity. Indeed, we find that when group identity is likely to be stronger following peer interaction - because participants consider their group to be more helpful than average, feel more attached than average to their peers or reach an agreement on possible answers in the group task very quickly - the magnitude of peer effects on risk behaviour does increase in comparison with peers matched by painting preference but who do not take part in peer interaction (for example, when the peer group is considered helpful, the heterogeneity in risk behaviour reduces by 3.8 boxes).

Finally, the relative riskiness within the group matters and individuals tend to adjust their choices to converge to their peers.

Our results showing that in an artificial social environment, i.e., a laboratory setting, peers affect individual risk behaviour and a less impersonal categorization procedure and an increased – positive – interaction with peers strengthen peer effects may be suggestive of an effect of the behaviour of the group of peers on individual's risk behaviour in the real world too. This would imply that targeting the risk behaviour of a few individuals might generate an effect on outcomes that have been found to be strongly influenced by risk, not only for the target pool of subjects but also for their peers. Moreover, given that the magnitude of peer effects increases as the individual's closeness to the group increases, a wise choice of the target pool may amplify the benefits of the policy intervention.

The **second chapter** (*Incentive Schemes and Peer Effects on Risk Behaviour: An experiment*) studies whether incentivizing performance with competition and cooperation-based incentive schemes, rather than just individual compensation, affects peer effects on subsequent risk behaviour.

We suggest that the introduction of a competition/cooperation-based incentive scheme is similar to the manipulation of group identity, meaning that it may influence peer effects on risk behaviour: compared with working individually but surrounded by random co-workers, subjects may be less likely to perceive a competitor as a member of their group because when peers are competitors, they are working to reach a personal goal and only one peer will be able to meet this goal. Instead, being teammates may (depending on the teammates' behaviour) increase the salience of peers and enhance the feeling of belonging to the peer group. In fact, with cooperation-based incentive schemes, like an equal-split-sharing-rule, peers work to reach a common goal and this enhances their group membership. However, since a peer's performance/contribution to the group's output positively affects the individual, peer relationships may also be weakened by a peer's contribution not meeting individual expectations, for example, because of the under provision of effort due to free-riding.

We answer our research question by running a laboratory experiment in which we introduce three different incentive schemes, namely piece-rate, equal-split-sharing-rule and tournament, as the compensation rule governing a real effort task that consists of recognizing the value and country of origin of Euro coins, performed between the ex-ante and ex-post elicitation of risk behaviour. We again find evidence of peer effects on risk behaviour. Peer influence is very similar in size under the piece-rate and cooperation-based compensation schemes (for each additional box collected in the first performance of the BRET by their peer, individuals increase their choice in the second performance of the BRET by about 0.20 boxes under the piece-rate and 0.17 boxes under the cooperation-based incentive schemes), while it is more than halved when performance is incentivized using competition (0.06 boxes), although this difference is not significant in statistical terms. Importantly, after competing with them, participants feel significantly less attached to their peer than after the implementation of both the piece-rate (-1.15 on a 0 to 10 scale) and cooperation-based compensation schemes (-1.72). Additionally, tournaments significantly attenuate self-reported peer influence compared with the other two compensation schemes (-17 percentage points *vs* piece-rate and -27 percentage points *vs* cooperation-based incentives). Finally, we find that relative performance in the incentivized task matters in terms of peer effects on subsequent risk behaviour, and that while the worst performing subjects within the group are influenced by their peers, the best performing subjects are not.

Our findings support the evidence of peer effects on risk behaviour, which are important from a policy perspective because in several environments policy-makers or private companies may be interested in influencing individuals' choices involving risk, and peer effects may amplify the effects of such interventions because they will spread them to peers as well. Our focus on if and how incentives influence peer effects on risk behaviour - and, in turn, subsequent decisions influenced by risk attitudes - allows us to understand both whether policy interventions that benefit from the multiplying effect of peer influence may still be successfully implemented under different incentive schemes, how to design the optimal compensation scheme and whether to base its evaluation only on performance.

The **third chapter** (*Competition and subsequent risk-taking behaviour: heterogeneity across gender and outcomes*) studies whether competition shapes subsequent risk behaviour and if such an effect is heterogeneous according to gender.

Competition is important in a wide range of economic decisions and is seldom a one-shot phenomenon, as individuals face many situations involving competitive pressure and make relevant decisions even after the competition is over. Therefore, besides its short-run effects on performance, competitive pressure may induce other effects, such as changes in risk behaviour, with the potential to affect subsequent decisions, adding to its long-run impact. Subjects may change their risk attitude after competitive endeavours for many reasons, such as experiences of stress or of different emotions and social comparison due to competition, which induces ex-post inequality and makes relative payoff concerns salient.

We investigate the causal effect of competition on subsequent risk-taking behaviour by running a lab experiment eliciting the risk attitudes of a sample of subjects who have performed a real effort task, which consists of recognizing the value and country of origin of Euro coins, exogenously manipulated in terms of the degree of competitiveness. We design the experiment in order to carefully control for wealth effects, isolating the pure effect of competition at the individual level and excluding social comparison considerations.

We find that, overall, subjects display more risk-averse behaviour after a competition yielding either a high or a low payoff than after receiving the same payoffs randomly (on average, they collect about 4 boxes less after competing, 0.24 SD). However, this positive relationship between competition and risk aversion is not statistically significant.

Since males and females have been shown to have different levels of fondness for competition (Niederle and Vesterlund, 2007), they may experience the competition differently; so, potential effects on subsequent risk behaviour may be different across gender. The analysis of gender heterogeneity shows that, while females' behaviour is not affected by competition or its outcomes, males become more risk-averse after losing in the competitive environment (they collect on average 9 boxes less than in the baseline). On the other hand, there is no evidence of a symmetric increase in risk-seeking behaviour after winning the tournament. We acknowledge that, given our design, the outcome-dependent evidence is only suggestive. However, we interpret our findings in terms of males' reaction to negative outcomes, driven by intrinsic motives. One possible explanation is that the negative outcome may arouse emotions that, in turn, affect subsequent decisions under risk. Alternatively, the negative outcome may induce a shift in the locus of control. Losing may reduce the extent to which one believes that he can predict or influence future events and this may, in turn, increase risk aversion. When losing in a competitive task, males might even be inclined to project their inability to control events onto subsequent decisions involving merely random outcomes. Identifying, in a controlled manner, the ultimate cause for which losing a competitive endeavour increases males' risk aversion constitutes an interesting goal for future research, together with further investigation into the future and indirect consequences of competition, over and above its immediate effect on productivity.

The evidence presented adds to the literature demonstrating that individual risk attitudes are not immutable, but are shaped by external factors. Specifically, it highlights the role played by the risk behaviour of peers, showing that peer influence already begins to emerge when bonds are weak and becomes stronger as the social link intensifies. Any policy oriented towards modifying risk attitudes (or that does so indirectly) will thus spread its effects to the target subjects' peers, and may amplify its success if the peer group is chosen wisely. A change in the characteristics of the environment due to the introduction of competition weakens subjects' attachment to their competing peers and may attenuate peer influence on risk behaviour. Moreover, competition per se has no direct impact on subsequent risk behaviour, except for males who become more risk-averse after losing.

Investigating whether the influence of group identity, along with other changes in the subjects' environment, on how peers affect risk behaviour is heterogeneous along both gender and ability dimensions, as well as the size and composition of the peer group, appear to be fruitful directions for future research. Furthermore, domains other than the monetary one in which risk plays a role should also be considered.

CHAPTER 1

Peer Effects on Risk Behaviour:

The Importance of Group Identity

Abstract

This paper investigates whether and to what extent group identity plays a role in peer effects on risk behaviour. We run a laboratory experiment in which different levels of group identity are induced through different matching protocols (random or based on individual painting preferences) and the possibility to interact with group members via an online chat in a group task. Risk behaviour is measured by using the Bomb Risk Elicitation Task and peer influence is introduced by giving subjects feedback regarding group members' previous decisions. We find that subjects are affected by their peers when taking decisions and that group identity influences the magnitude of peer effects: painting preferences matching significantly reduces the heterogeneity in risk behaviour compared with random matching. On the other hand, introducing a group task has no significant effect on behaviour, possibly because interaction does not always contribute to enhance group identity. Finally, relative riskiness within the group matters and individuals tend to adjust their choices to converge to their peers.

Keywords: Peer Effects, Group Identity, Risk Behaviour, Ranking

JEL Classification: D03, D81, D83, Z13

1.1 INTRODUCTION

The question of whether and how peers influence an individual's behaviour has been widely investigated in economics literature. Considerable evidence suggests that individuals who are physically or socially close to a subject influence his/her behaviour and choices. Peers' influence has been studied in the context of academic achievement, choice of university degree course, worker productivity, cheating behaviour and social outcomes such as joining student societies (Manski, 1993; Sacerdote, 2001; Zimmerman, 2003; Stinebrickner and Stinebrickner, 2006; Falk and Ichino, 2006; Carrell, Malmstrom and West, 2008; Mas and Moretti, 2009; Imberman, Kugler and Sacerdote, 2012; Falk, Fischbacher and Gächter, 2013).

Peer effects have also often been mentioned as a leading explanation for why people engage in risk taking activities such as smoking (Alexander et al., 2001), drug and alcohol use (Fergusson et al., 2002; Duncan et al., 2005; Powell et al., 2005; Lundborg, 2006; Clark and Lohéac, 2007), criminal activity (Fergusson et al., 2002; Bayer et al., 2009), financial decisions (Kelly and O'Grada, 2000; Hong et al., 2004; Brown et al., 2008; Bursztyn et al., 2014; Cai et al., 2015) and entrepreneurship decisions (Nanda and Sørensen, 2010; Falck et al., 2012; Lerner and Malmendier, 2013).

Despite their relevance for many social and economic interactions, little is known about the circumstances triggering peer effects. In this paper, we investigate the role of group identity, which psychologists define as "the portion of an individual's self-concept derived from the sense of belonging to the social group" (Hogg and Vaughan, 2002). Group membership is a ubiquitous feature of social and economic life. However, groups vary enormously and so does people's attachment to different social groups. We hypothesize that the sense of belonging to a social group may affect the realization and magnitude of peer effects.

Since the introduction of the minimal group paradigm by Tajfel (1970) and the subsequent development of the social identity theory (Billig and Tajfel, 1973), different levels of group identity have been introduced to understand how and why people behave differently towards those that they share a common identity with. In particular, numerous studies document that people tend to behave more prosocially when they interact with members of their own group, but become less generous, less trusting, and less cooperative towards individuals who belong to different groups (Tajfel et al. 1971; Götte, Huffman and Meier, 2006; Charness, Rigotti and Rustichini, 2007; Chen and Li, 2009).

The goal of this paper is to study whether and to what extent group identity plays a role in peer effects on risk behaviour. Some recent evidence suggests that not all peers matter and some matter more than others (Vaquera and Kao, 2008; Lomi et al., 2011; Lin and Weinberg, 2014; Borjas and Doran, 2015). The sense of belonging to a group may be a possible explanation for this finding: individuals may only be affected by social groups they feel they belong to and the peers they are particularly attached to may matter more than other peers. Knowing that group identity is one of the mechanisms triggering peer effects may help the design of policy interventions the benefits of which may be increased by choosing the target peer group wisely. Also, considering that risk is at play in a large range of social economic decisions, such as choice of career, university degree course or study effort (Saks and Shore, 2005; Belzil and Leonardi, 2007; Caner and Okten, 2010; De Paola and Gioia, 2012), and that recent evidence shows that an individual's risk behaviour is shaped by the behaviour of others in the immediate social environment, studying the role that group identity has in an individual's decision-making when faced with risk would appear to be especially worthwhile. To our knowledge, we are the first to look at the degree of group identity as a determinant of the strength of peer effects.

In this paper, we use procedures commonly used in the literature to induce different levels of group identity (Tajfel, 1970; Chen and Li, 2009) with the aim of investigating the impact of group identity on the magnitude of peer effects on an individual's decisions in a risky setting.

We run a laboratory experiment with 255 students. We measure individual risk behaviour by using the Bomb Risk Elicitation Task, an easy task in which subjects have to choose how many boxes to collect out of 100, 99 of which contain £0.10

while one contains a bomb. Earnings increase linearly with the number of boxes collected, but are zero if the bomb is collected. Peer influence is introduced by providing subjects with feedback on fellow group members' decisions in the immediately preceding performance of the task.

The experiment consists of a control group and four treatments. One treatment, called *Anchoring* treatment, is meant to distinguish peer effects from anchoring effects that may arise if the change in individual behaviour is driven by the exposure to numbers rather than by a desire to be similar to assigned peers. The other three treatments introduce a different level of group identity. The *Random* treatment matches individuals into groups of three at random. The *Painting* treatment introduces a less impersonal matching: individuals are first asked to express their painting preferences, by choosing their favourite paintings from within five pairs of paintings, and then are matched according to their painting preferences. Finally, the *Chat* treatment matches individuals according to their painting preferences and entails a group task which consists of their guessing the name of the artists responsible for two more paintings by using an online chat to ask for help from and offer aid to their fellow group members. This additional task is meant to enhance the level of perceived group identity by letting people interact with fellow group members more.

We find evidence of peer effects in risk behaviour and find that they depend on the level of group identity. Individuals who are assigned to groups based on their painting preferences are more likely to conform to their peers than the control group (the group standard deviation falls by 8.5 boxes collected in the BRET) and the anchoring treatment (-7.8 boxes). Also, enhancing the level of group identity, by making people aware that they have the same painting preferences as their peers, significantly increases (by about 4.4 boxes) peer effects beyond those produced through a random group assignment. While peer effects remain statistically significant when a difference-in-differences model is estimated, the size of the increase in the effect due to the less impersonal matching protocol based on a shared preference becomes smaller and no longer significant at conventional levels.

The chat treatment, which combines a preferences-based matching with a group task, does not induce significantly different peer effects from those found for the painting treatment (-7.8 boxes). We speculate that this may be because the group task has a different effect on perceived group identity as a consequence of the individual experience in the task. Indeed, we find that when interaction in the group task contributes to the enhancing of group identity, the magnitude of peer effects on risk behaviour does increase in comparison with the painting treatment. For example, with regard the control group, groups in the chat treatment whose participants consider their group to be more helpful than the average significantly reduce their heterogeneity in risk behaviour by 5.2 boxes more than groups in the chat treatment who do not find their group very helpful, and by 3.8 boxes more than groups in the painting treatment. Similar results are found for groups whose participants feel more attached than the average to their peers or reach an agreement on the possible answers in the group task very quickly.

The relative position of the individual within the group in terms of risk behaviour plays an important role in the individual's decisions when receiving feedback about peers' previous decisions. Individuals whose peers are riskier than they are tend to increase their choice by 12.3 boxes compared with individuals with mixed peers, while individuals whose peers are less risky than they are tend to decrease it on average by 5.5 boxes. When ruling out the component of the effect due to regression to the mean, peers' risk behaviour continues to play a significant role for bottom ranked individuals (+6.9 boxes, significant at the 1 percent level) while the effect is negative but very close to zero for top ranked individuals (-1 box). However, the increase in risk aversion experienced by top ranked individuals goes in the opposite direction and more than offsets the tendency to decrease risk aversion when performing the risk elicitation task for the second time that emerges in the literature and in our data. Instead, the increase in risk-seeking behaviour due to having riskier peers is similar to the increase in riskiness implied by a second risk elicitation.

The paper is structured in five parts. Section 1.2 presents a brief overview of the related literature. In section 1.3, we describe our experimental design. Section 1.4 presents our empirical analysis. Section 1.5 concludes.

1.2 LITERATURE REVIEW

This paper combines three different branches of economics and psychology literature: research investigating the extent to which an individual's behaviour is modified by his/her peers; research looking at the determinants of risk behaviour; research into the development of a group identity and its effects. Only a few very recent papers integrate the literature on peer effects and the literature on risk attitudes to look at the role played by peers in an individual's risk behaviour, but no one induces different levels of group affiliation as we did.

Gardner and Steinberg (2005) investigate the impact of peers on the orientation towards risk of different age groups and find that, on average, individuals are more risk seeking when in the company of their peers than when alone and that peer influence plays a stronger role in explaining risky behaviour among adolescents and youths than it does among adults. Unlike our study, the authors do not use incentivized tasks, but pay a fixed fee and, instead of giving feedback on peers' choices, they let peers work together or intervene when other peers are working. More importantly, they investigate the emergence of peer effects in a setting with a very high level of group identity because they require participants to invite two people they know of the same gender to the session and let these three people constitute a peer group.

Cooper and Rege (2011) show the existence of peer group effects in a series of binary choices under risk and ambiguity by using feedback about the choices made by other subjects as the channel for peer influence. They find that peer effects in risk behaviour may be explained by social regret, that is an individual decides to behave similarly to his/her peers because s/he experiences a lower loss in utility from not taking an action that would have led to higher payoffs *ex post* if his/her peers have also not taken that action. In our experiment, social regret is ruled out by design as a possible cause of peer effects because participants never choose from among the same lotteries. Thus even when choosing the same action, they might end up with different payoffs. Moreover, participants have all the time they need to make their decision in our setting, while time pressure might play a role in Cooper and Rege's experiments because, if subjects do not take a choice within about one minute, it is randomly taken by the computer.[3]

Another experimental paper investigating peer effects on risk behaviour is by Lahno and Serra-Garcia (2015). They use binary lottery choices as a task to be performed to test for two causes of peer effects, utility from payoff differences and utility from conforming to peers, and show that peer effects are mainly explained by the former and that responses to peers' decisions depend on whether peers' choices are voluntary or randomly imposed by the experimenter. As in our experiment, they use feedback on the peers' decision as the channel for peer influence; however, while we rule out relative payoff concerns by design, their focus is on the direct impact of payoff differences.

Evidence of peer effects on risk behaviour is also found by Bougheas, Nieboer and Sefton (2013), who use a laboratory experiment to study the importance of two channels, consultation and feedback, for peer interaction, rather than the causes of peer effects, and by Balsa, Gandelman and Gonzàles (2015) and Ahern, Duchin and Shumway (2013), who use survey data on adolescents and MBA students, respectively. Finally, Trautmann and Vieider (2012) present an overview of social influences on economic decisions under risk.

The other strand of literature this paper refers to, is the literature on group identity. There are two main experimental methods used to study social identity in social psychology: priming natural social identities and artificially inducing group

[3] The psychology and economics literature shows that time pressure is detrimental for decision quality (Diederich, 1997; Busemeyer and Diederich, 2002; Diederich and Busemeyer, 2003) and for performance (De Paola and Gioia, 2016).

identities. We decided in favour of induced group identities because our aim is to look at the effect of an increase in perceived social identity on peer group influence effects on risk behaviour. Priming would make it difficult both to create increasingly stronger group identities and to separate the effect of a stronger group identity *per se* from the meaning attached to the primed identity.[4]

The literature which induces different levels of group identity has typically used the minimal group paradigm, that is it has categorized people into some groups according to some trivial criterion, such as visual judgements (estimating the number of dots flashed onto a screen) or painting preferences (choosing between Klee or Kandinsky paintings), and has further increased the saliency of the group by introducing payoff communality and interaction among group members (Charness, Rigotti, and Rustichini, 2007; Chen and Li, 2009; Güth, Ploner, and Regner, 2009; Sutter, 2009; Arora et al., 2012).

This literature has mainly studied the role of social categorization in inter-group discrimination and social preferences and has shown that individuals who are assigned to novel social categories discriminate in favour of their own category. There are no studies that focus on the role of risk behaviour and use a setting where the individual decides just for himself and not for the other participants.

Among the main papers which study the effect of inducing a greater sense of group identity, Chen and Li (2009) look at social preferences and find that individuals are both more charitable and less envious towards members of the same group than towards people from outside the group and both more likely to reward a fellow group member *vs* an outsider for good behaviour and less likely to punish him/her for misbehaviour. Moreover, social welfare maximizing decisions are more likely when subjects are matched with fellow group members. Charness et al. (2007) show that

[4] Research using the priming method has shown that making different natural social identities salient through priming can affect outcomes, such as test performance or walking speed (Steele and Aronson, 1995; Shih, Pittinsky, and Ambady, 1999; Spencer, Steele and Quinn, 1999; Fershtman and Gneezy, 2001; Yopyk and Prentice, 2005; Bernhard, Fehr, and Fischbacher, 2006; Götte et al., 2006; Bargh, 2006; McLeish and Oxoby, 2011). However, the priming method may lack some of the desired control over the experimental situation and conclusions drawn from using this method may be hampered by confounding factors such as experimenter demand effects and spuriously induced behaviour changes (Zizzo, 2012).

participants act more aggressively to the benefit of their group and at the expense of outsiders as identity becomes more salient. Similarly, Arora et al. (2012) find that increases in group affiliation are accompanied by higher levels of cooperation, personal satisfaction and trust in one's group.

1.3 EXPERIMENTAL DESIGN

The individual level of risk aversion is measured by using the Bomb Risk Elicitation Task – BRET (Crosetto and Filippin, 2013). This method measures risk behaviour by having subjects choose how many boxes to collect out of 100, 99 of which contain £0.10 while one contains a bomb.

In both Economics and Psychology, there are a variety of experimental methods for eliciting and assessing risk behaviour (see Charness, Gneezy and Imas, 2013, for a review of advantages and disadvantages of the most common risk elicitation methods). We use the BRET because of a number of appealing features. First, its duration is very short and it can even be run with paper and pencil, which would allow the repetition of our experiment in the field where access to a computer is limited. This could prove very interesting given that field work would allow observation of levels of group identity that are very close to real-life ones. Second, the BRET is very easy to understand thanks to the visual representation of the game which illustrates probabilities and outcomes intuitively and transparently. Simple methods are most useful in studies like ours which try to capture treatment effects and differences in individual risk preferences (Charness, Gneezy and Imas, 2013). Moreover, the absence of complexity from the task should reduce the extent to which social learning drives peer effects on individual risk behaviour within our setting.[5]

[5] Social interaction may influence individual behaviour for many reasons. We do not aim to identify the specific mechanism at work in our setting however the most likely one is conformism, the act of changing one's behaviour to match the responses of others (Cialdini and Goldstein, 2004; Asch, 1955). If conformism is at work, the extent to which individuals like to behave similarly to their peers may be stronger, the deeper the sense of belonging to the group is. The scope for social learning is reduced to a

Finally, compared with other well-known tasks in the literature, the BRET allows precise measurement of both risk aversion and risk seeking, is defined entirely in the gain domain and does not provide any endogenous reference point, thus avoiding the presence of loss aversion as a potential confounding factor.[6]

We induce different levels of group identity following a procedure, similar to the one used by Chen and Li (2009) to study social preferences, that combines two assignment methods (random and based on painting preferences) and a collective problem solving task using an online chat program to enhance feelings of belonging to the assigned group.[7]

1.3.1 Procedure

We conducted the experiment in April 2014 through computers at the Behavioural Laboratory at the University of Edinburgh (BLUE) and programmed it by using z-Tree (Fischbacher, 2007). The experiment consists of four treatments and a control. We ran three sessions for each of the treatments and for the control. Each session was divided into three parts and the treatment protocol (group matching and feedback on group decisions) was introduced for the second and third parts.

