

The effects of physical activity on social interactions:

The case of trust and trustworthiness

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There is no doubt that physical activity improves health conditions; however, does it also affect the way people interact? Beyond the obvious effects related to team games or sharing common activities such as attending a gym, we wonder whether physical activity has in itself some effect on social behavior. Our research focuses on the potential effects of physical activity on trust and trustworthiness. Specifically, we compare the choices of subjects playing an investment game who were previously exposed to short-time physical activity to others who are not exposed to it, but involved in different simple tasks. On average, we find that subjects exposed to physical activity exhibit more trust and pro-social behaviors than those who are not exposed. These effects are not temporary.

Keywords: physical activity, investment game, trust, trustworthiness, gender effect.

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1. Introduction

Physical activity and a moderate level of fitness is a focal point in health benefits associated with lifestyle. Regular physical activity in adults can promote good health, improve cognitive function, and prevent disease.¹ Abundant research from the health and exercise science literature also present empirical evidence of positive “non-health effects” induced by physical activity or sports participation. Among the non-health effects, physical activity improves life satisfaction, happiness, subjective wellbeing, mental health and interpersonal relations.²

Our paper aims to contribute to the literature on the effects of physical activities. Beyond their health benefits, our idea is that physical exercises can significantly affect social interactions and promote pro-social behaviors. Specifically, physical activity may increase the levels of trust and trustworthiness.³ We propose two potential theoretical channels to rationalize the link between physical activity and pro-social behavior, later explained.

In the context of Sport Economics, there is a relatively recent strand of literature focusing on the relation between sports participation/physical activity and social capital formation (cf. Section 2.1). In this regard, sports participation can be identified as one of the ways social capital can be generated as long as the vast majority of sports are, by their nature, associational activities (Putnam, 1993; 1995; 2000).

¹ See, e.g., Morrow *et al.* (1999), Manson *et al.* (2002), Stone (2004), Bassey (2005), Blacklock *et al.* (2007), Brown *et al.* (2007), Humphreys *et al.* (2013), and Sarma *et al.* (2015).

² There is substantial evidence based on cross-sectional, longitudinal, experimental and intervention studies. See, among others, Wankel (1993), Penedo and Dahn (2005), Weatherly *et al.* (2009), Lee and Park (2010), Rasciute and Downward (2010), Biddle and Asare (2011), Kirk *et al.* (2011), Gothe *et al.* (2013), and Di Bartolomeo and Papa (2016a).

³ Regarding trust and trustworthiness, we refer to Berg *et al.*'s (1995) definition.

We are interested in a new potential channel that directly links physical activity to pro-social behaviors. Our research question is in fact “could the individual physical activity have a *per se* effect on trust and trustworthiness?” In particular, abstracting from the effects of being a member of an association or those from the social identity literature, we aim to verify if physical activity alone is sufficient to increase trust and trustworthiness. In our view, the association between physical activities *per se* and pro-social behaviors can be supported from different points of view (cf. Section 2.2).

We also use a new approach in the context of Sports Economics, but soundly adopted in others. We design a laboratory-randomized-controlled experiment to compare the pro-social behaviors of two sub-samples of participants randomly involved beforehand in two different activities. One group is exposed to physical activities; the control group is not.

Our findings are that subjects exposed to physical activity are more likely to exhibit pro-social behaviors on average, i.e., trust and trustworthiness. We also find that physical activity has gender effects: they are relatively more effective to induce trust in males.

The remainder of the paper is structured as follows. Section 2 discusses the existing literature based on large surveys and the potential channels according to which physical activity can *per se* affect pro-social behaviors. Section 3 describes our experiment and methodology. Section 4 illustrates and discusses the main outcomes of our experiments. Section 5 provides some concluding remarks.

2. Related literature

2.1 Evidence on sports participation from large-scale surveys

A growing literature examines the outcomes associated with sports participation by using large-scale surveys. The literature can be grouped in three strands. First, many authors have studied the impact of sports participation among other activities as one of the ways social capital can be generated. Secondly, other studies have focused on the role of sports on children, i.e., how sports activities favor the development of pro-social skills and attitudes. Finally, several authors have recently focused on the effects of social identity and a sense of belonging induced by team sports.