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minimum by our design and if it plays any role, given that the available information on peer behaviour is the same, its effect is plausibly similar across group identity treatments. Social utility in the form of relative payoff concerns and, thus, potential feelings of envy or guilt (Fehr and Schmidt, 1999) is unlikely in our setting because there is no direct spillover across individuals' payoffs and, even if they make the same choice, there is a very low probability of their earning the same payoff. Participants do not directly interact before performing the task, so there are no knowledge spillovers that involve direct sharing of information. Moreover, individuals and groups are anonymous, therefore there is no way of expressing approval or disapproval which might give rise to a social norm and there is no social pressure arising from the fear of being alone, marginalized by the peer group and/or considered "different".

[6] Moreover, unlike other risk elicitation methods, such as the Balloon Analogue Risk Task (Lejuez et al., 2002), there is no truncation of data in the BRET.

[7] By comparing different treatments, Chen and Li (2009) find that, on one hand, random assignment is as effective as group assignment based on participant painting preferences in inducing group identity; on the other hand, the group task using the online chat significantly increases the self-reported attachment to the group and might have a moderate effect on behaviour. The authors also introduce other-other allocation tasks and find that they have no significant effect. Based on these results and on the authors' concern that the group effect induced by categorization may deteriorate over time, we decide not to introduce the other-other allocation tasks and to reduce the length of the chat in the group task from 10 to 5 minutes.

Participants were recruited using the ORSEE software (Greiner, 2015). A total of 255 students participated in the experiment, distributed over 15 sessions of about 35 to 40 minutes each.

Upon entering the laboratory, we randomly assigned participants to a computer. Then, we read aloud the introductory instructions to the experiment, which were also displayed on the participants' computer screens. We gave detailed instructions at the beginning of each part and, when needed, before each relevant step in the experiment. On each occasion, after reading the instructions, we gave individuals some time to ask clarifying questions.

Participants always had to perform the same task: the Bomb Risk Elicitation Task (BRET). In both parts I and II of the experiment, participants performed the BRET once. They performed the BRET 10 times in part III of the experiment.

When playing the BRET, subjects see a square on their PC screen formed of 10x10 cells which represent the 100 boxes that they can collect (see Figure 1). They have to choose how many boxes to collect and write down their chosen number.[8] They can therefore choose their preferred lottery among 100 lotteries whose outcomes and probabilities are fully described by just one parameter, i.e. the number of collected boxes.

[Figure 1 Here]

Earnings increase linearly with the number of boxes collected, but participants are warned that their earnings are provisional. In fact, they know that one box contains a bomb without knowing which box this is.

Boxes are collected in numerical order starting from number 1 in the top left hand corner and continuing until the number of boxes chosen by the subject is

[8] We asked participants to write the same number twice and to confirm their choice in order to avoid measurement errors due to an incorrect number being input.

reached. While reading the instructions, we display a dynamic visual representation of the game on the main screen to show the order of collection.

If a participant collects the bomb, s/he earns zero. If s/he collects a number of boxes inferior to the number of the box containing the bomb (i.e. s/he does not collect the bomb), s/he obtains £0.10 for each collected box. After confirming their decision, participants see the square of boxes on their screen. This shows the collected boxes in light grey and a message with the potential earnings in both situations (if the bomb is collected or not). Figure 2 shows the computer screen for a participant who chose to collect 35 boxes.[9]

Participants are allowed to play a practice round before the beginning of the experiment. This practice round gives them an opportunity to make sure they understand the rules, the types of decisions they will make and how these will affect their earnings. The trial period, however, does not end with the draw of the bomb's position so as to avoid providing subjects with a reference point regarding the bomb's position.

[Figure 2 Here]

At the end of the experiment, participants completed a short questionnaire. Then, one of their decisions and the position of the bomb were selected by separate random

[9] We decided in favour of a static version of the BRET to avoid individual levels of impatience affecting participants' decisions and, thus, our indicator of risk behaviour (in the dynamic version of the BRET, one cell is automatically deleted from the screen each second, to represent a collected box, and subjects have to wait while the deletion process goes on until their chosen number of boxes have been collected. Even when the time interval between the deletion of the cells is reduced, this mechanism always entails an element of patience whereby a high level of risk aversion might reflect lower patience and vice versa). Nevertheless, given that Crosetto and Filippin (2013) point out higher comprehension problems in the static version, in order to be sure that a participants' decision was not driven by confusion or imperfect comprehension of outcomes and probabilities, we also introduced a dynamic visual representation of the collection process when explaining the rules of the task and a visual representation of the boxes collected and uncollected after each decision.

draws carried out at the individual level.[10] The selected decision and the corresponding earnings were shown on the computer screen together with the selected bomb position. We paid out total earnings (including a show-up fee of £3) in cash at the end of the experiment. We called participants individually on the basis of their computer number and they went into another room, signed a receipt and received their earnings in an envelope. Average earnings for participant were £5.45 (including the show-up fee).

1.3.2 Treatments

We exogenously sorted the experiment participants into a control group, a treatment group (Anchoring) designed to distinguish between anchoring effects[11] and peer effects[12] and three treatment groups (Random, Painting, Chat) designed to increase group identity.

Table 1 describes the main features of our treatments. There are 51 participants in the control group; 48 in the random and chat treatments and 54 in the anchoring and painting treatments.

[Table 1 Here]

Participants in the random treatment are randomly matched into groups of three.

In the painting treatment, the matching is based on individual preferences: individuals are shown five pairs of paintings and have to choose their favourite

[10] We decided to determine the position of the bomb individually because recent evidence on the BRET (Crosetto and Filippin, 2017) shows that there seem to be peer effects when the random draw is carried out once for the whole lab rather than individually.

[11] According to Tversky and Kahneman (1974) the anchoring effect is the disproportionate influence on decision makers to make judgments that are biased toward an initially presented value. The anchoring effect has been studied in different domains, such as valuations and purchasing decisions (Wansink et al., 1998; Mussweiler et al., 2000; Ariely et al., 2003). See Furnham and Boo (2011) for a review.

[12] The sessions of the Anchoring treatment were conducted in October 2015.

painting within each pair. In each pair, one painting is by Klee and one is by Kandinsky (individuals are not told who the artists are).[13] After having chosen their favourite paintings, they are classified as either a "Kandinsky fan" or a "Klee fan": an individual prefers Klee to Kandinsky if in at least three out of the five pairs s/he chooses Klee rather than Kandinsky, and vice versa. Then, subjects sharing the same painting preferences are assigned to groups of three and receive information about the painting preferences of all the members of their group.[14]

The chat treatment is very similar to the painting treatment. The only difference is that, after being matched into groups of three based on their painting preferences and before performing the BRET again with information, individuals in the chat treatment have to perform a group task. Subjects are shown two additional paintings[15] and are given five minutes to exchange information on the artists who produced the two paintings with fellow group members via an online chat program in order to choose the right answers. After the chat, they have to choose individually the artist responsible for each of such two additional paintings. Each correct answer is worth £1. The outcome of this task is only known at the end of the experiment together with the earnings from the selected decision.[16]

At the end of the experiment, after having completed the questionnaire, subjects in the painting and chat treatments received the answer key with the names of the artists who produced all the paintings.

Participants in the control group and in the anchoring treatment are not assigned to groups. A random matching is carried out simply for the purposes of analysis. The

[13] As in Chen and Li (2009), the five pairs of paintings are: 1A Gebirgsbildung, 1924, by Klee; 1B Subdued Glow, 1928, by Kandinsky; 2A Dreamy Improvisation, 1913, by Kandinsky; 2B Warning of the Ships, 1917, by Klee; 3A Dry-Cool Garden, 1921, by Klee; 3B Landscape with Red Splashes I, 1913, by Kandinsky; 4A Gentle Ascent, 1934, by Kandinsky; 4B A Hoffmannesque Tale, 1921, by Klee; 5A Development in Brown, 1933, by Kandinsky; 5B The Vase, 1938, by Klee.

[14] Having the three group members sharing the same painting preferences has not always been possible owing to the number of fans of each artist within the sessions being not a multiple of three. Three groups have only two members sharing the same painting preferences while the third member is a fan of the other artist.

[15] As in Chen and Li (2009) the two additional paintings are: Monument in Fertile Country, 1929, by Klee and Start, 1928, by Kandinsky.

[16] 56.25 percent of the participants provided correct answers to both paintings; 6.25 percent provided one correct answer and 37.5 percent provided zero correct answers.

presence of a group to which they have been assigned is never communicated to subjects.

The first part of each session is the same for all groups: participants in all treatments and the control group play the BRET individually once. The treatment protocol is introduced in part II of the experimental session and is also present in part III. Thus, in parts II and III, participants in the control group perform the BRET under the same conditions as in part I. Instead, participants in the random, chat and painting treatments perform the BRET after receiving information about the number of boxes that each member of the group decided to collect on the previous occasion that the BRET was performed. Instructions make it clear to subjects that their payoffs depend solely on their own choices, not on the choices of other subjects. The information on choices made previously by group members is displayed both on the waiting screen before the main BRET screen and in the top right corner of the main BRET screen (above the fields where the participants have to write the number of boxes they would like to collect). The members assigned to a group in part II are still in the same group in part III.[17]

The anchoring treatment is similar to the control group because, in parts II and III, subjects perform the BRET under the same conditions as in part I. However, as in the other treatments, subjects see the previous choice of a - randomly assigned - peer group. Since the goal of the anchoring treatment is to distinguish the simple hint received from numbers from the willingness to be similar to assigned peers, information on peers' previous choices is given through a different task where numbers are shown without reference to peers and subjects are not told that they are part of a group. Thus, participants in the anchoring treatment are asked about their painting preferences before performing the BRET. They are told that one hundred

[17] Since one of the aims of inducing a growing sense of group identity is to extrapolate our insights into the real world, where people often self-select into groups, we could have added another treatment requiring participants to invite two other people (maybe of the same gender) to the session and let these three people constitute a peer group, as in Gardner and Steinberg (2005). We decided not to introduce such a treatment because people in our setting do not know that they will be matched into groups until they are actually assigned to groups (part II). People invited to come with friends may presume that part or all of the experiment will involve some interaction with their friends and this may condition their behaviour, even in part I when they perform individually.

paintings by different artists have been selected (and are numbered from 1 to 100) and that they are going to see either two or three of these paintings, selected at random.[18] They have to choose their favourite painting and will be informed about their preferred artist. The numbers of the selected paintings (that correspond to the previous BRET choices of a randomly assigned peer group) are displayed on both the waiting screen before the painting preferences elicitation and the feedback screen, which informs subjects of their favourite artist, coming immediately before the new BRET screen.

1.4 EMPIRICAL ANALYSIS

1.4.1 Summary Statistics

Table 2 reports descriptive statistics for our indicator of risk behaviour and the dependent variable used to study peer effects, across treatment and control groups, before and after the implementation of the treatment protocol. It also reports two-sample t-tests for the equality of variable means between each treatment and the control group and an F-test for the equality of variable means across all groups. In this section and in the main analysis, we focus on just parts I and II of each experimental session in order to avoid the well known reflection problem (Manski, 1993) in estimating non-biased peer effects.[19] We analyse data from part III in section 1.4.4.

[Table 2 Here]

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[18] Instructions stated "either two or three paintings" because, if two of the previous choices were the same, subjects saw only two paintings. A case in which all three made the same choice did not occur.

[19] The reflection problem arises when peers interact repeatedly because if an individual's choice responds to his/her peers' choices, then the peers' subsequent choices will reflect the individual's own previous choices.

The variable *Choice* represents the number of boxes that each student decides to collect and, therefore, his/her risk behaviour.

In part I, where all subjects perform the task without being assigned to groups, the average number of collected boxes in the whole sample is 41.6. The majority of subjects (64.3%) display risk averse behaviour (i.e. choose a number of boxes below 50); 12.6% of the sample is risk neutral and the remaining 23.1% choose to collect more than 50 boxes, thus displaying risk seeking behaviour.[20] When looking at the average choice for the treatment and control groups separately, we see that the random treatment has the lowest average number of collected boxes (38) and that the anchoring and painting treatment have the highest average choice (about 43) while the control group and the chat treatment lie somewhere in the middle. Importantly, there are no significant differences across treatment and control groups in terms of subjects' risk behaviour in part I.[21]

In line with the findings of Crosetto and Filippin (2013), when subjects perform the task for a second time in part II, after being grouped and having had information on the choices made in part I by fellow group members, the average number of collected boxes overall (43.8) is significantly higher than in part I[22] (Wilcoxon signed-rank test p-value=0.0107) and subjects' behaviour is slightly less risk averse: about 61% is risk averse in part II, 14.5% is risk neutral and 24.5% is risk seeking. There are no significant treatment differences in the average choice in part II. A deeper analysis of the subjects' risk behaviour is presented in section 1.4.5.

To check the reliability of our variable *Choice* as a measure of individual's risk behaviour, we compute its correlation with self-reported indicators of risk attitudes

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[20] See Crosetto and Filippin (2013) for details on how to formalize subjects' decisions in the BRET.

[21] We present our randomization checks in Appendix A. Table A1 shows no systematic differences in any of the individual characteristics, including those that could be correlated with risk taking behaviour outside the lab, such as smoking. We also performed additional tests that confirm the absence of *ex ante* heterogeneity in risk behaviour across treatment and control groups (a two-sample Kolmogorov-Smirnov test for equality of distribution functions and an Epps-Singleton two-sample empirical characteristic function test). Similarly, the two-sample Wilcoxon rank-sum (Mann-Whitney) test confirms the absence of significant difference in the choice in part I between any two groups. (Results not reported and available upon request).

[22] The same results hold true when we regress the number of collected boxes on the dummy for part II.

derived from answers to some questions from the final questionnaire: the general risk question used in the German Socio-Economic Panel (SOEP)[23], that is "On a 0-10 scale, how do you see yourself: are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?", and similar domain-specific risk questions. We create risk indicators for both the general risk question and each of the domain-specific questions. These variables take values from 0 to 10 and increase with the propensity to take risk. We find that our measure *Choice* is positively and significantly (corr=0.2714, *p*-value=0.000) correlated in part I with the indicator of general risk attitudes.[24] Moreover, we find evidence of a positive and significant correlation between our variable and the domain-specific risk indicators for all the domains: driving or cycling, financial matters, leisure and sport, occupation, studies, health, faith in other people (correlation and significance vary depending on the domain. The highest level of correlation is for occupation – corr=0.2018, *p*-value=0.001 – and the lowest is for leisure and sport – corr=0.109, *p*-value=0.082).

Our main variable of interest is the standard deviation of the number of boxes chosen within a group ("*GroupSD*"). The higher *GroupSD* is, the higher heterogeneity within the group is. Since this variable is computed at the group level,

[23] The validity of using the self-reported general risk question as opposed to the results of incentivized lottery-based tasks to elicit risk attitudes has been explored by Dohmen et al. (2011), who show that self-reported answers can represent a valid low-cost substitute for incentivized lottery schemes.

[24] The correlation coefficients are higher than those usually found in the literature (Deck et al., 2013; Charness and Viceisza, 2015; Crosetto and Filippin, 2015). We investigate possible reasons. If we consider the average choice over the 12 BRET repetitions, the correlation of this variable to the indicator of general risk attitude is higher (corr=0.3851, p-value=0.000). The two correlation coefficients are significantly different at a 5.14 percent level. However, this result is driven by group identity treated subjects: the correlation coefficient increases from 0.2113 (p-value 0.009) to 0.3696 (p-value 0.000) when considering *Choice* in part I and the average choice over the 12 BRET repetitions, respectively, with a difference that is significant at the 4.36 percent level. The increase in the correlation coefficient value is not significant for the control group and the anchoring treatment. Thus, our data would suggest that the self-reported risk attitude measurement is affected by having been exposed to several BRET repetitions and possibly having converged to a risk attitude which is somewhat more in common with that of fellow group members. However, although correlation coefficients differ according to the variable considered (*Choice* in part I *vs* average choice), especially for treated subjects, they do not differ across treatments: we fail to reject the null hypothesis of equal correlation matrices for treated, control and anchoring subjects, either when using *Choice* in part I (p-value 0.400) or when using the average choice over the 12 repetitions of the BRET (p-value 0.104).

all the analysis investigating the emergence of peer effects is carried out by using one observation for each group.

There are 85 groups in our dataset: 18 in the anchoring and painting treatments, 17 in the control group and 16 in both the random and the chat treatments.

In part I, the standard deviation of subjects' choices within the group they belong to is 16.67 on average for the control group, slightly higher for the anchoring and random treatment and slightly lower for both the painting and the chat treatment. However, it is never significantly different across treatment and control groups. In part II, the average value of the variable *GroupSD* is substantially unchanged with respect to part I for the control group, while a remarkable reduction of varying size can be observed for the four treatment groups. This is suggestive of the emergence of peer effects and of a possible role of group identity, which will be analysed in depth in the following section, where we report our main results. The F-test for the equality of variable means across all groups shows statistically significant differences between groups and two-sample tests for the equality of variable means between each treatment and the control group show a significant difference for the painting and chat treatments.

1.4.2 Group Identity and Peer Effects

In this section, we investigate the existence and the magnitude of peer effects on risk behaviour in order to answer our main research question: does the level of group identity affect the intensity of peer effects? That is, are people more likely to change their behaviour in order to conform with the behaviour of their peers when they feel a stronger sense of membership to the assigned social group?[25]

[25] A simple model describing behaviour in our setting assumes that the individual chooses his/her optimal action by maximizing an additive utility function, such as $U_i = \pi(x_i) - \beta(GI_i)d(x_i, x_j)$ where the first term is a payoff deriving from the choice of x_i and the second term is the loss in utility arising from making a different choice from x_j, that of other group members, weighted by a function of the level of group identity, $\beta(GI_i)$.

We compare behaviour in each of the three group identity treatments with behaviour in the control group and the anchoring treatment with the aim of verifying two hypotheses. Our first hypothesis concerns the existence of peer effects: if peer effects on risk behaviour exist, the behaviour of treated groups will differ from the behaviour of the control group and the anchoring treatment. Our second hypothesis concerns the role of group identity: if group identity affects the intensity of peer effects, the magnitude of the effect will increase as the level of group identity increases (i.e. it will be lower for the random treatment, higher for the painting treatment and even higher for the chat treatment).

We estimate the following linear regression model:

$$Y_g = \alpha + \gamma A_g + \beta T_g + \varepsilon_g \tag{1}$$

where Y_g is the standard deviation of the choices of group g in part II, when the treatment protocol is introduced; A_g is the dummy for the anchoring treatment; T_g is a vector of dummies for the random, chat and painting treatments and ε_g is an error term.

The prediction is that, in the absence of peer effects, there should be no reason to expect the coefficients of the vector T_g to be significantly different from zero and from γ. Moreover, if group identity plays no role in the intensity of peer effects, there should be no statistically significant difference between the different group identity treatments in the magnitude of the effects.

In column (1) of Table 3, OLS estimates of the above model are reported.[26] Results show evidence of peer effects on risk behaviour. The standard deviation in the choices of groups of individuals in the random treatment is, on average, 4.1 boxes lower than the standard deviation in the choices of "fictitious" groups in the control, although the effect is not statistically significant (*p*-value=0.108). Participants in the

[26] In all estimates, we cluster observations at the group level. Moreover, results are also the same when checking for session random effects.

painting treatment have a group standard deviation which is, on average, 8.5 boxes lower than the group standard deviation of subjects in the control group, with an effect that is statistically significant at the 1 per cent level. The reduction in the standard deviation of group choices with respect to the control is very similar (7.8) for the chat treatment and the effect is again significant at the 1 per cent level. The coefficient of the anchoring treatment is negative, but very small and not statistically significant. The reduction in the standard deviation experienced by both the painting and the chat treatment is significantly larger than the anchoring treatment (***F***-stat=10.21 and 6.22, ***P***-value=0.002 and 0.015, respectively). Thus, what we observe in our data is a wish to be similar to the assigned peers and not simple anchoring to given numbers.

[Table 3 Here]

Moreover, our results show that group identity strengthens peer effects: an ***F***-test for the equality of the reduction in the group standard deviation experienced by the random and the painting treatments shows a statistically significant positive difference: ***F***-stat=3.48, ***P***-value=0.066. A similar test comparing the painting and chat treatments shows no statistically significant difference (***F***-stat=0.08, ***P***-value=0.775). A possible explanation for this is that the perceived behaviour of other group members in this task may either enhance or mitigate (or leave unaffected) the feeling of belonging to the group. Thus, the lack of an additional significant effect may be due to the average effect being estimated. A deeper analysis of this issue is presented in the following section.

In column (2), we run the same specification as column (1) by using data from part I, when all individuals perform the task under the same conditions and no treatment protocol is introduced. As expected, the coefficients of the treatment dummies are always not significantly different from zero and of a similar size.

Whereas Chen and Li (2009) found that pure categorization itself is sufficient to create group effects, because a random assignment is as effective as a group assignment based on participant painting preferences in shaping social preferences, our results show that, the typology of categorization matters when looking at an individual's risk behaviour and individuals are more affected by their peers when the group assignment is based on painting preferences rather than being random.

Much as in Chen and Li (2009), the group task does not increase peer effects. In the following section, we explore possible explanations for why we do not see a treatment effect for the chat treatment and show some circumstances under which the group task may contribute to strengthening peer effects.

Given the small sample size, we check the robustness of our results in the final column of Table 3 by estimating a difference-in-differences model, in order to extrapolate the effect due to the treatment protocol alone. Coefficients in the table represent the difference between *ex post* (part II) differences in the group standard deviation between the control group and each of our four treatments and the corresponding *ex ante* (part I) differences.[27] The effects are less precisely estimated, but results are consistent with the findings in columns (1) and (2): even when we exclude the *ex-ante* (not statistically significant) differences between the control group and our treatments, we find a negative effect of the treatment protocol on the standard deviation of group members' choices (*p*-values of the coefficients are 0.031, 0.021 and 0.106 for the random, painting and chat treatments, respectively). When comparing our treatments to look at the effect of different matching protocols, we find that peer effects are larger when the groups are formed on the basis of a shared preference rather than randomly but the difference between the painting and the random treatments is no longer statistically significant. As regards the chat treatment, much as in column (1), it does not produce a significant increase in the effect. Therefore, our difference-in-differences model confirms the existence of peer effects

[27] In terms of our difference-in-differences model, $Y_{gt} = \alpha + \gamma A_g + \beta T_g + \delta PartII_t + \varphi(A_g * PartII_t) + \theta(T_g * PartII_t) + \varepsilon_{gt}$, the coefficients in the table are the coefficients of the interaction terms between each treatment and the dummy for part II (φ and the vector θ).

on risk behaviour but shows that group identity does not significantly strengthen peer effects.

It is worth noting that the standard deviation of group choices in the control group does not change significantly across the two parts.[28] Given that participants in the control group are never exposed to feedback on group choices and are only randomly assigned to groups for the purposes of analysis, this result makes us confident that what we are observing is not spurious convergence towards a particular value in the second repetition of the task, but is convergence generated by the knowledge of peers' decisions and the desire to be similar to them.

1.4.3 Feeling of Attachment and Treatment Effects

In this section, we explore a possible explanation for why we do not see an additional treatment effect for the chat treatment. We speculate that there is a potential issue with regard the inducing of a higher level of group identity by having subjects perform a group task before the BRET given that the behaviour of individuals in the group task (for example absence of collaboration) may weaken the sense of belonging to the group instead of strengthening it. Besides spending more time with their assigned group, individuals receive new information about their peers during the group task that can either strengthen or weaken their perceived similarity to fellow group members. Therefore, depending on personal experience during the group task, perceived group identity might be either enhanced or mitigated and the lack of an additional significant effect may be due to the average effect being estimated.

To investigate this issue, we restrict our attention to the chat treatment and to a set of group characteristics that capture information about the quality of personal experience during the group task which we speculate might relate to perceived group identity. On the basis of the considered characteristics, we split groups in the chat treatment into those where group identity may have been enhanced by the group task

[28] That is δ, the coefficient on dummy ***Part II*** in the difference-in-differences model in footnote 26, is not significantly different from zero.

(*ChatX*) and those where the realization of the considered characteristics could have weakened group identity (*Chat*), thus estimating the following model: $Y_g = \alpha + \beta Chat_g + \theta ChatX_g + \varepsilon_g$. OLS estimates are shown in Table 4.

[Table 4 Here]

Firstly, we take into consideration a question from the final questionnaire which asks subjects to rate, on a scale from 0 to 10, how much they thought communicating with their group members helped solve the two extra painting questions in the group task.[29] We use the answers to this question to estimate, in column (1), peer effects on risk behaviour in the chat treatment separately for those groups whose participants felt that the level of help received from fellow group members during the online chat was higher than the average level, *Chat Helpful Group*[30], and for the remaining groups (coefficient on the variable *Chat*). Groups whose participants considered their group to be more helpful than the average have a group standard deviation which is, on average, 12.4 boxes lower than the group standard deviation in the control group, an effect which is statistically significant at the 1% level, about 5.2 boxes larger than the effect for the remaining groups in the chat treatment and 3.8 boxes significantly larger than the effect of the painting treatment (***F***-stat=5.83, ***p***-value=0.0181). Since the group task is likely to have enhanced the level of group identity for these groups in the chat treatment, this result confirms our idea that personal experience in the group task and additional information on group members gathered when interacting more may have both positive or negative effects on perceived group identity that may compensate for one another when an average effect is estimated.

Next, we use another question from the final questionnaire which asks subjects to rate, on a scale from 0 to 10, how closely attached they felt to their own group

[29] On average, subjects rate the help received from their group at the level of 5.5.

[30] On average 12.5% of the groups in the chat treatment perceive their group to be more helpful than the average in the group task.

throughout the experiment. This is used to identify groups where at least two members rated their attachment to their assigned peers at a higher level than the average (3.3), *Chat Attached to Group*.[31] Estimates in column (2) show that the effect for these groups is -12.4 boxes, statistically significant at the 1% level. This effect is 6.1 boxes larger than the effect for the remaining groups in the chat treatment and about 3.9 boxes significantly larger than the effect of the painting treatment (*F*-stat=3.34, *p*-value=0.071).

The time subjects spend chatting and the number of messages they exchange in order to reach an agreement on the answers in the group task are two additional indicators of the extent to which the group task actually contributes to the strengthening of group identity. Indeed, an increase in the time (and number of messages) needed to find a common answer to the questions signals a higher diversity of opinions among group members and greater difficulty in converging towards a common view. At one extreme, members of groups that are not able to find an agreement may even find that the group task weakens any sense of group attachment they might have. In columns (3) and (4), we estimate peer effects on risk behaviour separately for groups that, in order to reach an agreement, needed to chat for a number of minutes that is lower (*Chat <= Median Minutes for Agreement*) or higher (*Chat*) than the median (1.3) and needed to exchange a number of messages that is lower (*Chat <= Median Number Of Messages for Agreement*) or higher (*Chat*) than the median (9), respectively.[32] Both estimates show that the magnitude of peer effects is higher when the time or the number of messages needed to reach an agreement on

[31] On average 25% of the groups in the chat treatment have at least two members who expressed a level of attachment above the average. There are no groups where all the three members declared an above average level of attachment.

[32] In our sample, only one group out of 16 did not reach an agreement on the name of the artists responsible for the two additional paintings shown in the group task. We read the log files of the chat process for the remaining 15 groups to compute two indicators of the difficulty in reaching an agreement (and, thus, weaker feelings of belonging to the group). On average, subjects need about 1.8 minutes and 9.6 messages to agree on an answer for the group task. Results also hold true when considering the mean instead of the median. In order to compute these indicators, we do not take into consideration time and messages that were used for purposes other than to agree on the task answers (i.e. greetings and comments). In total, subjects chatted for about 3.1 minutes and exchanged 13.6 messages on average.

the possible answers in the group task is lower than the median, possibly because individuals feel more similar to their assigned peers.

Overall our estimates suggest that the weaker peer effects found for the chat treatment are due to the fact that the group task does not always enhance the level of group identity. When the level of group identity actually increases across treatments, so does the magnitude of peer effects on risk behaviour. It is worth noting that being able to investigate further how different individual experiences in the group task influence perceived group identity and, in turn, its impact on peer effects comes at the price of introducing some endogeneity into our model. Indeed, in such estimates we cannot exclude the existence of an omitted variable which correlates with both our outcome variable and the perceived (helpfulness, attachment) or actual (time and messages to reach an agreement) experience in the group task.

1.4.4 Peers' Influence Over Time

In this section, we extend our analysis by also looking at data from part III of the experimental session, where individuals are in the same group as they were in part II and perform the BRET another 10 times. On each of these occasions, they have information on the number of boxes that each group member decided to collect in the previous repetition of the task.

In Table 5, we estimate the same specification as in column (1) of Table 3[33] by considering both parts II and III, that is all the repetitions of the task in which participants have information on group members' previous choices (column 1), and data from part III only, to check whether peer effects are short lived or longer lasting (column 2). There are no anchoring effects in either regression and the coefficients of our group identity treatment dummies are significantly different from zero.[34] This confirms our result that individuals are affected by their peers when taking decisions

[33] We obtain similar results when we estimate the difference-in-differences model as in column (3) of Table 3.

[34] The magnitude of the effect in the painting treatment is larger than in the random treatment, but the difference is not statistically significant.

in risky settings and shows that peer influence does not vanish after the first interaction.[35]

[Table 5 Here]

Results remain the same even when we control for the number of the repetition within the sequence of 11 (part II + part III) or 10 (part III) repetitions of the task (columns 3 and 4). In particular, for part III, each repetition of the task further reduces the group standard deviation by 0.2 boxes on average with an effect that is significant at the 5 percent level.[36]

1.4.5 Relative Risk Behaviour and Change in Individuals' Decisions

In this section, we want to investigate whether, when making their choices, individuals are influenced by their riskiness rank within the three-person group they belong to – something that can be easily figured out from the feedback on group members' previous decisions – and whether different rank positions are associated with different systematic behaviours. As in our main analysis, we only use data from parts I and II in this section.

On the basis of the choice made in part I, a student can find him/herself matched with two peers that are either both riskier or both less risky than him/her or

[35] When we replicate the specification in column (1) of Table 4, we find that the effect on perceived group identity, produced by personal experience in the group task and additional information on group members gathered during greater interacting, attenuates over time and is no longer statistically significant.

[36] When, separately for each treatment, we regress our dependent variable *GroupSD* on a categorical variable for the repetition number of the task in part III of the experiment, we find that, on average, the group standard deviation of subjects in the random and painting treatments is reduced by 0.3 and 0.4, respectively, for each repetition of the task in part III of the experiment, an effect which is significant at the 10% level. No significant effect emerges for subjects in the anchoring and chat treatments or in the control group. Results are reported in Appendix B, Table A2.

with peers that are mixed in terms of riskiness (one riskier and one less risky than him/her).

Figure 3 shows, separately for treatment and control groups, how the number of boxes collected in part II differs from the decision in part I for each of the three typologies of peers that a student may face. On the one hand, when a student in the random, chat or painting treatment is assigned to a group whose members are both riskier than him/her, that is s/he is the bottom ranked in terms of the number of boxes collected when the BRET task is performed for the first time, s/he tends to significantly increase the number of boxes collected in part II. On the other hand, being the top ranked member of the group, so having two less risky peers, is related to a reduction in the number of boxes collected in the second repetition of the task: on average the difference between the second and first choice is negative and is statistically significant for the painting treatment. Finally, the change in choice for subjects with mixed peers is always not significantly different from zero. For completeness, we report data from the control group and anchoring treatment as well. For these subjects, the effects are very imprecisely estimated and not significantly different from zero.

[Figure 3 Here]

In Table 6, we use individual level data in part II of the experiment to run OLS estimates of a linear regression model with the aim of investigating whether different rank positions within the group, determined on the basis of the choices made in part I, are associated with different systematic behaviours.

[Table 6 Here]

In columns (1) to (4), we use the change in choice between the two parts as the dependent variable and dummies for the typology of peers that a student may face (mixed peers is the reference category) as control variables. Estimates confirm what has been shown by the graph: on the one hand, individuals whose peers are both less risky decrease their choice in part II by about 3.7 boxes on average compared with individuals with mixed peers; on the other hand, individuals whose peers are both riskier tend to increase their choice by about 11.6 boxes compared with people who have mixed peers.

When looking at relative risk behaviour for the control group, the anchoring treatment and the group identity treatments separately, we find that individuals assigned to less risky peers in the random, painting and chat treatment reduce their choice significantly by about 5.5 boxes and individuals assigned to riskier peers increase their choice significantly by about 12.3 boxes. Similar effects are observed in the anchoring treatment although the effect for subjects who have less risky peers is very imprecisely estimated. As regards the control group, the coefficients are positive regardless of the typology of peers that participants engage with (although the effect is not significant for subjects who have less risky peers). This may possibly reflect the general trend of reduced risk aversion in the second repetition of the task with a larger reduction for very risk averse individuals.

In column (5) we estimate a difference-in-differences model to compare the change in choices driven by different rank positions within the group observed in the group identity treatments with that emerging in the control group. Coefficients in the table represent the interaction terms between having less risky or riskier peers, respectively, and a dummy for being in the group identity treatments instead of in the control group. The estimation confirms what explained above, that is there is not a statistically significant increase in the risky choice due to being in the group identity treatments for subjects having riskier peers but there is a significant decrease in choice for subjects in the group identity treatments whose peers are less risky.

As shown in section 1.4.1, when the BRET is repeated, individuals tend to be more risk seeking in the second risk elicitation. Our results suggest that when group identity goes in the same direction of the effect of a second risk elicitation (i.e. when peers are riskier than the individual) the already large increase in risk-taking behaviour does not amplify. Instead, when group identity works in an opposite direction (i.e. when the individual has two less risky peers) the tendency to increase risk seeking in the second risk elicitation is more than offset by the desire to converge to the less risky peers.

Using the change in choice between the two parts as the dependent variable means assuming persistence in risk behaviour, in other words forcing the coefficient on the choice that is made the first time the task is performed to be 1. In column (6), we relax this assumption and run a regression which has the number of boxes collected in part II as the dependent variable and introduces the number of boxes collected in part I among the regressors. This specification, estimated on the subsample of individuals in the group identity treatments, allows us to separate peer effects on risk behaviour from mean regression effects. The coefficient on ***Choice Part I*** shows that part of the observed effect is due to regression to the mean: subjects who collected one additional box in part I will collect 0.7 additional boxes on average in part II. Even when controlling for regression to the mean, peers' risk behaviour plays a role in shaping an individual's decision in part II if the student has two riskier peers: his/her choice in part II increases by about 7 boxes with an effect that is statistically significant at the 1 percent level. Subjects with two less risky peers decrease their choice on average, but the effect is not significantly different from zero.[37] However, when compared with the tendency to decrease risk aversion emerging in the control group (column 7), the increases in risk aversion for individuals in a group identity treatment whose peers are less risky is statistically

[37] Our results remain qualitatively unchanged if, instead of considering a dummy for the individual's rank within the group based on the level of riskiness of peers, we look at how far the top and bottom ranked subjects are from either the choice of the middle ranked student or the mean choice of their group. Moreover, our results are robust also when we restrict the analysis to the subsample of participants belonging to the group identity treatments whose initial risk attitude is at a level for which we have at least one subject for each riskiness rank. We find that participants who start from the same risk attitude and end up having riskier peers significantly increase their choice in part II by 5.5 boxes. A significant role of peers' risk behaviour for subjects with riskier peers is found also when considering the change in choice between the two parts as the dependent variable.

significant. Instead, the increase in risk-seeking behaviour due to having riskier peers is economically important but is very imprecisely estimated.

All in all our estimates suggest that subjects tend to adjust their choice on the basis of their relative position: individuals whose peers are both riskier/less risky tend to increase/decrease their choice in part II when compared with individuals with mixed peers. When ruling out the component of the effect caused by regression to the mean, peers' risk behaviour continues to play a significant role for bottom ranked individuals while it is very close to zero for top ranked individuals in the subsample of individuals in the group identity treatments. However, while for subjects having riskier peers the decrease in risk aversion goes in the same direction of the evidence of a more risk-seeking behaviour in a second risk elicitation emerging in the literature and in our data, the opposite is true for top ranked individuals who experience a significant increase in risk aversion when performing the BRET for the second time, after being grouped and having had information on the choices made in part I by fellow group members.

1.5 CONCLUDING REMARKS

In this paper, we study whether and to what extent group identity affects the magnitude of peer effects on an individual's risk behaviour. We believe our paper is the first to provide evidence of how different perceptions of membership to an assigned social group can affect the tendency of individuals to change their risk behaviour in order to match the prevalent behaviour of their peers.

We run a laboratory experiment where an individual's risk behaviour is measured by using the Bomb Risk Elicitation Task. Peer effects are introduced by giving subjects information on their peers' previous decisions and different levels of group identity are induced by combining two assignment methods (one random and one based on painting preferences) and a collective problem solving task that uses an online chat program to enhance the feeling of belonging to the assigned group. The presence of anchoring effects is controlled by running a treatment where individuals are shown numbers without any reference to a peer group and peers' choices.

We find that subjects are affected by their peers' choices and they change their decisions in order to assimilate their behaviour to that of their peers when they have information on the choices made by the fellow members of their group. This change in behaviour is not driven by anchoring, but represents pure peer effects. Moreover, the typology of categorization matters and individuals are significantly more affected by their peers when the group assignment, instead of being random, is based on painting preferences, that is group identity is intensified because group members are more likely to feel similar to each other due to their sharing at least one characteristic with their peers. The effect of a less impersonal matching protocol based on shared preferences is still positive but no longer statistically significant when a difference-in-differences model is estimated. Also, we do not observe a significant increase in the magnitude of peer effects when the less impersonal preference-based matching procedure is combined with a group task. We speculate that this may be due to the fact that the group task does not always contribute to the enhancing of group identity and find that the magnitude of peer effects increases when the group task strengthens the feeling of group belonging because group members feel attached to each other, help each other during the online chat and/or the group reaches an agreement on the possible answers to the group task very quickly.

Peer effects are persistent over time while the effect of personal experience during the group task on perceived group identity, and in turn on peer effects, is weakened with further repetitions of the risk elicitation task. Moreover, we find that individuals are influenced by their riskiness rank within the three-person group they belong to, which they can easily work out from the feedback on group members' previous decisions. Individuals whose peers are less risky tend to make less risky choices, while individuals matched with riskier peers tend to take on more risk. This latter effect remains significant for treated participants even when ruling out the component of the effect due to regression to the mean. The increase in risk aversion experienced by subjects having less risky peers goes in the opposite direction and more than offsets the tendency to decrease risk aversion when performing the risk elicitation task for the second time that emerges in the literature. Instead, the increase in risk-seeking behaviour due to having riskier peers is similar to the increase in riskiness implied by a second risk elicitation.

Studying the influence peers have on an individual's risk behaviour may provide an important contribution to the optimal design of policy interventions aimed, for example, at remediating deficits in educational achievement and improving the labour market prospects of the young unemployed. We show that peers influence an individual's risk behaviour in an artificial social environment, i.e. a laboratory setting, and that a less impersonal categorization procedure and an increased -positive- interaction with fellow group members strengthen peer effects. Our results may be indicative of the effect peer group behaviour may have on an individual's risk behaviour in the real world too. This would imply that targeting the risk behaviour of a few individuals may have an effect on outcomes which have been found strongly influenced by risk, not only for the target pool of subjects, but also for their peers. Moreover, given that the magnitude of peer effects increases as the closeness to the group increases, choosing the target pool wisely may amplify the benefits of the policy intervention.

Our result that more interaction among peers is, in itself, not sufficient to enhance the salience of group identity makes the investigation of the dynamics of peer interaction and of the influence of new information on group members interesting. Moreover, our experiment focuses on risk behaviour by referring to monetary decisions in the gain domain. Risk matters across a whole range of other domains, too (i.e. monetary-loss domain, health, leisure and sport, occupation, etc.). Hence, studying the role of group identity and peer effects on a person's decision making in other risk domains would appear to be a fruitful avenue for future research.

APPENDIX A

Randomization Checks

In the first five columns in Table A1, the means for a number of individual characteristics are reported in treatment and control groups separately. In the last two columns, we report the F-stat and the p-value of a test for the equality of variable means across all groups.

[Table A1 Here]

APPENDIX B

Peer Influence in Part III: Effect of Repetition Number

In Table A2, we regress our dependent variable *GroupSD*, separately for each treatment, on a categorical variable for the repetition number of the task in part III of the experiment. We find that, on average, the group standard deviation of subjects in the random and painting treatments diminishes by about 0.3 and 0.4, respectively, for each repetition of the task in part III of the experiment, with an effect that is significant at the 10% level. No significant effect emerges for subjects in the anchoring and chat treatments or in the control group.

[Table A2 Here]

Figure 1: Participant's computer screen when performing the BRET

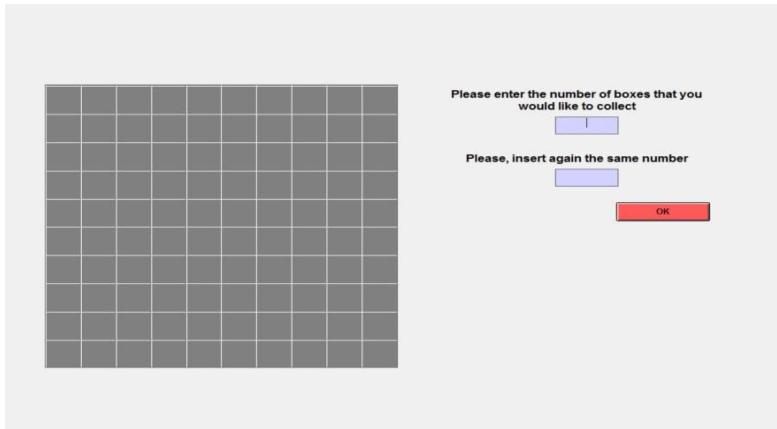


Figure 2: Computer screen for a participant who chose to collect 35 boxes

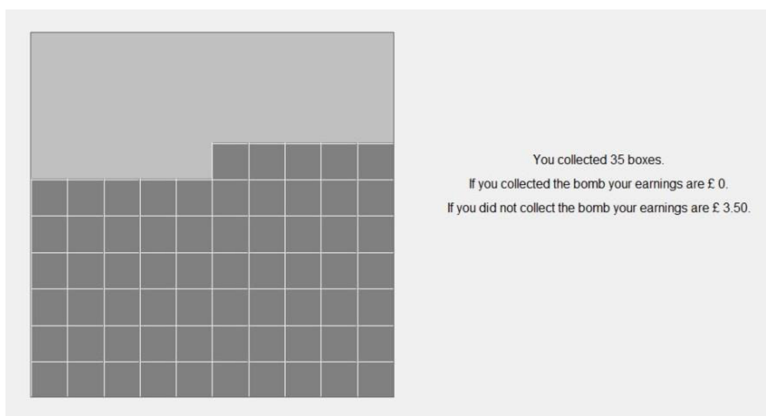
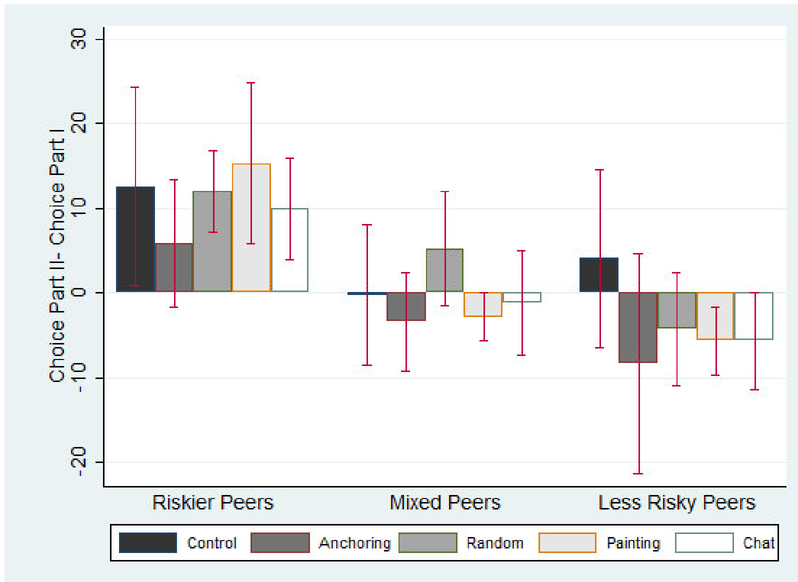


Figure 3: Rank position in part I and change in the number of collected boxes



The whiskers in the box plots indicate 95% confidence intervals.