In the tradition of social capital studies, Seippel (2006) finds that being a member of a voluntary sports organization is positively related to social trust, but he also finds that sports association is less effective in creating social capital compared to other associative organizations. Delaney and Kearney (2005) find that sports participation is closely related to the frequency of socializing and meeting with friends. Several other studies report that physical activity in the form of sports participation is a strong predictor of trust, network connections and reciprocity (see Long and Sanderson, 2001; Tonts, 2005; Perks, 2007; Skinner *et al.* 2008; Spaaij and Westerbeek, 2010; Brown *et al.* 2014; Hoye *et al.* 2015).

By using a sample of about 31.000 observations from 30 countries, however, Downward *et al.* (2014) find that sports association reduces trust. Indeed, they show that results depend on the methodology used. Simple OLS regressions revealed that participation in sports and civic organizations promotes trust, whilst cultural and church organizations reduce it, but estimations based on GMM (used to control for endogeneity) lead to the different result.⁴

Looking at the effects of sports participation on skills development in children, Felfe *et al.* (2016) find that cognitive and non-cognitive skills are both affected by

⁴ GMM estimations confirm results of OLS for religious and civic association, while impacts of cultural association and relative network become insignificant.

sports participation. They also find that children participating in sports have fewer problems with peers and this fosters better relationship. They used two large datasets of 3-10 German children (a cross-section survey of 5632 observations and a panel of 1449 children). Similarly, by using a three-round panel of 658 Peruvian children, Pawlowski *et al.* (2016) suggest that participation in a sports group has positive effects on subjective health and on pro-social attitudes (defined as the supporting friends in difficult times).

A complementary strand of literature focuses on the impact of physical activities through social identity and a sense of belonging induced by team sports. Walseth (2006) finds that being involved in team sports produced feelings of belonging to traditional communities with face-to-face contact among the members. These communities seem to produce strong feelings of belonging based on the norm of reciprocity. As a result, members of the community support each other both inside and outside the sports context. The fact that a team must solve tasks together might be one of the structural conditions for belonging to this form of community. Along these lines, MacDonald *et al.* (2011) show that positive experiences by participants in team sports were most strongly predicted by affiliation with peers, self-referenced competency, and effort expenditure. Ottesen *et al.* (2010) report that team sports have an advantage over individual sports in the development of social capital (they compare football to running).

Summarizing, the positive association between physical activities and pro-social behaviors, as shown, could be motivated (directly or indirectly) by some social identity or associative participation arguments. Although with some caveats and potential biases, the literature supports the idea that the experience of being a member of a (sports) organization and/or sharing the organization/team goals and community can be sufficient to observe a higher level of trust, e.g., by participating in team goals people increase trust and cooperation and identify themselves with the community.

The interpretation of the above outcomes from large surveys should be taken into account with some caution. Several authors suggest method-dependency of results and potential biases when endogeneity is ignored.⁵ However, their results can be checked for them. Results can also depend on how trust is measured, i.e., how different questions are aggregated to obtain a trust index, since trust behavior cannot be directly observed. In this regard, our methodology has the advantage that there is no problem of self-selection bias or endogeneity, because our participants are randomly assigned to the treatments. Moreover, trust is directly observed and clearly defined in economic terms as according to Berg *et al.* (1995).

Although our experimental laboratory does not suffer from problems of self-selection bias or endogeneity, nevertheless the external validity issue needs to be briefly discussed since our results are based on students' samples. Using students in the laboratory is a common practice in experimental economics, which has become an integral part of the field of economics (Bardsley *et al.*, 2009). The external validity of the experiments is thus debated,⁶ many arguments recognize it when correctly posed (Fréchette and Schotter, 2015). In several contexts, including trust/investment games, in fact, no difference has been documented between students and no-students (see, e.g., Cleave *et al.* 2013; Alm *et al.* 2015; Fréchette, 2015).

2.2 Theoretical background

The existing literature argues that certain institutions (e.g., clubs) or specific sports (e.g., team sports) are relevant for social capital formation; we instead aim

⁵ See, e.g., Downward *et al.* (2014), Cabane and Lechner (2015).

⁶ See Levitt and List's (2007) criticisms and Camerer's (2015) reply.

to test if pure exercise (in a non-team context and in an artificial environment) is also able to build trust and trustworthiness.

Our argument is based on two complementary major lines: empathy and stress reduction. The first one is grounded on social psychological motivations. The second argument is instead built on the effects of social activity on physical status. The two arguments are explored here below.

Social psychologists consider empathy to be a key motivator for altruistic behavior (empathy-pro-social hypothesis).⁷ Empathic states and, to a smaller extent, empathic traits are in fact good predictors of pro-social behaviors. In a randomized-controlled experiment, Klimecki *et al.* (2016) induce an empathic state in a subsample of subjects by showing them videos depicting a person suffering and in need. They find that self-reports of empathic feelings predicted a large degree of pro-social behavior. Several other studies induce empathy by direct or observed painful experiences and document a link with pro-social behaviors.