Table 1. Treatments of the experiment

Treatments	Group assignment: *Random*	Group assignment: *Preference Based*	Group assignment: *Group task*	Information on peers' previous choices: Part I	Information on peers' previous choices: Part II	Information on peers' previous choices: Part III	Information on peers' previous choices: Channel	No. of Sessions	No. of Subjects
Control	NO	NO	NO	NO	NO	NO	-	3	51
Anchoring	NO	NO	NO	NO	YES	YES	INDIRECT	3	54
Random	YES	NO	NO	NO	YES	YES	DIRECT	3	48
Painting	NO	YES	NO	NO	YES	YES	DIRECT	3	54
Chat	NO	YES	YES	NO	YES	YES	DIRECT	3	48

Table 2. Descriptive statistics and treatment comparisons

	Control	**Anchoring**		**Random**		**Painting**		**Chat**		
	Mean (St.Dev.)	Mean (St.Dev.)	t stat (*p*value)	Mean (St.Dev.)	t stat (*p*value)	Mean (St.Dev.)	t stat (*p*value)	Mean (St.Dev.)	t stat (*p*value)	F stat (*p*value)
Choice										
Part I	40.784	43.167	-0.600	38.396	0.614	43.611	-0.807	41.604	-0.232	0.60
	(18.590)	(22.231)	(0.552)	(20.007)	(0.540)	(17.243)	(0.422)	(16.567)	(0.817)	(0.661)
Part II	46.275	41.185	1.361	42.542	0.999	46.167	0.033	42.542	1.127	1.00
	(19.284)	(19.022)	(0.177)	(17.881)	(0.320)	(13.566)	(0.974)	(13.286)	(0.263)	(0.407)
Obs.	51	54		48		54		48		
GroupSD										
Part I	16.670	18.117	-0.509	18.716	-0.827	15.286	0.692	14.272	1.037	0.97
	(5.800)	(10.222)	(0.615)	(7.889)	(0.415)	(5.791)	(0.494)	(7.091)	(0.308)	(0.429)
Part II	17.596	16.853	0.284	13.459	1.623	9.065	3.764	9.784	2.901	4.74
	(7.040)	(8.136)	(0.778)	(7.278)	(0.115)	(6.033)	(0.001)	(8.035)	(0.007)	(0.002)
Obs.	17	18		16		18		16		

The second column in each treatment reports *t* statistic and *p*-value of two-sample *t* tests for the equality of means between the corresponding treatment and the control group. The last column reports the *F*-stat and the *p*-value of a test for the equality of variable means across all groups.

Table 3. Group identity and peer effects. OLS estimates

	Group Standard Deviation		
	Part II	Part I	Difference
	(1)	(2)	(3)
Anchoring	-0.7433	1.4477	-2.1910
	(2.6215)	(2.8487)	(3.7205)
Random	-4.1368	2.0464	-6.1832**
	(2.5459)	(2.4715)	(2.8217)
Painting	-8.5312***	-1.3836	-7.1476**
	(2.2684)	(2.0010)	(3.0361)
Chat	-7.8124***	-2.3978	-5.4146
	(2.6899)	(2.3088)	(3.3113)
Observations	85	85	170
Adj R-squared	0.151	-0.001	0.111

The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

Table 4. Feelings of attachment and treatment effects. OLS estimates

	Group Standard Deviation			
	(1)	(2)	(3)	(4)
Chat	-7.1606**	-6.2873*	-4.4881	-4.1849
	(2.9233)	(3.1233)	(3.6472)	(4.1434)
Chat Helpful Group	-12.3752***			
	(1.8850)			
Chat Attached to Group		-12.3878***		
		(2.3486)		
Chat <= Median Minutes for Agreement			-9.8128***	
			(3.1668)	
Chat <= Median Number Of Messages for Agreement				-9.4233***
				(2.9313)
Observations	33	33	32	32
Adj R-squared	0.184	0.213	0.189	0.186

The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

Table 5. Peer effects in further repetitions of the task. OLS estimates

	Group Standard Deviation			
	Part II + Part III	**Part III**	**Part II + Part III**	**Part III**
	(1)	(2)	(3)	(4)
Anchoring	-1.6957	-1.7910	-1.6957	-1.7910
	(1.8945)	(1.9242)	(1.8955)	(1.9253)
Random	-5.9115***	-6.0889***	-5.9115***	-6.0889***
	(1.9670)	(2.0176)	(1.9681)	(2.0188)
Painting	-7.2910***	-7.1669***	-7.2910***	-7.1669***
	(1.7612)	(1.8145)	(1.7622)	(1.8155)
Chat	-6.8399***	-6.7427***	-6.8399***	-6.7427***
	(1.9748)	(1.9891)	(1.9758)	(1.9902)
Repetition number			-0.1229	-0.2471**
			(0.0855)	(0.0975)
Observations	935	850	935	850
Adj R-squared	0.114	0.109	0.115	0.115

The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

Table 6. Rank position in part I and number of collected boxes

	Choice Part II-Choice Part I					**Choice Part II**	
	Whole	*Control*	*Anchoring*	*Group Identity Treatments*	*Difference with control*	*Group Identity Treatments*	*Difference with control*
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Less Risky Peers	-3.6556*	4.3529	-5.0667	-5.5336***	-9.8866**	-1.0027	-18.963***
	(1.9401)	(4.6598)	(5.6511)	(1.9787)	(4.9364)	(1.9885)	(5.5297)
Riskier Peers	11.6264***	12.8235**	9.1754**	12.2818***	-0.5418	6.9330***	8.9020
	(1.9212)	(5.5615)	(3.6232)	(2.3836)	(5.9006)	(2.1448)	(6.8862)
Choice Part I						0.6685***	0.5447**
						(0.0722)	(0.2160)
Observations	255	51	54	150	201	150	201
Adj. R-squared	0.143	0.031	0.053	0.278	0.183	0.439	0.380

The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

Table A1. Participants' characteristics across treatment groups

	Means					*F*-stat	*p*-value
	Control	*Anchoring*	*Random*	*Painting*	*Chat*		
Choice	40.784	43.167	38.396	43.611	41.604	0.603	0.661
Female	0.647	0.648	0.646	0.630	0.75	0.511	0.728
Age	22.647	22.241	22.688	22.685	22	0.184	0.946
Asian	0.333	0.333	0.417	0.296	0.271	0.663	0.618
European	0.588	0.611	0.5	0.593	0.604	0.405	0.805
Economics	0.196	0.278	0.208	0.241	0.167	0.542	0.705
HSS	0.627	0.556	0.563	0.556	0.625	0.290	0.884
MVM	0.078	0.000	0.042	0.093	0.104	1.611	0.172
Distinction	0.235	0.315	0.271	0.407	0.271	1.099	0.357
Good	0.627	0.519	0.479	0.444	0.521	0.973	0.423
Mother Uni Degree	0.529	0.500	0.646	0.519	0.625	0.900	0.465
Father Uni Degree	0.667	0.556	0.75	0.648	0.646	1.072	0.371
Brothers	0.824	0.741	0.625	0.852	0.667	0.604	0.660
Sisters	0.725	0.759	0.729	0.611	0.563	0.585	0.674
Self-Reported Risk	5.333	5.481	5.125	5.537	5.521	0.307	0.873
Smoker	0.137	0.111	0.063	0.093	0.125	0.441	0.779
Drinker	0.922	0.889	0.875	0.870	0.938	0.470	0.758
Study Alone	0.863	0.926	0.896	0.926	0.813	1.148	0.334
Observations	51	54	48	54	48		

Notes: In the last two columns, we report the *F*-stat and *p*-value of a test for the equality of variable means across all groups. HSS is the Humanities and Social Sciences degree. MVM is the Medicine and Veterinary Medicine degree.

Table A2. Effect of repetition number in part III. OLS estimates

	Group Standard Deviation				
	Control	**Anchoring**	**Random**	**Painting**	**Chat**
Repetition Number	-0.2461	-0.3613	-0.3469*	-0.4037*	0.1564
	(0.2364)	(0.2535)	(0.1963)	(0.1948)	(0.1905)
Observations	170	180	160	180	160
Adj R.squared	0.001	0.007	0.011	0.020	-0.003

The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

CHAPTER 2

Incentive Schemes and Peer Effects on Risk Behaviour: An Experiment

Abstract

This paper studies whether incentivizing performance with competition and cooperation-based incentive schemes, rather than individual compensation, affects peer effects on subsequent risk behaviour. We run a laboratory experiment in which we introduce three different compensation schemes - piece-rate, the equal-split-sharing-rule and a tournament - associated with a real effort task. Risk behaviour is measured by using the Bomb Risk Elicitation Task. We find that competition more than halves peer influence on risk behaviour compared with piece-rate compensation, but treatment effects are not statistically significant. Competition also significantly reduces an individual's feeling of attachment to their peers and self-reported peer influence. Finally, we find that relative performance in the incentivized task affects the extent of peer effects on subsequent risk behaviour: the worst performing subjects within the group are influenced by their peers, while the best performing subjects are not.

Keywords: Risk Behaviour, Incentive Schemes, Peer Effects, Competition, Equal-split-sharing-rule

JEL Classification: D03, D81, D83

2.1 INTRODUCTION

Risk is inherent in a wide range of economic decisions, such as the choice of pathway taken in secondary school, the field of study chosen at university, job decisions, health-related behaviours, marriage, parenthood, migration and, of course, the allocation of financial assets (Saks and Shore, 2005; Belzil and Leonardi, 2007; Schmidt, 2008; Caner and Okten, 2010; Jaeger et al., 2010; Light and Ahn, 2010; Spivey, 2010; De Paola and Gioia, 2012). Recent research has shown that individual risk attitudes are not immutable personality traits, but are shaped at least partly by the environment, such as family structure or the gender composition of the classroom (Dohmen et al, 2012; Booth and Nolen, 2012), by emotional states (Bassi et al., 2013; Conte et al., 2013; Campos-Vazquez and Cuilty; 2014), by life experiences such as poverty, job loss or violence (Haushofer and Fehr, 2014; Hetschko and Preuss, 2015; Callen et al., 2014) and, more directly relevant to this paper, an individual's risk attitudes appear to be shaped by their peers (Cooper and Rege, 2011; Lahno and Serra-Garcia, 2015).

Peer effects are particularly valuable from a policy perspective because they amplify the benefits of any policy intervention thanks to the social multiplier effect (Mansky, 1993). We do however know little about what determines the existence and strength of peer effects. Peers are, by definition, part of the same social setting, but the nature of their social interactions may differ. At school or at work, peers may be competing to be the best or to be promoted. However, they may also have incentives to cooperate, in order to share specific knowledge or carry out complex projects. Competitive and cooperative incentive schemes are widely used by educational institutions, organizations and private companies to increase individual performance. In this paper, we investigate the extent to which the nature of incentive schemes to which individuals are exposed affects the existence and strength of peer effects. In a nutshell, we ask: are you more likely to be influenced by your peers if you compete with them or if you have to cooperate? Since peer interactions outlast the competitive/cooperative task, we are not interested in peer effects on immediate productivity, but instead study peer effects on subsequent risk behaviour and, in turn, on subsequent decisions influenced by risk attitudes, which could affect future productivity.

We hypothesize that the introduction of a competition/cooperation-based incentive scheme is similar to the manipulation of group identity[38], meaning that it may influence peer effects on risk behaviour: compared with working individually but surrounded by random co-workers, subjects may be less likely to perceive a competitor as a member of their group because when peers are competitors, they are working to reach a personal goal that only one peer will be able to meet. Instead, being teammates may (depending on the teammates' behaviour) increase peer salience and enhance the feeling of belonging to the peer group. In fact, with cooperation-based incentive schemes, like an equal-split-sharing-rule, peers work to reach a common goal, which enhances their feelings of group membership. However, since a peer's performance/contribution to the group's output has a positive effect on the individual, peer relationships may also be weakened if a peer's contribution does not meet individual expectations, for example, if they do not make enough effort due to free-riding. The first chapter has shown that group identity affects peer effects: higher levels of group identity significantly increase peer effects on risk behaviour; that is, individuals with a stronger feeling of group membership, and a greater sense of belonging to the social group, are significantly more influenced by the risk behaviour of their peers when taking decisions involving risk.

Our hypothesis is inspired by recent empirical research in organizational psychology and management, which shows that incentive schemes affect relationships between colleagues and this, in turn, has an impact on job satisfaction, commitment to an organization and turnover (Ducharme and Martin, 2000; Morrison, 2004; Morgeson and Humphrey, 2006; Quigley et al., 2007; Chiaburu and Harrison, 2008; Barnes et al., 2011; Taylor and Westover, 2011; Skaalvik and Skaalvik, 2011; Onemu, 2014). Our research is also motivated by recent evidence in the literature on

[38] Group identity is defined by psychologists as "the portion of an individual's self-concept derived from the sense of belonging to the social group" (Hogg and Vaughan, 2002).

peer effects, which suggests that not all peers matter and some matter more than others (Vaquera and Kao, 2008; Lomi et al., 2011; Lin and Weinberg, 2014; Borjas and Doran, 2015). We add to this literature by considering the long-lasting nature of peer relationships, thus focusing on the influence of teammates and competitors on risk behaviour – and decisions involving risk – following the incentivized work, and not just on how peers affect immediate performance.

We answer our research question by conducting a laboratory experiment with three treatment conditions corresponding to three different compensation schemes - piece-rate (PR), the equal-split-sharing-rule (ESSR) and a tournament (TO). Each of these schemes is associated with an effort task, named the Coin Task, which consists of five minutes spent recognizing the value and country of origin of a random sequence Euro coins, displayed on a computer screen. Risk preferences are measured both before and after the incentivized task by using the Bomb Risk Elicitation Task (Crosetto and Filippin, 2013), a simple elicitation method in which participants must choose how many boxes to collect out of 100. 99 of the boxes contain £0.10, while one contains a bomb that destroys all the participants' earnings. At the end of the experiment, subjects complete a short questionnaire including a question on their attachment to peers and a question on perceived peer influence.

We find that participants in the PR treatment group are influenced by their randomly assigned peer when making their risky choice following the effort task: for each additional box collected in the first performance by their randomly assigned peer, they increase their choice in the second performance of the BRET by about 0.20 boxes, an effect significant at the 5% level. Peer effects are very similar in size to the former scheme for participants in the ESSR treatment group (+0.17 boxes chosen for a unitary increase in their teammate's previous choice, significant at the 5% level), while they are more than halved when performance is incentivized by competition (+0.06 boxes, not statistically significant). Thus, our findings confirm the evidence of peer effects on risk behaviour which has emerged from the economic literature and seem to point to a role of incentivizing schemes on peer influence, particularly for tournaments as these produce an economically significant attenuation of peer influence. This effect is not statistically significant using OLS estimates, but becomes so when using WLS estimates, as the latter take into account heteroscedasticity.

In a setting of complete information, where individuals can observe both their peers' behaviour before the incentivized task and the outcome of this task (which commonly occurs), incentives may heterogeneously shape subsequent peer influence because, after the incentivized task, peers are no longer under equal conditions (for example, after a competition there are winners and losers). Therefore, the extent to which individuals are influenced by their peers may depend on these conditions. In fact, the literature on feedback, which typically focuses on its effects on performance, considers different behaviours depending on ranking (i.e., underdogs *vs* frontrunners) (Eriksson, Poulsen and Villeval, 2009; Kuhnen and Tymula, 2012). Likewise, the literature on emotions associates different emotions with positive and negative feedback (Kräkel, 2008; Belschak and Hartog, 2009). We investigate whether peer effects differ depending on relative performance in the incentivized effort task, finding that peer influence on risk behaviour is mostly driven by participants with the lowest scores (+0.38, significant at the 1% level in PR), while peer effects are significantly smaller and no longer statistically significant for subjects who obtain the highest scores (+0.10, p-value=0.438 in PR). This evidence comes mainly from peer groups that are very heterogeneous in terms of their performance in the effort task. Differences in peer influence across treatments are never statistically significant. However, they are close to zero for the highest scoring subjects, but become larger for the lowest scoring subjects: the influence of a better performing teammate is about one third higher than that of a better randomly assigned person, while the influence of a winner is roughly halved compared with the latter.

Since our hypothesis that incentives affect peer influence was based on the idea that the implementation of incentive schemes may change feelings of group membership, we use the answers to the question in the final questionnaire on attachment to peers to check this assertion. We find that after competing, participants feel significantly less attached to their peer than after the implementation of either a piece-rate compensation scheme (-1.15 on a 0 to 10 scale) or a cooperation-based incentive scheme (-1.72). Moreover, tournaments significantly attenuate the probability of self-reported peer influence compared with the other two compensation schemes (-17 percentage points *vs* PR and -27 percentage points *vs* ESSR).

Our findings have implications for the design and evaluation of optimal compensation schemes. For instance, suppose that we have to structure the environment in compulsory education. Since we care about individual performance, as we think that it reflects the accumulation of skills or knowledge which will improve human capital and have some value in the labour market, we might want to choose an incentive scheme that produces the highest increase in performance, and evaluate it only on the basis of the performance boost achieved. However, suppose that we also publicly finance higher education. If individuals face some risk in their chances of successfully finishing higher education, we might worry about people being less risk-averse in making their decisions. Therefore, the incentives implemented in compulsory education become important, as they may affect peer relationships and influence which, in turn, has an effect on individual decisions and the payoffs to society from financing higher education. Likewise, in research and development, individuals care about the results of their current projects, but risk attitudes will shape the types of future projects that are attempted.

The paper is structured into five parts. Section 2.2 briefly presents the related literature. In section 2.3, we describe our experimental design. Section 2.4 presents our empirical analysis. Section 2.5 concludes.

2.2 RELATED LITERATURE

Studying the impact of different compensation schemes on peer effects on risk behaviour makes three contributions to the existing economics literature. First, it offers new evidence on peer effects on risk behaviour. As a consequence, it sheds more light onto the extent to which the characteristics of the environment can shape risk attitudes, which are often considered to be innate behavioural traits. Last but not least, it improves our understanding of the consequences of implementing incentive schemes which, especially in a long-run perspective with repeated and continuous interaction, may exert effects beyond a change in immediate performance.

In the first chapter, we have studied the role of group identity on peer effects on risk behaviour. We use the same risk elicitation task and the same design to provide feedback on peers' ex-ante risk behaviour but, instead of manipulating group identity between the ex-ante and ex-post risk elicitation, we manipulate the incentive structure associated with a real effort task.[39]

Our hypothesis, i.e., that collaborators and competitors represent different types of peers and that the implementation of such incentive schemes may therefore trigger different levels of attachment to the peer group and induce peer effects of different magnitudes, deepens our understanding of recent evidence in the peer effects literature. This evidence suggests that not all peers matter and some matter more than others. For example, Borjas and Doran (2015) use very nice data on the emigration of Soviet mathematicians after the collapse of the Soviet Union to study how changes in the composition of peer groups (i.e., losing a competitor - researcher working on the same topic -, a co-worker - researcher employed by the same department -, or a collaborator - co-author -) changes the productivity of the remaining mathematicians. They find that the productivity of the mathematicians who lose competitors increases, while researchers who lose their co-workers and collaborators, especially those of high-quality, lose the positive knowledge spillover associated with these peers. Similarly, Chan, Li and Pierce (2014) examine data from a department store in which multiple brands establish their own counters to compete on a common retail floor; each firm may use either team-based (TC) or individual-based (IC) compensation schemes for its salespeople. The authors find that TC incentives improve team

[39] In addition, we have pairs instead of groups of three, because we also want to study the role played by the outcome of the incentivized task. Having pairs allows us to compare subjects who obtain different outcomes across treatments. In fact, within the pairs there is a winner and a loser in the competition-based scheme, and a best and worst performing subject in the piece-rate and teamwork schemes (ties are not a major issue, because subjects receive feedback on their performance, and in such a case the winner is randomly chosen). With groups of three, there are instead a winner and two losers in the competition, but in the other two treatments there is a three-level ranking, with the middle ranked individual not necessarily being considered as the bottom ranked individual.

performance by stimulating positive peer effects. On the other hand, IC incentives stimulate competition between salespeople working for the same firm. Heterogeneity in the ability of salespeople also improves team performance at TC counters, while at IC counters worker heterogeneity reduces overall sales. We go one step further by looking at peer influence not only on productivity, but on subsequent risk behaviour and, in turn, on subsequent decisions involving risk which could affect future productivity.

We therefore contribute to the recent literature showing that risk behaviour is not an immutable personality trait, but is influenced by characteristics of the environment, emotional states and peer behaviour. Dohmen et al. (2012) show evidence of the role played by family size and birth order on the intergenerational transmission of risk attitudes, with firstborn children and children with fewer siblings being more strongly influenced by their parents. Booth and Nolen (2012), in a field study, show instead that women's risk preferences are influenced by the classroom's gender composition. Haushofer and Fehr (2014) point to a positive relationship between the psychological consequences of poverty, such as stress and negative affective states, and risk-averse decision-making. A positive relationship with risk aversion has also been highlighted for job loss, exposure to violence and emotional states like sadness (Callen et al., 2014; Campos-Vazquez and Cuilty, 2014; Hetschko and Preuss, 2015). Finally, several papers (see, among the others, Gardner and Steinberg, 2005; Cooper and Rege, 2011; Ahern, Duchin and Shumway, 2013; Bougheas, Nieboer and Sefton, 2013; Balsa, Gandelman and Gonzàles, 2015; Lahno and Serra-Garcia, 2015) show evidence of the role played by peers in an individual's risk behaviour.

To the best of our knowledge, we are the first to suggest the implementation of incentive schemes as a possible mechanism for shaping an individual's risk behaviour through a change in peer influence. Most of the literature on incentive schemes has focused on their impact on individual performance.[40] However, the consequences of

[40] See among others Gneezy, Niederle and Rustichini, 2003; Gneezy and Rustichini, 2004; Ivanova-Stenzel and Kübler, 2005; Niederle and Vesterlund, 2007; Antonovics, Arcidiacono and Walsh, 2009;

implementing incentive schemes are not limited to productivity alone, as it has also been shown that they affect colleague relations. This in turn has an impact on job satisfaction, commitment to an organization and turnover (Ducharme and Martin, 2000; Morrison, 2004; Morgeson and Humphrey, 2006; Chiaburu and Harrison, 2008; Barnes et al., 2011; Taylor and Westover, 2011; Skaalvik and Skaalvik, 2011; Onemu, 2014). For example, Anderson et al. (2007) highlight the deformation of relationships and a decline in the free and open sharing of information and knowledge as being among the negative consequences of competition between scientists. Quigley et al. (2007) study knowledge sharing and performance, suggesting a positive role played by incentives that emphasize group performance and that are strongly reinforced through more positive norms for knowledge sharing.

We contribute to this literature by investigating how the change in colleague relations after an incentivized task affects peer influence on subsequent decisions. There is some literature which focuses on the role played by peers in cooperative/competitive settings, but it mainly focuses on the (heterogeneous) effect of peers on individual performance in the task to be accomplished under a cooperative/competitive compensation scheme (Gneezy, Niederle and Rustichini, 2003; Ivanova-Stenzel and Kübler, 2005; Antonovics, Arcidiacono and Walsh, 2009; Lavy, 2012; Datta Gupta, Poulsen and Villeval, 2013). As we said above, we go beyond the widely studied "incentive schemes – performance" relationship, because in real life peer relationships outlast an incentivized task and so the effects of the incentives may spread to other decisions and behaviours, which may have important consequences for the individual and also for society.

Paserman, 2010; Niederle and Vesterlund, 2011; Dohmen and Falk, 2011; Lavy, 2012; Bandiera et al., 2013; Datta Gupta, Poulsen and Villeval, 2013.

2.3 EXPERIMENTAL DESIGN

2.3.1 Tasks

In order to exogenously sort subjects into treatment groups exposed to different incentives, we manipulate the compensation scheme associated with a real effort task called the *Coin Task*, which consists of recognizing the value and country of origin of randomly selected Euro coins. A similar task has been used by Belot and Schröder (2013, 2016) to study counterproductive behaviour and monitoring.

When performing the Coin Task, participants see on the left-hand side of their computer screen a table with different Euro coins; for each coin, the indication of the value and country is shown (see Figure 1). A Euro coin randomly drawn from the table appears on the right hand side of the screen. They have to select the value and country of the Euro coin from two lists, one with all the countries that use the Euro as their domestic currency, and the other with all of the values that Euro coins may take. After confirming their choice, a new table and a new coin to identify appear on the computer screen.

[Figure 1 Here]

Participants have five minutes to recognize as many coins as they can. Their score in the Coin Task is the number of coins that they are able to successfully recognize within this five-minute time period. There is no penalty for wrong answers. Before they start, participants are allowed to practice the task for one minute. The number of coins correctly identified during this practice period does not affect their earnings.

The use of real effort tasks to manipulate incentives is commonplace in the literature on competition, cooperation and their impact on performance. We choose to influence the competitive/cooperative nature of the environment using this new task because it is simple and the outcome is easy to measure. More importantly, compared with the widely used task of adding sets of two-digit numbers (Niederle and Vesterlund, 2007), there is no gender stereotype associated with the identification of coins. Furthermore, answering correctly does not require any knowledge or ability, as subjects may in principle get all of the answers correct, provided that they exert a sufficient level of effort. This does not, of course, mean that ability or knowledge do not help, as people who are very good may be faster at the task and their effort cost may be lower; however, no specific knowledge is required to answer correctly. Finally, it does not involve learning and can be performed with real money and outside of the lab for field studies, as in the study of Belot and Schröder (2013, 2016).

Individual levels of risk aversion are measured using the Bomb Risk Elicitation Task – BRET (Crosetto and Filippin, 2013).[41] When playing the BRET, subjects see on their PC screen a square formed by 10x10 cells, which represent the 100 boxes that they can collect (see Figure 2a). They have to choose how many boxes to collect and write their chosen number.[42] They can therefore choose their preferred lottery among 100 lotteries, whose outcomes and probabilities are fully described only by one parameter, i.e., the number of collected boxes.

Earnings increase linearly with the number of boxes collected, but participants are warned that their earnings are provisional. In fact, they know that one box contains a bomb without knowing in which box the bomb is located. The position of the bomb is randomly determined for each participant at the end of each performance of the task, but it is not revealed.

The boxes are collected in numerical order starting from box one in the top left-hand corner and continuing until the number of boxes chosen by the subject is reached. While reading the instructions, we displayed a dynamic visual representation of the game on the participants' computer screens to show the order of collection.

[41] In both economics and psychology, there are a variety of experimental methods for eliciting and assessing risk behaviour. See Charness, Gneezy and Imas (2013) for a review of the advantages and disadvantages of the most common risk elicitation methods.
[42] We asked participants to write the same number twice and to confirm their choice in order to avoid measurement errors due to an incorrect number being input.

[Figure 2 Here]

If a participant collects the bomb, s/he earns zero. If s/he collects a number of boxes lower than the number of the box containing the bomb (i.e., s/he does not collect the bomb) s/he obtains £0.10 for each collected box. After confirming their decision, participants see on their screen the square of boxes showing the collected boxes in light grey and a message displaying their potential earnings in both situations (if the bomb is collected or not). Figure 2b shows the computer screen for a participant who chose to collect 35 boxes.[43]

Participants are allowed to play a practice round before the beginning of the experiment. This practice round gives them the opportunity to make sure that they understand the rules, the types of decisions they will make and how these will affect their earnings. The trial period, however, does not end with the draw of the bomb's position, so as to avoid providing subjects with a reference point regarding the bomb's position.

We chose to elicit risk attitudes using the BRET because of a number of appealing features. It is very easy to understand, thanks to the visual representation of the game which intuitively and transparently illustrates its probabilities and outcomes[44], and its duration is very short. Moreover, compared with other well-known tasks in the literature, the BRET allows both risk aversion and risk seeking to be precisely measured, is defined entirely in the gain domain and does not provide

[43] As explained in the first chapter, we decided in favour of a static version of the BRET to prevent the individual levels of impatience from affecting participants' decisions, and thus our indicator of risk behaviour. At the same time, we make sure that the participants' decisions were not driven by confusion or an imperfect comprehension of outcomes and probabilities, by further introducing a dynamic visual representation of the collection process when explaining the rules of the task, along with a visual representation of the boxes collected and not collected after each decision.

[44] Simple methods are most useful in studies such as ours trying to capture the effects of different treatments and differences in individual risk preferences (Charness, Gneezy and Imas, 2013). Moreover, the absence of complexity in the task should reduce the extent to which social learning drives peer effects on individual risk behaviour.

any endogenous reference point, thus avoiding the presence of loss aversion as a potential confounding factor.[45]

2.3.2 Treatments

Our design entails three treatment conditions which correspond to three different compensation schemes: PR (Piece Rate), ESSR (Equal-Split-Sharing-Rule) and TO (Tournament).

Table 1 describes the main features of our treatments. We have 54 participants, corresponding to 27 groups, in the PR and TO treatments and 52 participants, corresponding to 26 groups, in the ESSR treatment.

[Table 1 Here]

In the PR treatment group, participants receive £0.20 per correctly identified coin.

In the ESSR treatment group, the subject's earnings depend both on his own performance and on the performance of a randomly selected participant. The two form a team that shares the money earned equally between them. The output of the team is achieved by the sum of the number of correct answers of the two members, and each teammate earns £0.10 for each correct answer for the team.

In the TO treatment group, the subject's earnings depend on his performance relative to the performance of a participant randomly selected to be his competitor. Within each group composed of two participants, the subject with the highest score receives £0.40 for each correct answer, while his competitor receives £0. In the case of a tie between group members, the winner is randomly selected and the other subject receives nothing. The tournament's pay scheme is designed so that, for a

[45] Moreover, compared with other risk elicitation methods, such as the Balloon Analogue Risk Task (Lejuez et al., 2002), in the BRET there is no truncation of the data.

given performance, a subject with a 50% chance of winning the tournament receives the same expected payoff from the tournament as from the piece-rate scheme.

We test our hypothesis in a setting of complete information, where subjects working under any treatment condition can observe their own output as well as the output of the other subject, even if it is irrelevant for their own payoff. In order to make the design less artificial for the PR treatment group in terms of viewing additional "useless" information, thus attenuating any potential experimenter demand effect, all subjects are informed before reading the instructions for the Coin Task and being given a detailed explanation of how the earnings of the task are computed that, at the end of the task, they will see their earnings, their own score as well as the score of a randomly drawn participant in the session. They are told that, although the score of the other person may or may not affect their earnings, they will still see it. Thus, at the end of the task, subjects in the PR treatment group (which serves as a control group) are informed of their earnings, the number of coins they have personally identified correctly, as well as the score of a randomly selected participant. ESSR and TO subjects are informed of their earnings, their own score and the score of their teammate or competitor, respectively.

To increase the saliency of the cooperative/competitive nature of peer interaction, both in the instructions and in the on screen information we refer to the peer as "teammate" or "competitor" in the TE and TO treatment groups, respectively, while s/he is called "other person" in the PR treatment group.

2.3.3 Experimental Procedure

We conducted the experiment in October 2015 at the Behavioural Laboratory at the University of Edinburgh (BLUE), using z-Tree (Fischbacher, 2007).[46] 160 students were recruited using the ORSEE software (Greiner, 2015). A total of 9 sessions were

[46] The experiment is part of a bigger experiment that includes also two tasks on social preferences performed in part III. Here we describe only the parts of the experiment relevant for the analysis.

organized, each lasting about 45 minutes, and each student participated in a single session only.

The experiment is divided into two parts (Part I and Part II), as shown in Table 2.

[Table 2 Here]

In Part I, we elicit risk behaviour.

In Part II, subjects are randomly matched in pairs. Then, they perform the Euro coin recognition task with the assigned incentive scheme and receive feedback on their individual potential earnings and the score of both group members. Finally, they once again perform the risk behaviour elicitation task as in Part I, but this time, they have information about the choices made by the other group member in the previous performance of the same task. The instructions make it clear to subjects that their payoffs depend solely on their own choice, not on the choice of their partner. The information about the choice made previously by the group members is reported both on the waiting screen before the main screen of the BRET and in the top right corner of the main screen of the BRET.

Upon entering the laboratory, participants were assigned randomly to a computer. Then, we read aloud the instructions for the experiment, which were also displayed on the participants' computer screens. We gave detailed instructions at the beginning of each part and, when needed, before each relevant step in the experiment. Every time, after reading the instructions, we gave individuals some time to ask clarifying questions.

At the end of the experiment, the participants completed a short questionnaire. Then, the task selected for payment and their earnings were shown on the computer screen. By only paying for one task, we reduce the chance that decisions in a given task may be used to hedge against outcomes in other tasks. Subjects received a show-up fee of £3. We paid out their total earnings (including the show-up fee) in cash at the end of the experiment. We called participants individually, based on the number of their computer; they went into another room, signed a receipt and received their earnings in a sealed envelope.

2.4 EMPIRICAL ANALYSIS

2.4.1 Descriptive Statistics

Table 3 reports the descriptive statistics of our main variables, both at the aggregate level and by treatment group. Variables are divided into three groups: outcomes of the Coin Task, risk behaviour measured by choices in the BRET and individual predetermined characteristics. In the first four columns, the means of the variables are reported. In the last two columns, we report the ***F***-stat and the ***p***-value of a test for the equality of variable means across all groups.

We first present the variables relating to the Coin Task. During the five minutes that the effort task lasts, participants try to identify on average about 28 coins. The average number of attempts is virtually invariant across treatments, but it ranges from 9 to 45 in the PR scheme and from 15 to 45 and 18 to 40 in the ESSR and TO schemes, respectively. Similarly, on average, PR participants correctly identify about 25 coins (value ranging from 1 to 43) while ESSR and TO participants have on average 25.8 correctly identified coins (values ranging from 13 to 38 and 16 to 38, respectively). The identification of about 2 coins is incorrect.[47] The variable ***Highest Scoring Within Pair*** indicates the winners of the competition in TO, the best performing partner in PR and the partner who has contributed more to the payoff of the team in ESSR. Overall, about 51% of the participants can be classified as best

[47] The variable ***Euro Zone*** shows that almost 90% of our sample comes from a country that does not use the Euro as its currency. Differences in the distribution of people familiar with Euro coins are not significant across treatments.

performing because of one tie in the ESSR treatment group. This variable is used to investigate who drives peer effects and if they vary depending on the performance rank. None of the variables representing the outcomes of the effort task is significantly different across treatments.

[Table 3 Here]

As regards the risk elicitation task, the variable *Choice* represents the number of boxes that each student decides to collect in the first performance of the BRET and, therefore, his/her ex-ante risk behaviour. In Part I, when all participants perform the BRET for the first time, the average number of collected boxes in the whole sample is 43.1. The majority of participants (58.75%) display risk-averse behaviour (i.e., they choose a number of boxes below 50); 16.25 per cent of the sample is risk-neutral and the remaining 25% choose to collect more than 50 boxes, thus displaying risk-seeking behaviour.[48] When looking at the average choice separately by treatments, we see that TO has the lowest average number of collected boxes (41.7); PR the highest (44.4) and ESSR lies somewhere in the middle. Importantly, there are no significant differences across treatment groups[49] in terms of participants' risk behaviour in Part I. However, *Choice* is still an important control variable in our estimates, as ex-ante and ex-post risk behaviour are positively and significantly correlated (corr=0.6817, p=0.000).

Choice After is our dependent variable. It represents subjects' choices when they perform the BRET in Part II, after the Coin Task; therefore, it also represents their ex-post risk behaviour. In this performance of the BRET, subjects collect an average of about 44 boxes overall, meaning that their behaviour is slightly less risk-averse. About 59.38% of subjects are risk-averse in Part II, 16.88% are risk-neutral

[48] See Crosetto and Filippin (2013) for details on how to formalize subjects' decisions in the BRET.
[49] Two-sample t-tests for the equality of variable means within each pair of treatments show that we cannot reject the null hypothesis of similar mean ex-ante risk behaviour within each pair of treatments.

and 23.74% are risk-seeking. Risk behaviour after the Coin Task differs significantly across treatments, with participants in the PR and ESSR groups increasing their choice to about 46 boxes on average and the TO group decreasing its choice on average to 39 boxes. In PR, subjects' ex-post risk behaviour converges to risk neutrality, as about 5.6% of the sample switches from either risk aversion (3.7%) or risk propensity (1.9%) to risk neutrality. In ESSR, about 5.8% of the sample, who ex-ante was risk-averse, become either risk-neutral or risk-seeking. Instead, in the TO group, both ex-ante risk-seeking and ex-ante risk-neutral subjects become ex-post risk-averse (11.1 percent).

Most Risky is a dummy variable taking the value of 1 for subjects who have the highest ex-ante risk propensity within the peer group (on average 47%), and is used to control for the possibility that peer effects vary depending on the relative ex-ante riskiness ranking within the peer group.

Finally, we use the last set of variables (together with the variable *Choice*) to check if our randomization was successful in creating comparable treatment groups. We find no systematic differences across treatments in any of the individual predetermined characteristics, including those that could be correlated with risk-taking behaviour outside the lab, such as smoking or drinking and neither, as we said before, do we find them in ex-ante risk behaviour.[50]

2.4.2 Incentive Schemes and Peer Effects on Risk Behaviour

Many organizations and educational institutions often use competition for career advancement, sought-after jobs or high grades, and teamwork with compensation equally shared among group members as incentives for their employees/students to

[50] The most worrying of the not statistically significant, but potentially important, differences across the groups is the percentage of subjects enrolled in the field of *Economics*, which is much higher in the TO treatment group. In fact, on the one hand, different personality "types" may choose different majors; on the other hand, economics training may change how subjects behave under different incentive schemes and in laboratory experiments. When we run our main estimates including only subjects not enrolled in the field of economics, we find a bigger effect size for the TO treatment (i.e., a bigger reduction in peer effects on risk behaviour compared with the piece-rate scheme), but this is less precise due to the lower sample size.

increase their performance. Evaluations of the effects of these incentive schemes are usually limited to the resultant level of workers'/students' productivity. However, besides their effect on performance, incentive schemes could also change the nature of peers' relationships (Ducharme and Martin, 2000; Morrison, 2004; Morgeson and Humphrey, 2006; Quigley et al., 2007; Chiaburu and Harrison, 2008; Westover and Taylor, 2011; Skaalvik and Skaalvik, 2011; Onemu, 2014) and this, in turn, may have an impact on the existence and magnitude of peer effects.

We hypothesize that competition may hamper peer attachment, because competitors work to reach a personal goal that only one of the peers will be able to meet; on the contrary, an equal-split-sharing-rule evokes cooperation, working to reach a common goal, and this may enhance peers' relationships. However, it could also weaken the relationship if a peer's performance/contribution does not meet individual expectations due to free-riding.[51] Thus, compared with a situation where earnings depend only on individual performance, we expect peer effects to be smaller in magnitude, or absent, in competition because of the rivalry between peers. A less clear-cut prediction may be made for peer effects after an equal-split-sharing-rule incentive scheme due to the opposite effects of a positive impact on peers and disappointment in a peer's poor performance. If no effect is predominant, then the average effect will not be significantly different from peer effects after piece-rate compensation.[52]

In this section, we investigate whether incentive schemes have an impact on peer effects on subsequent risk behaviour by estimating the following model:

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[51] Moreover, if we consider the effort task and the BRET task as a portfolio of lotteries, we could think about the former as a lottery in which individuals have less control over both outcomes and probabilities than they have in the BRET. In fact, while in the BRET subjects know how much they may earn and the probability of it happening for every possible choice, in the effort task, first, they do not know how their effort maps into performance and second, when performance is incentivized using an equal-split-sharing-rule or a tournament, they are exposed to further uncertainty coming from the assigned peer's ability and performance. So, after playing the first lottery, they may be more desirous to control for risk when they can and thus, they may be less influenced by their peers.

[52] Distinguishing the contribution of each of these mechanisms to peer effects is beyond the aims of this paper.

$$ChoiceAfter_i = \beta_0 + \beta_1 PeerChoice_i + \beta_2 Choice_i + \beta_3 ESSR_i + \beta_4 TO_i + \beta_5 PeerChoice_i * ESSR_i + \beta_6 PeerChoice_i * TO_i + \beta_7 X_i + \varepsilon_i$$

where ***ChoiceAfter**$_i$* is the ex-post risk behaviour of subject ***i***; ***PeerChoice**$_i$* represents the number of boxes collected by the peer in the first performance of the BRET and its effect is our measure of peer influence; ***Choice**$_i$* is the subject ***i***'s ex-ante risk behaviour; ***ESSR**$_i$* and ***TO**$_i$* are two dummy variables for the treatment status (PR is the reference category); ***PeerChoice**$_i$***ESSR**$_i$* and ***PeerChoice**$_i$***TO**$_i$* are the interaction variables between the treatment status and the measure of peer influence used to analyse heterogeneity in peer effects across treatments; ***X**$_i$* is the vector of our control variables included to reduce the error variance, that is, a dummy variable to control for gender (***Woman***), a dummy variable to control for the riskiness rank within the pair (***Most Risky***)[53] and a dummy variable describing the outcome of the Coin Task (***Highest Scoring Within Pair***); ε_i is an error term.

Our prediction is that, in the absence of peer effects on risk behaviour, we should not be able to reject the null hypothesis that the coefficient β_1 is equal to zero (in the reference category, piece-rate, subjects receive information on the risk behaviour of a randomly assigned participant as in the ***Random Treatment*** in the first chapter). Moreover, if incentive schemes do not have any impact on peer effects on risk behaviour, then there should be no reason to expect the coefficients β_5 and β_6 to be significantly different from zero and, in particular, if competition does not hamper peer effects, there should be no reason to expect the coefficient β_6 to also be negative.

We define peer effects as a change in the subject's choices due to non-monetary reasons, triggered by the knowledge of their peers' previous choice and their comparison of themselves with their peers. We measure peer effects on risk behaviour by computing the change in the subject's ex-post risk behaviour produced by the ex-ante risk behaviour of the randomly assigned peer. This method is common

[53] In the first chapter we show that relative riskiness within the group matters, and that peer effects are especially strong for individuals whose peers are riskier than they are and who take on average riskier decisions, even when controlling for regression to the mean.

in most of the literature on peer effects, where the existence of peer influence is measured by regressing some individual outcome of person i in group j on the mean value of the - pre-determined - outcome for all of the other people in group j (Zimmerman, 2003; Mas and Moretti, 2009; Lavy, Silva, and Weinhardt, 2012; Balsa, Gandelman and González, 2015). However, there are alternative ways of testing the hypothesis we are interested in. For example, in the first chapter we study the role of group identity on peer effects on risk behaviour by looking at the standard deviation of group choices: lower standard deviations are interpreted as stronger peer effects, since they highlight more similar choices within the peer group. Despite the similarity of the design, here we decide to carry out our analysis according to the former method, rather than using the standard deviations of group choices. In fact, after the manipulation of the incentive scheme, peers are no longer under equal conditions (for example, after a competition there are winners and losers); therefore, the extent to which individuals are influenced by their peers may depend on these conditions. By working with individual data, rather than with data collapsed at the group level, we may study heterogeneity in peer effects between different outcomes of the effort task (see section 2.4.3).[54]

Table 4 reports OLS estimates of our model. In column (1), we only control for the individual and peer's ex-ante risk behaviour. We find that overall, subjects are significantly influenced by their peer's choice: given their own initial choice, for each additional box collected by the peer, they collect on average 0.15 boxes more. This means that the average peer will change their individual ex-post choice by about 6.5 boxes (0.15*43.1). The magnitude of this effect is slightly less than one third of the effect of their own previous choice.

[54] When we study peer effects by computing the standard deviation of the boxes collected within the pair, keeping only one observation for each pair and estimating the difference-in-differences model $SD_{gt} = \alpha + \beta Treatment_g + \delta After_t + \theta(Treatment_g * After_t) + \varepsilon_{gt}$ as in the first chapter, we obtain similar results: we find that the standard deviation of the choices within the pair is significantly lower ex-post in the PR and ESSR treatment groups, but not in the TO treatment group. However, the difference between PR and TO, although big (3.06 boxes – the average SD is 8.47 boxes), is imprecisely estimated and not significant.

In column (2), to check if peer effects are significantly different across treatments, we include the treatment dummies and the two interaction dummies between treatment status and peer choice. The data again show evidence of peer effects on risk behaviour: participants in the PR treatment group significantly increase their choice in the second performance of the BRET by about 0.20 boxes for each additional box collected in the first performance by their randomly assigned peer. Peer effects are very similar in size for participants in the ESSR treatment group, while they are more than halved when performance is incentivized by using competition (*Peer Effects in TO*=0.06). The interaction terms are imprecisely estimated, so the difference in peer effects between the PR and TO groups, despite being economically relevant, is not statistically significant.

A possible source of such imprecision may be heteroscedasticity (White's general test p=0.074; White's special test p=0.0085). Thus, in addition to using the Huber-White estimate of variance, we also estimate WLS (Wooldridge, 2009), by using as estimates of the standard deviation function the fitted values of a regression having as dependent variable the absolute value of the residuals from our model. The assumed heteroscedasticity function produces a weighted model that achieves higher precision and that predicts point estimates close to the OLS estimates in column (2). The estimate of this weighted model is reported in column (3) and shows that, if the proposed model of heteroscedasticity is a reasonable approximation of the true unknown model[55], then, once heteroscedasticity is controlled for, there is evidence for a statistically significant reduction in peer effects on risk behaviour after a competition (-0.148, p=0.054).

Overall, our findings confirm the evidence of peer effects on risk behaviour, which has emerged from the economic literature and seem to point to the role played

[55] If the assumed heteroscedasticity function is wrong, WLS estimator is generally consistent. There are two consequences of using WLS with a wrong variance function. The first is that the computed standard errors and test statistics are no longer valid, even in large samples. This issue may be fixed using standard errors robust to arbitrary heteroscedasticity (as with OLS). The second is that the WLS estimator is not guaranteed to be more efficient than OLS. However, in cases of strong heteroscedasticity, it is often better to use WLS with a wrong variance function, than OLS ignoring heteroscedasticity (Wooldridge, 2009).

by incentive schemes in peer influence. This is particularly true of tournaments, which attenuate peer influence, possibly because of peer rivalry.

[Table 4 Here]

The results remain stable in columns (4) and (5), where we add among the regressors our control variables for gender, outcome of the Coin Task and relative riskiness rank within the pair. Again, we find that peer effects are statistically significant and that, when we take into account heteroscedasticity, performing the effort task in competition with a peer significantly attenuates the peer's influence.

As far as control variables are concerned, the choice in the first performance of the BRET is always an important determinant of subsequent risk behaviour, while the outcome of the effort task (*Highest Scoring Within Pair*) and the relative riskiness rank [56] do not play any significant role. Of particular interest is, instead, the coefficient of the variable *Woman*, which shows that women are significantly more risk-averse ex-post than men. While ex-ante there are no gender differences in risk behaviour[57], the higher risk aversion ex-post in women is driven by the PR treatment (men's *ChoiceAfter* in PR=51.76; women's *ChoiceAfter* in PR=44.11; Mann-Whitney *p*=0.0949). There are no statistically significant gender differences in the other two treatments but it is interesting to note that, while in the ESSR treatment group, women are more risk-averse than men, the opposite is true in the TO group. In addition, if we look at ex-post risk behaviour within gender and across treatments, we find that men in the TO treatment group are significantly more risk-averse than men in PR. This is due to men becoming both significantly more risk-averse after

[56] We have also checked whether peer effects are different depending on the relative riskiness rank within the pair. We find that overall, peer influence seems more important for subjects with the highest ex-ante risk aversion within the pair, but the difference between them and the ex-ante most risk-seeking subjects is not statistically significant. Also, we do not observe any statistically significant difference across treatments in the effect of relative riskiness rank on peer influence.

[57] In the first performance of the BRET, both men and women decide to collect on average about 43 boxes.

competition and significantly more risk-seeking after the piece-rate compensation scheme. Finally, there are no gender differences in the impact of peer effects, both overall and within treatments.

2.4.3 Outcome of the Effort Task and Subsequent Risk Behaviour

In this section, we consider the fact that the outcome of the incentivized task is typically observed by all subjects, and that peers' relationships typically outlast the incentivized task; therefore, subsequent peer influence may be affected by the observed outcome.

Similarly to what happens for relative payoffs concerns, where subjects may feel envy if they have a lower monetary payoff and compassion if the inequality in income is to their advantage (Fehr and Schmidt, 1999), individuals may use information on their relative performance in the effort task as an indicator of ability, promptness or even luck. They may then experience different feelings about themselves or their peers that may, in turn, translate into different levels of peer influence. So, peer effects after the incentivized task may vary according to the outcome of the task. This effect may already be present in the piece-rate compensation scheme if individuals care about their relative performance even compared with random co-workers, and it may be different for competition/cooperation-based incentive schemes if individuals add concerns about the effects of winning/losing or contributing/free-riding to those over relative performance.

In particular, we suggest that the willingness to conform to peers may be stronger for the lowest scoring subjects, because they are more likely to perceive their peers as better than they are and so may expect them to make a better decision in subsequent choices as well (i.e., the BRET). Moreover, this social learning effect may get stronger as the difference in performance gets bigger; that is, the better the peer is compared to the subject itself. The fact of being teammates instead of random co-workers may amplify the difference in peer effects between low and high ranked individuals if, besides ability, the act of contributing more to the group's output without free-riding also increases the influence on the lowest scoring peer. On the contrary, being competitors may shrink this difference if the losers are less willing to imitate the winners because they feel disappointment or anger towards them.

In Table 5, columns (1) and (2), we estimate the same specification as in Table 4 column (4) for the subsample of the highest and lowest scoring subjects within the pair, respectively. We find that the peers who perform worse do not have a statistically significant influence on the highest scoring subjects in any treatments. However, while the point estimate is small for both the PR and TO treatment groups, we cannot reject the possibility of a modest effect for the ESSR group (0.15), despite it being not statistically significant.

Instead, peer effects are strong and significant for the lowest performing subjects. For this subsample, we find again that competition almost halves the size of peer effects compared with the piece-rate compensation scheme, while an increase in peer influence of similar economic relevance is observed after the cooperation-based incentive. However, we do not have enough statistical power to make confident conclusions; so, we cannot exclude the possibility that teammates are influenced by the more cooperative team member and losers by their winning counterparts in the same way that the lowest scoring subjects are influenced by a better performing random person.

In column (3), we estimate on the whole sample the same specification as in Table 4 column (4) adding our dummy for being the highest scoring subject within the pair in the Coin Task and the full set of interaction terms between the choice of the peer, the treatment status and being the highest scoring subject. We run this estimation in order to check whether peer effects significantly differ depending on the binary outcome of the effort task, as it seems to emerge from columns (1) and (2). The only difference between the estimation in column (3) and those included in the first two columns is that in the latter all controls can change depending on the score in the effort task, while column (3) focuses only on peer effects and treatment status. The data show that subjects who obtain the lowest score within the peer group in the

PR scheme are significantly influenced by their peers (+0.38, significant at the 1% level), while peer effects are significantly smaller and no longer statistically significant for subjects who obtain the highest score (coeff.=0.10, *p*-value=0.438). Interaction terms between peer effects and treatment status are never statistically significant. However, it is worth commenting on their economic relevance, pointing out that while the differences across treatments are close to zero for the highest scoring subjects, they become bigger for the lowest scoring subjects: the influence of better performing teammates is about one third higher than that of better randomly assigned people, while the influence of winners is lower by about a half compared with the piece-rate compensation scheme.

To sum up, the relative rank of performance in the effort task matters, and while high performers exert influence, low performers do not.

[Table 5 Here]

Performance in the Coin Task is an important indicator of peers' homogeneity, which in the ESSR group also represents teammates' contribution to the group output and, in the TO group, the margin of the win/defeat. The binary outcome may thus be more or less salient depending on the difference in performance. To investigate this, in columns (4) to (6), we split our sample according to the absolute value of the difference in the number of correct answers within the pair, considering the first quartile (<=3), the interquartile range and the fourth quartile (>9.5). In the specifications reported in Table 5, we look at the overall heterogeneity in peer effects according to the binary outcome for each subsample; when we also add the interaction terms with the treatment status (as in column 3), we find again that differences across treatments are very imprecisely estimated and never statistically significant.

The estimations in columns (4) to (6) suggest that the differences in peer effects between the highest and lowest scoring subjects within the pair, and the absence of peer influence for the highest scoring participants, come mainly from the right hand tail of the distribution of absolute difference in performance: when the difference in performance is very big (i.e., for very heterogeneous peer groups), the highest scoring subjects are not influenced by their peers; instead, for smaller differences in performance, peer effects are statistically similar for the two outcomes (although the point estimates of the interaction terms in the first two subsamples are quite big in relative terms).

2.4.4 Incentive Schemes, Attachment to Peers and Self-Reported Peer Influence

This section analyses if incentive schemes change the individual's feeling of attachment to their assigned peer and their perception of peer influence. We use two questions from the final questionnaire to create our measures of attachment to peers and perceived peer influence. The first question asks subjects to rate, on a scale from 0 to 10, how closely attached they felt to their peer throughout the experiment. Based on participants' answers, we create the variable *Attached*, which takes values between 0 and 10. On average, subjects' reported level of attachment is 3.2. The second question, used to create an indicator of *Self-Reported Peer Influence*, asks subjects if, in the second performance of the BRET, they considered their peer's previous choice when taking their decision. On average, 55% of subjects state having been influenced by their peer's choice.

In Table 6, we estimate a linear regression model where we regress *Attached* (columns 1 to 3) and *Self-Reported Peer Influence*[58] (columns 4 to 6) on the two treatment dummies (PR is our reference category) and our control variables.

We find that participants in the TO treatment group feel significantly less attached to their peer than individuals in both the PR (-1.1481) and ESSR (-1.7208)

[58] Results do not change when we estimate a Probit model.

treatment groups, and that they are less likely than in the PR (-0.1667) and ESSR (-0.2657) groups to admit to having considered their peer's choice. These results are robust when we control for gender, outcome of the effort task and ex-ante risk behaviour (columns 2 and 5), as well as when we add to the controls the peer's ex-ante risk behaviour and the individual's choice in the second performance of the BRET (columns 3 and 6).

Our results suggest that incentivizing performance using tournaments has an effect on peers' relationships, as it reduces feelings of attachment to the assigned peer. Moreover, despite the absence of a statistically significant change in observed behaviour, tournaments significantly attenuate self-reported peer influence.

[Table 6 Here]

2.5 CONCLUDING REMARKS

In this paper, we study the relationship between incentive schemes and peer effects on risk behaviour.

Risk attitudes are an important driver of many decisions that individuals take in their daily lives: what to eat, what to study, where to work, whom to marry, etc. Recent evidence shows that they are neither exogenously given by nature nor immutable, but are shaped by environmental factors like peer influence. The understanding of what determines the existence and magnitude of peer effects on risk behaviour has received particular attention because it has been shown that not all peers matter and that some matter more than others. We contribute to this research by investigating if teammates or competitors exert a different influence compared with random peers.

Work environments and educational institutions often implement incentive schemes, such as equal-split-sharing-rules or tournaments, to improve their employees'/students' performance. By changing the nature of relationships between peers, these incentives may affect the extent to which subjects are influenced by their peers. Furthermore, since peer interactions outlast the incentivized task, the effects of the change in peer influence may spread to subsequent decisions. In addition, in a setting of complete information, where employees/students interact and can observe each other both before and after the incentivized tasks, peer effects may differ depending on the outcome of the incentivized task.

We answer our research question by collecting data from a laboratory experiment with three treatment conditions, which correspond to three different compensation schemes: piece-rate, equal-split-sharing-rule and tournament. These are associated with a real effort task, the Coin Task, which consists of recognizing the value and country of origin of Euro coins. Risk preferences are measured by using the Bomb Risk Elicitation Task (Crosetto and Filippin, 2013), which is performed both before and after the Coin Task to measure ex-ante and ex-post risk behaviour, respectively.

We find evidence of peer effects on subsequent risk behaviour that, despite being statistically similar across treatments, are economically weaker after competition: the influence of a random person is about three times as big as the influence of a competitor. This difference becomes significant when we run WLS estimates to control for heteroscedasticity. Moreover, the outcome of the incentivized task matters, with peer influence on risk behaviour being mostly driven by participants with the lowest score in the effort task within the pair. Peer effects are instead significantly smaller and no longer statistically significant for subjects who obtain the highest score. This result mainly comes from very heterogeneous peer groups in terms of performance in the effort task.

When probing more deeply into the subjects' feelings, we find that they feel significantly less attached to their competitors than to their teammates and random peers, and that self-reported peer influence is significantly lower among competitors than under the other two incentive schemes.

Establishing the existence of peer influence on decisions involving risk is important from a policy perspective, because in several environments, policy makers or private companies may be interested in influencing individuals' choices involving risk: peer effects may amplify the effects of any intervention because, by targeting a few subjects, the effects will spread to their peers as well.

Also, our results contribute to a better understanding of the different consequences of implementing incentive schemes, particularly tournaments. Our findings suggest that if peers are viewed as competitors, the feeling of attachment to the peer group weakens, as does the likelihood of taking peers' choices into consideration before deciding. It would be interesting to investigate whether there is complementarity or substitutability in the influence of different "kinds" of peers, whether these results hold under repeated competition and what happens when peer groups need to face both cooperative and competitive situations, as is the case in many working environments.

Finally, our evidence that relative performance matters in order for peers to exert an influence on subsequent risk behaviour, and that the lowest scoring individuals are influenced by the highest scoring individuals but not vice versa, highlights that the study of the role played by group size and the composition of the peer group should be considered as promising directions for future research.

Figure 1. Participant’s computer screen in the Coin Task

Figure 2. Participant’s computer screen

(a) when performing the BRET **(b) after having chosen to collect 35 boxes**

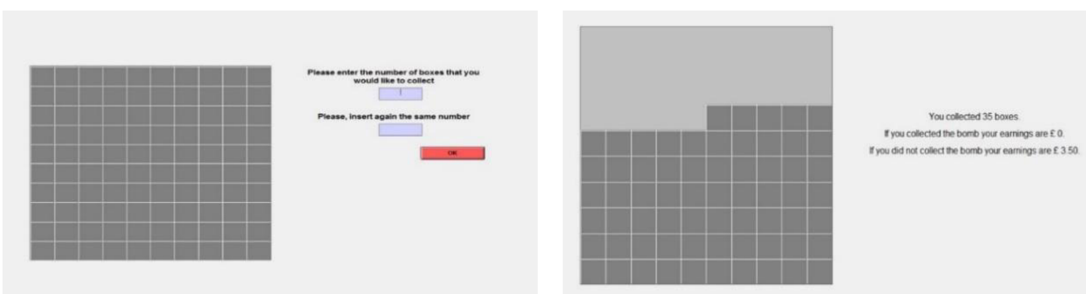

Table 1. Treatments of the experiment

	Pay Scheme	Number of Sessions	Number of Subjects	Number of Groups
Piece Rate (PR)	£0.20 per UIO	3	54	27
Equal-Split-Sharing-Rule (ESSR)	1/2*(£0.20 per UGO)	3	52	26
Tournament (TO)	£0.40 per UIO or £0	3	54	27

Note: UIO denotes unit of individual output; UGO denotes unit of group output; Output denotes the number of correctly identified coins.

Table 2. Structure of the experiment

	Risk Behaviour	Coin Task	Risk behaviour with information on previous choice
Part I	Yes	-	-
Part II	-	Yes	Yes

Table 3. Descriptive statistics

	Means					
	ALL	**PR**	**ESSR**	**TO**	**F-stat**	**p-value**
Coin Task						
Total Coins	27.725	27.6667	27.7115	27.7963	.0073	.9928
Correct	25.55	25.0926	25.7885	25.7778	.2271	.7971
Wrong	2.175	2.5741	1.9231	2.0185	.4074	.6661
Highest Scoring Within Pair	.5062	.5	.5192	.5	.0255	.9748
BRET						
Choice	43.1	44.3704	43.2308	41.7037	.2917	.7474
Choice After	44.075	46.5185	46.1346	39.6482	3.6129	.0292
Most Risky	0.4688	0.5	0.4615	0.4444	0.1725	0.8418
Pred. Charact.						
Female	.65	.6852	.5577	.7037	1.4623	.2348
Age	22.6813	22.4630	22.5385	23.0370	.0934	.9108
Asian	.2438	.2778	.2308	.2222	.2572	.7735
European	.6938	.6852	.6731	.7222	.1619	.8507
Euro Zone	.1063	.1296	.0962	.0926	.2326	.7927
Economics	.3188	.2593	.2692	.4259	2.1803	.1164
HSS	.5188	.5926	.4808	.4815	.8833	.4155
MVM	.0313	.0370	.0577	0	1.5014	.2260
Distinction	.3688	.3889	.3846	.3333	.2171	.8051
Mother Uni Degree	.5875	.5926	.5577	.6111	.1576	.8543
Father Uni Degree	.6313	.6296	.5769	.6852	.6604	.5181
Brothers	.8	.7037	.9423	.7593	.9777	.3785
Sisters	.8125	.6481	.8462	.9444	1.5082	.2245
Self-Reported Risk	5.3813	5.0556	5.4615	5.6296	.8191	.4427
Smoker	.1688	.1296	.1538	.2222	.8792	.4171
Drinker	.8938	.8704	.8846	.9259	.4665	.6280
Observations	160	54	52	54		

Notes: In the last two columns, we report the *F*-stat and *p*-value of a test for the equality of variable means across all groups. HSS is the Humanities and Social Sciences degree. MVM is the Medicine and Veterinary Medicine degree.

Table 4. Incentive Schemes and Peer Effects on Risk Behaviour

	CHOICE AFTER				
			Weighted		**Weighted**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Peer Choice	0.1501***	0.1979**	0.2327***	0.2397**	0.2808***
	(0.0513)	(0.0865)	(0.0611)	(0.0922)	(0.0714)
Choice	0.5523***	0.5508***	0.5487***	0.5199***	0.5214***
	(0.0690)	(0.0674)	(0.0658)	(0.0821)	(0.0779)
*Peer Choice*ESSR*		-0.0313	-0.0872	-0.0405	-0.0943
		(0.1172)	(0.0964)	(0.1183)	(0.0952)
Peer Choice TO*		-0.1358	-0.1480*	-0.1202	-0.1434*
		(0.1255)	(0.0762)	(0.1298)	(0.0857)
Equal-Split-Sharing-Rule		1.8235	4.3309	1.8798	4.7406
		(5.9559)	(5.1727)	(5.8843)	(4.8365)
Tournament		0.7885	1.3876	0.3638	1.9840
		(6.3559)	(4.4818)	(6.5270)	(4.8208)
Woman				-3.6733*	-4.1653**
				(1.8778)	(1.8546)
Highest Scoring Within Pair				-1.4957	-1.9300
				(1.6918)	(1.5808)
Most Risky				2.2905	2.3670
				(2.2349)	(2.1414)
Constant	13.8046***	13.2975***	11.8026***	14.9347***	13.2005***
	(3.4732)	(5.0431)	(4.2157)	(5.1338)	(4.3563)
Peer Effects in ESSR		0.1666**	0.1455*	0.1992**	0.1865**
		(0.0798)	(0.0752)	(0.0881)	(0.0773)
Peer Effects in TO		0.0621	0.0847*	0.1195	0.1374**
		(0.0927)	(0.0480)	(0.1020)	(0.0626)
Observations	160	160	160	160	160
Adj. R-squared	0.490	0.510	0.545	0.518	0.571

Standard errors (corrected for heteroscedasticity) are reported in parentheses. The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively. *Peer Effects in ESSR* and *Peer Effects in TO* are computed as the linear combination of the coefficient of *Peer Choice* and the coefficient of the interaction of *Peer Choice* with *ESSR* and *TO*, respectively.

Table 5. Outcomes of the Effort Task and Peer Effects on Subsequent Risk Behaviour

			CHOICE AFTER			
	Highest Scoring Within Pair	Lowest Scoring Within Pair	All	I Q	II-III Q	IV Q
	(1)	(2)	(3)	(4)	(5)	(6)
Peer Choice	0.1009	0.3734***	0.3812***	0.3195*	0.3601***	0.4446**
	(0.1466)	(0.1066)	(0.1052)	(0.1718)	(0.1123)	(0.1973)
*Peer Choice*ESSR*	0.0517	0.1484	0.1415			
	(0.1745)	(0.1543)	(0.1593)			
Peer Choice TO*	-0.0129	-0.1637	-0.1737			
	(0.2048)	(0.1318)	(0.1339)			
Peer Choice Highest Scoring Within Pair*			-0.2767*	-0.1905	-0.1979	-0.5702***
			(0.1644)	(0.2116)	(0.1276)	(0.2016)
*Peer Choice*ESSR* Highest Scoring Within Pair*			-0.1168			
			(0.2272)			
Peer Choice TO* Highest Scoring Within Pair*			0.1393			
			(0.2445)			
ESSR Highest Scoring Within Pair*			7.3707			
			(11.0539)			
TO Highest Scoring Within Pair*			-1.2169			
			(12.1174)			
Highest Scoring Within Pair			8.0095	6.4083	8.5158	16.3823*
			(7.5971)	(10.5283)	(6.6324)	(8.7612)
Choice	0.4643***	0.5362***	0.5080***	0.5752***	0.4406***	0.5518***
	(0.1414)	(0.0991)	(0.0819)	(0.1628)	(0.1314)	(0.1239)
Equal-Split-Sharing-Rule	-0.1763	-7.2984	-6.7533	5.1430	-1.6493	-0.6523
	(8.2884)	(7.3446)	(7.6241)	(4.1141)	(3.4625)	(4.0318)
Tournament	-0.8375	0.9509	1.3022	-5.8817*	-0.8456	-3.1101
	(10.5738)	(5.8779)	(5.9495)	(3.1024)	(4.2664)	(2.8420)
Woman	-1.7002	-5.9525**	-3.6983**	-0.4816	-2.7928	-8.1251**
	(2.5793)	(2.4341)	(1.7843)	(3.5219)	(3.6745)	(3.3636)
Most Risky	4.8680	3.0174	3.7293	2.6954	3.1853	3.9336
	(3.7767)	(3.1079)	(2.4222)	(3.9188)	(4.4584)	(3.3783)
Constant	17.1439**	10.0700*	8.9995*	6.1136	10.4248	8.6130
	(7.6893)	(5.9926)	(5.3985)	(8.5639)	(7.5633)	(9.9560)
Observations	81	79	160	58	62	40
Adj. R-squared	0.400	0.632	0.532	0.490	0.538	0.603

In Table 5 columns (1) and (2) we run the same specification as in Table 4 column 4 in the subsamples indicated by the columns' label. In the remaining columns, we also add interaction terms with the outcome of the coin task. Standard errors (corrected for heteroscedasticity) are reported in parentheses. The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

Table 6. Incentive Schemes, Attachment to Peers and Self-Reported Peer Influence

	ATTACHED			*SELF-REPORTED PEER INFLUENCE*		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Equal-Split-Sharing-Rule	0.5726	0.4617	0.4546	0.0990	0.1005	0.1048
	(0.5071)	(0.5207)	(0.5191)	(0.0945)	(0.0963)	(0.0962)
Tournament	-1.1481**	-1.1551**	-1.0231**	-0.1667*	-0.1676*	-0.1673*
	(0.4513)	(0.4533)	(0.4404)	(0.0958)	(0.0971)	(0.1001)
Woman		-0.6846	-0.5725		0.0125	0.0036
		(0.4531)	(0.4571)		(0.0856)	(0.0866)
Highest Scoring Within Pair		0.2720	0.3259		-0.0338	-0.0372
		(0.3765)	(0.3667)		(0.0815)	(0.0824)
Most Risky		-0.6837*	-0.8418		-0.0324	0.0461
		(0.4121)	(0.5828)		(0.0937)	(0.1224)
Choice		0.0069	-0.0068		0.0004	-0.0001
		(0.0128)	(0.0165)		(0.0025)	(0.0033)
Peer Choice			-0.0087			0.0031
			(0.0141)			(0.0028)
Choice After			0.0295			-0.0016
			(0.0184)			(0.0036)
Constant	3.3889***	3.7591***	3.3562***	0.5741***	0.5797***	0.5088***
	(0.3696)	(0.7545)	(0.8927)	(0.0679)	(0.1375)	(0.1836)
Observations	160	160	160	160	160	160
Adj. R-squared	0.071	0.075	0.079	0.036	0.014	0.008

Standard errors (corrected for heteroscedasticity) are reported in parentheses. The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

CHAPTER 3

Competition and subsequent risk-taking behaviour: heterogeneity across gender and outcomes

Abstract

This paper studies if competition affects subsequent risk-taking behaviour and if such an effect is heterogeneous across gender. We run a laboratory experiment in which the rewards of a real effort task consisting in recognizing the value and country of origin of Euro coins (Coin Task) are determined on the basis of a tournament between two subjects, in the treatment group, and of a random draw of the same monetary payoffs for pairs of subjects in the control group. Risk behaviour is measured after the incentivized task by using the Bomb Risk Elicitation Task. We find that competition increases risk aversion, especially for males, but not in a significant manner. When conditioning on the outcome, we find that males become significantly more risk averse after losing a competition than after randomly earning the same low payoff. In contrast, males do not become more risk-seeking after they win the tournament, while females' average risk-taking behaviour is unaffected by participation in the tournament and its outcomes. We interpret our findings in terms of males' reaction to negative outcomes driven by intrinsic motives, such as emotions or a shift in the locus of control from internal to external.

Keywords: Competition, Risk behaviour, Gender

JEL classifications: C81; C91; D81

3.1 INTRODUCTION

Every day people are faced with many decisions involving risk. Most of such decisions have economic relevance and affect not only individuals' immediate well-being but also their long-term situation. Recent research in economics has shown that risk attitudes are shaped by life experiences and by the characteristics of the environment.[59] Our paper contributes to this emerging literature by studying the effect of competition on subsequent risk behaviour and its heterogeneity along the gender dimension.

People compete for better paid jobs, for career advancements, for mates, and for monetary and non-monetary rewards. In general, competition is widely used as incentive scheme. It constitutes an important motivating device especially in situations where measuring absolute performance is difficult and where common shocks that affect performance are highly likely. Competition may be a useful incentive also when performance evaluation is subjective because, in such situations, employees' motivation may be weakened by the employer's incentives to underreport performance (to avoid additional payments like bonuses) or by his reluctance to distinguish between good or bad performance in order to avoid inequalities. The fact that risk attitudes and competitiveness may correlate is rather intuitive, as tournaments typically imply uncertain outcomes. Thus, the decision to enter the competition and the behaviour in a competitive environment are naturally influenced by subjects' risk attitudes.

In this paper, we go one step further and analyse the possible consequences of competitive endeavours on risk behaviour. Being exposed to some risk while competing, due to the random component of the outcomes, may have carryover effects on future decisions involving risk, even without competitive incentives.

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[59] For instance, Booth and Nolen (2012) find that women's risk preferences react to the gender composition of the education environment. Eckel et al. (2009) show that Hurricane Katrina evacuees exhibit risk-loving behaviour shortly after the disaster, while an opposite reaction is reported by Cameron and Shah (2015), who instead find that individuals in Indonesian villages that had suffered from a flood or an earthquake exhibit a long-lasting increase in risk aversion.

However, the randomness in the outcome is not the only source of uncertainty that competitors in a tournament face. A second source of uncertainty arises from the nature of tournaments because they require agents to think strategically about their competitors' effort or decisions (Bull, Schotter and Weigelt, 1987).[60] Being exposed to such a strategic uncertainty while competing may in turn affect subsequent decisions involving risk even if they do not require any strategic thinking.

Uncertainty is not the only link between competition and subsequent risk-taking behaviour. Competitive pressure in the lab also involves stress (Buckert et al., 2015; Zhong et al., 2016), and acute stress has been shown to affect decisions under risk (Starckle and Brand, 2012). Competitive endeavours may also trigger a set of different emotions and feelings (Cerin and Barnett, 2006; Kräkel, 2008), and emotions have been shown to play an important role in decision-making under risk.[61] Finally, subjects performing in a competitive environment know that the outcome is not a pure chance event because their ability and effort also matter. How subjects weigh the role played by their characteristics with that played by luck may have carryover effects as long as their locus of control gets affected.

Whatever the cause, investigating whether the competitiveness of the environment can in turn shape subsequent decisions under risk is important because the analysis of competition is usually focused only on its immediate effects on productivity. Competition as a one-shot phenomenon is mainly an abstraction of laboratory experiments, while choices are usually taken in situations where competition occurs repeatedly or is followed by other decisions.[62] Hence, besides

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[60] As explained by Bull, Schotter and Weigelt (1987), "The agents will have to take into account two sources of uncertainty. One of these is a part of the existing theoretical literature, namely, the distribution of the prizes induced by the randomness in production [..]. The second source of uncertainty, which is not in the literature, is precisely the uncertainty concerning how the specific tournament that the agent enters will be played".

[61] Conte et al. (2013) find that four specific emotional states (joviality, sadness, fear, and anger) induce risk-seeking behaviour, while Campos-Vazquez and Cuilty (2014) report that risk aversion increases with sadness. Bassi et al. (2013) attribute to subjects mood the role of mediator between weather conditions and risk-taking behaviour.

[62] Gill and Prowse (2014) study how the outcome of competition affects the productivity of men and women in subsequent competitive interactions. They find that for women losing per se is detrimental to productivity, while for men such an effect is observed only when the prize at stake is big enough.

short-run effects on performance, the exposure to competition may have long-run consequences and the change in risk attitudes may constitute a transmission mechanism.

We answer our research question through a laboratory experiment in which competition occurs in the Coin Task, a real effort task that consists in recognizing the value and country of origin of Euro coins. We measure participants' risk preferences by using the Bomb Risk Elicitation Task (Crosetto and Filippin, 2013), where subjects have to choose how many boxes to collect out of 100, 99 of which contain 10 Euro cents while one contains a bomb that destroys the earnings. We then compare risk preferences between subjects in a treatment in which the rewards in the Coin Task are determined in a tournament within pairs and subjects in a baseline condition, in which comparable payoffs are instead randomly assigned. Such a (between-subject) design allows us to control for another reason why competition may affect subsequent risk-taking, namely social comparison. Competition induces ex-post inequality, thereby making relative earnings salient in models such as Fehr and Schmidt (1999) and Charness and Rabin (2002). There is a growing literature showing that social comparison plays indeed a relevant role in decisions under risk (Linde and Sonnemans, 2012; Gamba et al., 2014; Fafchamps et al., 2015; Schmidt et al., 2015). Our design allows us to control for wealth effects and focus on the effect of competition on risk-taking behaviour net of any social comparison consideration.

We also aim at investigating whether the relationship between the competitiveness of the environment and risk behaviour is different for men and women. Some contributions in the literature claim that women are more risk-averse than men (Eckel and Grossman, 2008; Croson and Gneezy, 2009) although the estimated gender difference in risk attitudes depends on the method used to measure risk attitudes (Filippin and Crosetto, 2016). On the other hand, the literature has documented significant gender differences in the level of fondness for competition and in performance in competitive situations (Gneezy et al., 2003). At least since

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Haenni (2016) finds in a sample of amateur tennis players that it takes on average 10% longer to compete again after losing than after winning.

Niederle and Vesterlund (2007), it has been shown that women tend to shy away from competition. The combination of these two strands of the literature suggested that even unequal outcomes in the labour market can be rationalized by the fact that women are less willing to engage in competitive endeavours because they are more risk-averse (Booth and Nolen, 2012). However, while the gender gap in tournament entry has been largely replicated, the role played by risk attitudes has been further investigated showing a limited impact.[63] In light of this evidence, we believe that it is worth investigating whether competition affects risk preferences differently for men and women. For example, if women are both more risk-averse and less willing to engage in competition than men, after being exposed to the risk of a competitive endeavour they may be more likely to avoid further - although independent - risk. Similarly, since men like competition more and tend to perform better, after the competitive experience, they may be more likely to take on further risk.[64]

Our results suggest that on average competition does not affect risk-taking behaviour. When investigating gender heterogeneity, we still find that, for both genders, performing the Coin Task in a tournament does not significantly change risk aversion as compared to the baseline condition, even though the difference in the risky choice in the baseline and after competing is quite large for males.

An interesting finding about males' behaviour emerges when disaggregating the results by both gender and outcomes: males become significantly more risk averse after they lose the tournament than after they earn the same payoff in the baseline treatment. There is instead no evidence of a more risk-seeking behaviour after winning the tournament. As regards females, their risk behaviour is unaffected by participating in the tournament and by its outcome. Since our design does not allow for causal inference on outcome-related effects of competition, this further

[63] See Niederle (2016) and references therein.

[64] Some papers have documented that also stress may have an effect on choices under risk that is different for men and women. Lighthall et al. (2009) run an experiment where participants play the Balloon Analogue Risk Task (Lejuez et al., 2002), a computer game measuring risk taking, fifteen minutes after completing a stress challenge or control task. They find that acute stress amplifies sex differences in risk-seeking: men take more risk under stress while women become more risk averse. Similarly, Ceccato et al. (2015) study the relationship between stress and risk-taking in the gain domain and find that women generally take less risk and report slightly higher stress levels than men.

investigation on the role played by winning or losing is only suggestive. However, several mechanisms may explain the pattern of observed results. On one hand, since winning or losing is not only a pure chance event but also relies upon individual characteristics, such as ability or effort, losing a tournament may trigger a feeling of loss of control over one's outcomes, or, in other words, is likely to shift the locus of control from internal to external. By thinking that their decisions are controlled by environmental factors which they cannot influence, males who lose may become less confident in their probability of succeeding even in a pure chance task and therefore become more risk-averse. Beisswingert et al. (2016) indeed show that exogenously determining a loss of control induces a more risk averse behaviour.[65] On the other hand, the relationship between losing the competition and having a higher degree of risk aversion may be explained by the emotions induced by tournaments. Subjects feel joy, pride, self-esteem when outperforming their opponent, whereas they feel sadness, disappointment, anger and low self-esteem when falling behind.

Up to our knowledge, very few contributions investigate the effect of competition on subsequent decisions under risk, and they do not emphasize a direct effect of competition on risk behaviour at the individual level. The second chapter of the thesis studies the impact of peer effects on risk behaviour under different incentive schemes, including tournaments. Here, instead of comparing different incentive schemes, we look only at competition and study the direct effect of introducing competition on individual risk-taking behaviour in an environment in which individuals cannot observe their peers' risk behaviour and so cannot be influenced by them when making decisions involving risk. Apicella et al. (2014) study the effect of changes in the level of testosterone induced by winning or losing a rock-paper-scissors tournament on subsequent willingness to take risk. They report an increase in testosterone levels after the tournament, higher for winners than for losers,

[65] Beisswingert et al. (2016) propose a computer game in which participants have to predict where an object would be displayed on a circle by recognizing the systematic pattern underlying the previously displayed objects. They show that manipulating the degree of difficulty of the task induces significantly more risk-averse choices in the Devil's task (Slovic, 1966), a risk elicitation method that has many features in common with the Bomb Risk Elicitation Task (BRET) that we use.

and greater for subjects who win by a tighter margin. The authors find that testosterone significantly correlates with the decision of taking more risk in a multiple price list task. However, Apicella et al. (2014) use a task that is based on pure chance, similar to our baseline condition. But competition is not a pure chance event, because ability and effort also matter. So, to study the effect of competition on subsequent risk behaviour, we use an effort task and design the incentives in order to compare the effects of a competition with those of a tournament based only on chance. Also, while Apicella et al. (2014) do not study the behaviour of females, we offer also some insights on gender differences. Finally, Buser (2016) studies the effect of competition on the willingness to seek further challenges. He finds that when subjects perform at the individual level the same task (adding two-digit numbers) in which they have previously lost in a winner-takes-all tournament, they tend to set a higher performance target to meet for payment but also to perform worse. In Buser (2016) risk attitudes act as a mediator between competition and the decisions in the second stage. However, decisions also depend on ability and effort, which instead do not play any role in our setting as we administer a pure risk task.

The structure of the paper is as follows. Section 3.2 describes the tasks adopted as well as the experimental design and procedures. In Section 3.3, we present the results of the experiment, first at the aggregate level, and then disaggregated by gender and outcome in the tournament. Section 3.4 concludes.

3.2 EXPERIMENTAL DESIGN

The experiment entails the exogenous manipulation of the degree of competitiveness of a real effort task performed before eliciting subjects' risk preferences. We implement two conditions in a between-subject design: a treatment in which the rewards in the real effort task are decided by a tournament within pairs of subjects (Competition), and a control condition in which comparable payoffs are instead exogenously assigned (Baseline).

The real effort task that subjects perform is the Coin Task. A similar task has been used by Belot and Schröder (2013, 2016) to study counterproductive behaviour and monitoring. The Coin Task consists of recognizing the value and country of origin of Euro coins. Participants see on the left-hand side of their computer screen a table with Euro coins of different values from several countries, and on the right-hand side a coin randomly drawn from the table (see Figure 1). The task of the subjects is to identify the value and the country of the selected coin. After the answer is submitted, a new table and a new coin to identify appear on the subject's screen. Participants have five minutes to recognize as many coins as possible. The score is the number of coins successfully recognized, with no penalty for wrong answers.

[Figure 1 Here]

The main advantage of this task in comparison to other real effort tasks is that in the Coin Task subjects may in principle get all of the answers correct, provided that they exert enough effort. This doesn't of course mean that ability or knowledge do not help, as people who are very good may be faster at the task and their effort cost may be lower; however, no specific knowledge is required to answer correctly. Also, there is no gender stereotype associated with the task and it is very easy to understand and perform.

The Coin Task is always played in groups of two and the rules for the payment determine our treatment conditions. Treated participants are in competition with their randomly determined opponent: the subject reaching the highest score gets 8 Euros while the other one gets 2 Euros.[66] Participants in the baseline receive the same monetary payoffs (one player 2 Euros, the other 8 Euros), which are randomly assigned so that there is no competition, and they know their payoffs prior to

[66] Possible ties are broken first by looking at the total number of attempts, i.e., also including wrong answers in the score. In case of a further tie, we look at the time taken to identify the coins correctly.

engaging in the real effort task. Monetary rewards in both treatments are conditional upon identifying at least 5 coins, otherwise the payoff is zero. We do so for the effort task to be perceived as incentivized in both conditions and, therefore, to avoid house-money effects (Kahneman et al., 1990, 1991; Thaler and Johnson, 1990). The chosen threshold is low in order to avoid losing observations because subjects do not earn a positive amount.

The focus of our research is the pure effect of competition on subsequent risk-taking behaviour and, therefore, we want to avoid the possible confound represented by wealth effects. Wealth effects may affect risk-taking both in absolute and in relative terms. First, previous earning can shape participants' willingness to take risks by cushioning the impact of bad outcomes in the BRET. Higher earnings in the Coin Task could induce a more risk-seeking behaviour in the BRET and such an effect do not need to be linear.[67] For the sake of minimizing the heterogeneity in the outcomes we opt for fixed prizes in the tournament (either 2 or 8 Euros), rather than for rewards that change at the margin with individual productivity. To be salient, however, competition needs to map into different outcomes for winners and losers and this leads to the second concern. Earning different amounts may affect choices under risk via social comparison. For this reason, we add the baseline condition in which subjects are randomly matched in pairs and receive the same rewards that are however randomly assigned instead of determined by the relative performance.[68] Social comparison based on monetary outcomes is expected to be the same in the two conditions and will therefore cancel out when considering the difference across them. Thus, the comparison across conditions allows us to isolate the pure effect of competition on risk behaviour.

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[67] For instance, Crosetto and Filippin (2013) show that earnings in previous tasks have a U-shape effect on subsequent choices in the BRET. The most risk-averse choice follows a payoff of about 2 Euros, while higher and lower earnings are associated to more risk-seeking decisions.

[68] Our baseline condition allows us to control for wealth effects. We opted for an earlier risk resolution (knowledge of own earnings) to avoid uncertainty to play any role during the effort task in the baseline. One possible extension useful to separate the role of uncertainty due to the randomness in the outcome from strategic uncertainty could be an additional baseline condition where earnings are randomly determined but known at the end of the effort task.

After the completion of the Coin Task, we elicit subjects' risk preferences by using the BRET (Crosetto and Filippin, 2013). The BRET is a simple risk elicitation method in which participants see on their computer screen a field containing 100 boxes, as shown in Figure 2. A subject has to choose how many boxes to collect knowing that 99 boxes contain 10 Euro cents while one contains a bomb that, if collected, destroys the earnings. Boxes are collected in numerical order starting from the top-left corner and ending at the box corresponding to the participant's chosen number. The bomb can be in any box with the same probability and its position is randomly determined at the end of the experiment, i.e., after the choice is made, in order to avoid truncation of the data. The BRET allows to span the whole domain of risk preferences, with a risk neutral choice (under CRRA preferences) corresponding to 50 boxes. A higher (lower) choice identifies risk-seeking (aversion). After selecting a number of boxes, subjects are informed about the lottery they are going to play. The chosen number of boxes is shown in light grey and the potential earnings and their corresponding probabilities are explicitly described. Participants may change their choice as many times as they like before confirming it.

[Figure 2 Here]

We elicit risk attitudes only once, after the effort task. The reason is that we want to avoid possible confounds, such as negative correlation among subsequent choices, hedging, or possible violation of the Reduction Axiom that could stem from additional risk elicitations. In Crosetto and Filippin (2013), the authors suggest to implement a one-shot versions of the BRET, stressing that a lower risk aversion could be observed when the salience of the single decision is diluted by the repetitions of the task.

3.2.1 Experimental Procedure

The experiment took place at the University of Milan in March 2016. It was programmed using z-Tree (Fischbacher, 2007). Subjects were recruited using the ORSEE software (Greiner, 2015) ensuring a balanced representation by gender.

Upon their arrival subjects entered the laboratory and were randomly assigned to computer terminals, separated by partitions. After reading aloud the instructions illustrating the Coin Task, participants were solicited to raise questions. Once all doubts had been privately dispelled, the first stage of the experiment began.

Participants were randomly matched in pairs and were given the chance to practice for one minute in order to familiarize with the Coin Task. Coins identified during this minute did not add to the final score. They had then five minutes to perform the incentivized task, which consisted in recognizing as many coins as possible. Before starting, subjects were asked to guess the number of coins they were going to correctly identify and whether this number was higher, equal, or lower than the average of the other participants. We ask these questions in order to elicit subjects' expectations and be able to build a proxy for overconfidence. At the end of the real effort task, subjects were told their own score and, in the competition treatment, also the outcome of the tournament. Subjects were not told their peer's score.

The experimenter then read aloud the instructions of the BRET and participants were given again the opportunity to clear up any doubts individually. Subjects played the BRET and, after submitting their choice, completed a short questionnaire. The position of the bomb was then randomly determined at the individual level. Subjects were notified about their final earnings (2.5 Euros of show-up fee, plus their earnings in both the Coin Task and the BRET), received their payment in a sealed envelope and left the laboratory.

3.3 RESULTS

A total of 130 subjects took part in the experiment: 62 in the baseline and 68 in the competition treatment. Table 1 presents summary statistics of our main variables separately for the two conditions. The last column of the table reports the *p*-value of a Mann-Whitney test for the equality of the variable means across the two conditions.

Subjects in the two conditions are homogeneous in terms of individual characteristics such as gender, age and ability. Females represent 42 percent of subjects in the baseline and 53 percent of treated subjects but the difference is not statistically significant. Participants in the whole sample are on average 21 years old.

In order to perform the Coin Task subjects do not need any specific cognitive ability. A sufficient amount of effort is enough to get a correct answer. However, subjects endowed with higher levels of speed of thought, patience and ability to focus may be faster than other subjects and thus more likely to win.[69] In order to control for the effect of differences in ability, in the final questionnaire we ask the average grade obtained over the first semester of the academic year (*Average Grade*). Grades range from 18 to 31 (30 cum laude) and participants report an average grade of 25.4 in the baseline and 26 in the treatment (not significant difference).

[Table 1 Here]

In what follows we present the results of our experiment starting from the real effort task to then focus on our main variable of interest, i.e., risk behaviour. We comment on subjects' expectations in the appendix to the paper.

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[69] Different knowledge of Euro Coins is not an issue in our dataset because all students have the Euro as national currency.

3.3.1 Coin Task

A comparison of the performance in the Coin Task across treatments allows us to check the effectiveness of our incentive scheme. In the baseline participants have to correctly identify only five coins in order to earn their payoff, while in the competition treatment their earnings also depend on their relative performance. Table 1 shows that competition improves subjects' performance, as expected. Subjects in the baseline try on average 23.6 coins, 21.6 of which are correctly identified. The corresponding figures are significantly higher when subjects perform the Coin Task in competition: the number of coins attempted on average is 26.8 with an average of 24.3 correct answers.[70]

As regards the gender dimension, we find that females perform significantly worse than males (Table 2). However, differences in the performance are significant both in the baseline and in the competition treatment and are of similar size.[71] Hence, gender differences in competitiveness do not seem to play any role.[72]

[Table 2 Here]

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[70] The high performance in the Baseline conditions can be rationalized by the fact that subjects dislike inactivity in the lab and tend to avoid it even at a cost such as exerting effort (see Jensenius, 2017, and references therein).

[71] Estimates of the differences-in-differences model $Correct_i = \beta_0 + \beta_1 Competition_i + \beta_2 Female_i + \beta_3 Competition_i * Female_i + \varepsilon_i$ show that the gender differences across conditions ($\beta_3 = -0.8$) do not statistically differ.

[72] Many studies have shown that the competitiveness of the environment may induce a gender gap in performance. Starting from Gneezy et al. (2003) this result has been largely replicated particularly in mixed-gender competition and using stereotypical male endeavours, such as solving mazes and math tasks (Shurchkov, 2012). Niederle (2016) also notes that not all the tasks are suitable to measure changes in performance under different incentive schemes. For instance, no change in performance is observed using the task of adding five two-digit numbers as in Niederle and Vesterlund (2007). This is likely the case of the Coin task, too, as a similar effect of competition on performance across gender is also found with the data from the second chapter.

3.3.2 Risk Behaviour

In this section we answer our main research question, namely whether competition affects risk behaviour, possibly in a different way along the gender perspective.

Table 1 reports the descriptive statistics of our main variables of interest and shows that on average subjects are risk-averse in both conditions.[73] Competition does not significantly affect risk aversion: subjects in the baseline collect about 43.5 boxes on average, while the corresponding figure for the treated is about 39.5, but the difference is not statistically significant.

Therefore, at first glance, competition does not seem to produce additional effects as compared to the baseline condition. However, since males and females have been shown to have different levels of fondness for competition (Niederle and Vesterlund, 2007), they may experience the competition differently; so, potential effects on subsequent risk behaviour may be different for males and females. To investigate gender heterogeneity we split our sample by gender considering the overall data by treatment. We find a potentially important effect for males, whose difference in the BRET choice (46.61 in the baseline vs 39.25 in competition) is quite large though not significant at conventional levels (Table 3). In contrast, females' behaviour is not affected by the treatment.

[Table 3 Here]

As already described in the introduction, there are several reasons why competition may affect subsequent risk behaviour, such as uncertainty of the outcomes, stress, loss/gain of control, emotions, and social comparison. By comparing decisions of individuals who experienced competition with those of individuals ending up in the same financial situation without competing, our design allows us to control for the randomness in the outcomes, wealth effects as well as for what the payoffs trigger in

[73] A risk-neutral choice in the BRET corresponds to choosing 50 boxes.

terms of emotions or superstition.[74] We can therefore isolate the effect of competition that can be outcome dependent, over and above its monetary consequences.

We do so in Table 4 reporting the average decision in the BRET separately by treatment and outcome. Data show that on average subjects in competition choose to collect 38.2 boxes when experiencing the bad outcome and 40.7 boxes after experiencing the good outcome, while the corresponding figures in the baseline are 42.2 and 44.7, respectively. However, none of the differences reaches traditional significance levels.

It is worth noting that the study of the existence of outcome-dependent effects of competition on subsequent risk-taking behaviour comes at the price of introducing some endogeneity. Indeed, due to differences between baseline and competition groups in how outcomes are determined, the characteristics of subjects who experience, e.g., a good outcome, may vary between the baseline and competition groups. This means that when we look at the effect of competition on risk preferences by disaggregating the data according to the outcome we may be varying both the degree of competition and demographics or other characteristics. We can only partially deal with this by also estimating regressions including demographic controls. Therefore, we acknowledge that our outcome-related evidence is only suggestive and should be investigated in depth in a controlled manner.

[Table 4 Here]

Results with aggregate data may hide important effects that are outcome-dependent: losers may become more risk-averse if, for example, a bad outcome induces a shift in their locus of control. In contrast, winners may become more risk-seeking if they think to be better able to beat the odds. These effects can also be gender-specific, so

[74] Here by superstition we mean thoughts like "I got the bad outcome, so I will be unlucky again" or instead "I have been unlucky the first time, I will be lucky the second time".

in Table 5 we further break down the data both by gender and by outcome in the effort task.

By conditioning the gender analysis on the level of payoffs, we find that nothing emerges for females, whose average choice is rather stable across conditions and outcomes. In contrast, an interesting pattern emerges for males, who become significantly more risk averse when losing the tournament as compared to receiving the low payoff in the baseline. No statistically significant effect is instead observed when they win the tournament as compared to earning the same amount of money in the baseline. [75]

[Table 5 Here]

Note that by focusing only on the BRET choices of participants in the tournament, one could be tempted to infer that males are affected by the outcome of the competition becoming more risk seeking after winning than after losing (42.44 vs. 35.14). However, once wealth effects are taken into account, competition does not induce a more risk seeking behaviour for winners: if we compare the choices in competition with the corresponding choices in the baseline, we see that winning the tournament does not make males more risk seeking.[76] Therefore, in the subsample of males, winners become relatively less risk-averse than losers, but competition does not increase their risk tolerance as compared to subjects earning the same amount of money without competing. [77]

[75] The differences-in-differences model $BRETChoice_i = \beta_0 + \beta_1 Competition_i + \beta_2 GoodOutcome_i + \beta_3 Competition_i * GoodOutcome_i + \varepsilon_i$ estimated in the subsample of males shows a difference $\beta_3 = 3.023$ with *t*-stat=0.34.

[76] We cannot exclude a false negative in the ***Good Outcome*** case, possibly because of the low number of observations, but note that the point estimate goes in the opposite direction as what one might expect.

[77] A differences-in-differences regression estimated on the whole sample including demographic controls confirms evidence of a statistically significant effect of competition only on males obtaining the bad outcome.

Our results are not compatible with stress being the link between competition and risk taking. Other mechanisms may rationalize why males become more risk averse when losing the tournament. One possible explanation is that the negative outcome in the tournament may arouse emotions (over and above those triggered by the level of the payoffs) which, in turn, affect the subsequent decision under risk. Alternatively, the negative outcome may induce a shift in the locus of control. Losing may reduce the extent to which one believes that he can predict or influence future events and this may, in turn, increase risk aversion.

Competition is not a pure chance event because outcomes are also influenced by ability or effort. Therefore, a negative outcome may have a stronger effect for males who perform better. The reason is that losing despite an effective completion of the effort task may raise more intense emotions or induce a stronger shift in the locus of control. Indeed, we find that the higher the performance in the Coin Task of males losing the competition, the higher their risk aversion (corr *ChoiceBRET*, *Correct*=-0.63, p=0.0153). We are aware that a possible reverse causality link may exist between the two variables, as a higher risk aversion may simply induce to optimally choose a higher level of effort in the Coin Task. If purely endogenous, however, such a relationship should hold in general, while we observe it only for males losing the tournament. Figure 3 shows that a negative correlation between risk-seeking behaviour and performance in the Coin task does not characterize males who win the tournament (left-hand panel).[78] Since one could argue that this comparison is made difficult by a different average performance, the right-hand panel compares all the subjects losing the tournament, showing that females' choices under risk are not related to their performance.

[Figure 3 Here]

[78] When we restrict the observations to the performance range where we observe both males winning and males losing, we still find evidence of a negative relationship between performance and risk-seeking behaviour for males losing and we find a weakly positive relationship for males winning the tournament.

Table 6 provides an econometric representation of this evidence. In the first two columns, we restrict the analysis to the subsample of males in the tournament treatment and compare the effect for winners and losers (as in the left-hand panel of Figure 3). In columns (3) and (4), we restrict the analysis to the subsample of losers and compare males with females (as in the right-hand panel of Figure 3). Therefore, in all estimates, the coefficient of the variable *Correct* shows the effect of an additional correct answer for males who lose the competition.

Results show that choices under risk negatively correlate with the performance in the Coin Task only for males losing the tournament, even in a multivariate framework controlling for the degree of confidence and ability.[79] The effects of performance for males winning the tournament (*Correct (Male) Winner*) and for females losing (*Correct Female (Loser)*) are reported at the bottom of the Table. They are never statistically significant and they are significantly different from the effect that emerges for males losing (the interaction terms between *Correct* and *Winner* in the subsample of males and between *Correct* and *Female* in the subsample of losers are always significant at the 5% level except in column 3 where p-value=0.105). This confirms that the positive relationship between risk aversion and performance in the Coin Task is not purely endogenous because it does not hold in general but we observe it only for males losing the tournament.

[Table 6 Here]

Further suggestive evidence that the relationship highlighted above may be genuine can be derived from the data of the second chapter which point to a not significant correlation between ex-ante risk attitudes and performance in the competitive endeavour.

[79] Results in columns (1) and (2) are robust when we restrict the observations to the performance range where we observe both males winning and males losing the competition.

3.4 CONCLUDING REMARKS

Competition is important in a wide range of economic decisions, and this paper contributes to the literature by analysing the consequences of being exposed to competitive environments on subsequent individual risk-taking behaviour. The economics literature typically evaluates relative performance pay schemes only through their direct impact on productivity. However, competition is seldom a one-shot phenomenon, as individuals face many situations involving competitive pressure and make relevant decisions even after competition is over. Therefore, besides short-run effects on performance, competitive pressure may induce other effects that can affect subsequent decisions adding to its long-run impact. From this point of view risk attitudes are a natural candidate as a transmission mechanism.

We investigate the causal effect of competition on subsequent risk-taking behaviour by running a lab experiment eliciting the risk attitudes of a sample of subjects that have performed a real effort task exogenously manipulated in terms of the degree of competitiveness. We do not find evidence of a statistically significant relationship between competition and risk aversion. We devote particular attention to the analysis of the effects across gender because several studies find that women differ from men in terms of both risk aversion and fondness for competition. Indeed, we find a novel and counterintuitive result: while females' behaviour is stable across treatments and outcomes, males become more risk averse after losing in the competitive environment. Instead, there is no evidence of a symmetric more risk-seeking behaviour after they win the tournament.

The design of the experiment carefully controls for wealth effects and any other payoff-related determinant, thereby isolating the pure effect of competition at the individual level and excluding social comparison considerations. However, due to differences between treatment and control groups in how outcomes are determined, the evidence on outcome-dependent effects of competition on subsequent risk-taking behaviour is only suggestive.

We interpret our findings in terms of males' reaction to negative outcomes driven by intrinsic motives. One possible explanation is that the negative outcome may arouse emotions, which in turn affect the subsequent decision under risk. Alternatively, the negative outcome may induce a shift in the locus of control. Losing may reduce the extent to which one believes that he can predict or influence future events and this may, in turn, increase risk aversion.

When losing in a competitive task, males might have an inclination to project their inability to control events even on subsequent decisions involving merely random outcomes. Our explanation is consistent with previous findings in the literature, e.g. that a shift in the locus of control causes an increase of risk aversion (Beisswingert et al., 2016).

We believe that testing in a controlled manner our evidence on outcome and gender-dependent effects of competition on risk behaviour and identifying the ultimate cause why losing a competitive endeavour increases male’s risk aversion constitute interesting goals for future research.

APPENDIX

Expectations

Part of the literature on the gender gap in performance ascribes differences in competitive endeavours to overconfidence for males and underconfidence for females (Niederle and Vesterlund, 2007). In order to check whether confidence has explanatory power in our setting, before performing the effort task, we elicit subjects' expectations on their performance. We then use the difference between expected and realized score to measure their confidence, as commonly done in the literature on overconfidence (De Paola et al., 2014; Ifcher and Zarghamee, 2014). A negative number means that subjects are underconfident, as they identify more coins than what they expected. Vice versa, positive values indicate overconfidence.

Subjects in our sample are underconfident on average, as the mean of the *Confidence* variable is equal to −9.15. Table 1 shows that the expected performance is lower than the actual one both in the baseline (12.9 − 21.6 = −8.7) and in the competition treatment (14.7 − 24.3 = −9.6). Confidence does not significantly differ either by treatment or by gender (Table 1A).

As far as risk behaviour is concerned, a positive correlation emerges between confidence and the choice in the BRET (corr=0.152, p=0.085): forecasts improve with risk-seeking. This result is driven by the competition treatment (corr=0.238, p=0.051) while no correlation emerges for the baseline.

[Table A1 Here]

Although far from the observed performance on average, subjects' expectations in the effort task turn out to be quite reliable, as they significantly correlate with the actual performance. Rather surprisingly, the correlation is stronger in the baseline (correlation coefficient 0.54, significant at the 1% level) than in the competition treatment (0.21, significant at the 10% level).

Figure 1. Participant's computer screen in the Coin Task

Figure 2. Participant's computer screen when performing the BRET

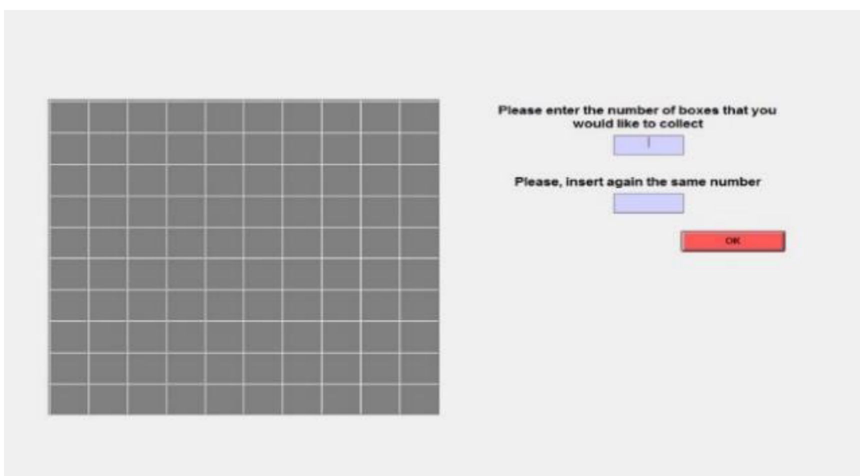

Figure 3. Males' risk behaviour when losing in competition

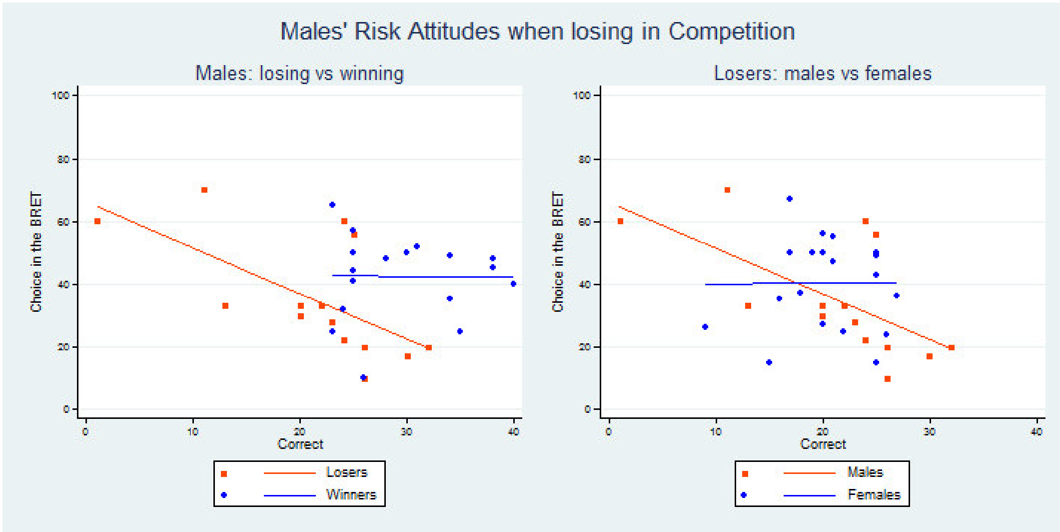

Table 1. Summary statistics by treatment

	Baseline		Competition		Mann-Whitney
	Mean	**Std. Dev**	**Mean**	**Std. Dev**	**p-value**
Female	0.419	0.497	0.529	0.503	0.2113
Age	21.177	2.440	21.294	3.686	0.8558
Average Grade	25.419	4.091	25.985	2.668	0.5923
Coin Task					
Total Coins	23.645	5.204	26.868	6.601	0.0048
Correct	21.597	4.792	24.309	6.611	0.0035
Wrong	2.048	3.07	2.559	3.312	0.0960
Risk Behaviour					
Choice BRET	43.452	19.018	39.471	14.878	0.3588
Expectations					
Expected Guessed Coins	12.935	6.563	14.706	7.704	0.2332
Observations	62		68		

Table 2. Performance in the Coin Task by Treatment and Gender

	All	**Baseline**	**Competition**	Difference	Mann-Whitney
Males	24.12	22.53	25.91	1.59	p=0.008
Females	21.81	20.31	22.89	1.5	p=0.041
Difference	2.31	2.22	3.02		
Mann-Whitney	p=0.027	p=0.080	p=0.035		

Table 3. Risk Behaviour by Treatment and Gender

	Males	**Females**	Difference	Mann-Whitney
Baseline	46.61	39.08	7.53	*p*=0.136
Obs.	36	26		
Competition	39.25	39.67	-0.42	*p*=0.668
Obs.	32	36		
Difference	7.36	-0.59		
Mann-Whitney	*p*=0.126	*p*=0.848		

Table 4. Risk Behaviour by Treatment and Outcome

	Bad Outcome	**Good Outcome**	Difference	Mann-Whitney
Baseline	42.23	44.68	-2.45	*p*=0.587
Competition	38.21	40.74	-2.53	*p*=0.547
Difference	4.02	3.94		
Mann-Whitney	*p*=0.385	*p*=0.385		

Table 5. Risk Behaviour by Treatment, Gender and Outcome

	Males			**Females**		
	Bad Outcome	**Good Outcome**	Mann-Whitney	**Bad Outcome**	**Good Outcome**	Mann-Whitney
Baseline	44.35	48.63	*p*=0.407	39.64	38.42	*p*=0.980
Obs.	17	19		14	12	
Competition	35.14	42.44	*p*=0.177	40.35	38.81	*p*=0.620
Obs.	14	18		20	16	
Mann-Whitney	*p*=0.058	*p*=0.183		*p*=0.699	*p*=0.870	

Table 6. Risk behaviour and performance in competition

	Choice BRET			
	Males		Losers	
	(1)	**(2)**	**(3)**	**(4)**
Correct	-1.4602***	-1.7035***	-1.4602***	-1.6214***
	(0.3795)	(0.5124)	(0.3779)	(0.4522)
*Correct*Winner*	1.4279**	1.4989**		
	(0.6521)	(0.6310)		
*Correct*Female*			1.4739	1.8188**
			(0.8820)	(0.8072)
Winner	-22.7209	-25.9121		
	(19.7591)	(18.7123)		
Female			-26.0464	-31.9327*
			(19.0715)	(17.9474)
Confidence		-0.1983		-0.0884
		(0.3014)		(0.2696)
Average Grade		1.5852		2.9573***
		(1.1964)		(0.8325)
Constant	66.1194***	71.0617***	66.1194***	68.2202***
	(8.7244)	(10.3456)	(8.6880)	(8.9368)
Correct (Male) Winner	-0.0323	-0.2047		
	(0.5304)	(0.6595)		
Correct Female (Loser)			0.0137	0.1973
			(0.7969)	(0.6751)
Observations	32	32	34	34
Adj. R-squared	0.208	0.219	0.157	0.301

Heteroscedasticity-robust standard errors are reported in parentheses. The symbols ***, **, * indicate that the coefficients are statistically significant at the 1, 5 and 10 percent level, respectively.

Table A1. Confidence by Treatment and by Gender

	Confidence		Confidence
Baseline	-8.66	**Males**	-9.79
Competition	-9.60	**Females**	-8.45
Difference	0.94		-1.34
Mann-Whitney	*p*=0.291		*p*=0.301

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