Simply doing things together with others rather than alone creates a sort of mutual fellow feeling among strangers supporting pro-social behaviors. Bastian *et al.* (2014) argued that living similar experiences, not necessarily occurring simultaneously, could reinforce this feeling, especially when experiences were painful.⁸ The argument that painful experiences may promote cohesion and solidarity within groups is indeed old, it dates back to Durkheim (1912).⁹ Our

⁷ Social psychologists placed great attention to the issue (see, e.g., Eisenberg and Miller, 1987; Eisenberg and Fabes, 1990; de Waal, 2007).

⁸ Among other painful experiences, Bastian *et al.* (2014) consider leg squat exercises. However, their focus is oriented on physical pain rather than on a similar experience of fatigue. For instance, they also consider prolonged contact with an icy object.

⁹ Examples are provided by studies on soldiers' fellowship after war trauma (Elder and Clipp, 1989) or on the effects of religious rituals in primitive societies (Whitehouse, 1996).

intuition is that practicing tiresome physical activities, sharing similar effort and fatigue, could magnify the effects of fellow feelings by the empathic channel.

Some indirect evidence to our argument in sports or related contexts can be drawn from Turner and Wainwright (2003) and Davis *et al.* (2015). Both explore solidarity within groups. The former focuses on injuries in ballet companies and the later on intensity and synchronicity in physical exercises in small groups.

A second potential channel that links physical activity to pro-social behaviors operates through the effects of physical exercises on the psychophysical status. Many studies show that physical exercises reduce anxiety and stress. Even 30 minutes of exercises can boost participants' moods (see, for a survey, Petruzzello *et al.*, 1991). Physical activities cause in fact immediate increases in levels of key neurotransmitters that are depleted by anxiety and stress.¹⁰ In turn, several experimental studies have shown that the relaxation and reduction in stress and anxiety is associated with cooperative behavior.¹¹

It is worth noting that the two lines described above are not mutually exclusive. On the contrary, they are complementary. Many social psychologists argue that stress reduction fuels empathy (e.g., Birnie, *et al.*, 2010).

3. Experiment

3.1. Design

The baseline experimental task is a two-stage investment game (Berg *et al.*, 1995). In this game, one participant (investor) first decides how much of an endowment to give to another participant (trustee). The amount given is

¹⁰ See Dishman and O'Connor, (2009), Dinas *et al.* (2011), Fox (1999), Kim *et al.* (2012) and the references therein.

¹¹ See Riedl and Javor (2012) and the references therein.

multiplied by three. Then the trustee decides how much of this increased amount to allocate to the investor.

The Nash equilibrium of the investment game implies that the investor will decide to give nothing to the trustee. Assuming selfish people, in fact, the investor may transfer a certain amount of money to increase the total pie, but the trustee does not have any incentive to return money. Therefore, the investor who expects the trustee's decision will also not transfer any amount.

The above result is however rarely observed. Experimental studies show that investors usually send positive amounts and trustees reciprocate sending positive amounts, too.¹² The intuition behind is that people can be rational but they are not selfish: they have instead social preferences, i.e., their preferences include the effects (or the expected effects by the others) of their actions on the others' well-being (Geanakoplos *et al.*, 1989; Rabin, 1993; Fehr and Schmidt, 1999). Then preferences and beliefs can be affected by many psychological factors including empathy, social identity, envy, inequality and/or guilt aversion and those circumstances that trigger them (among others, Kirchsteiger, 1994; Bolton and Ockenfels, 2000; Cox, 2004; Charness and Dufwenberg, 2006; Dufwenberg and Battigalli, 2007; Chen and Li, 2009; Di Bartolomeo and Papa, 2016b; Di Bartolomeo *et al.*, 2017).

Formally, we consider two subjects are initially endowed with 10 tokens each.¹³ They interact in two stages during which they can increase or decrease their initial endowments depending on their choices. In the first stage, one of them (called subject A, i.e., the investor) can transfer part, all or none of his endowment (i.e., from 0 to 10 tokens) to the other subject (called subject B, i.e., the trustee). Before

¹² This outcome has been first observed by Berg *et al.* (1995). Then, their results have been replicated hundreds of times in many variants (see, for a meta-analysis, Johnson and Mislin, 2011).

¹³ The value of each token was equal to 0.5 euro.

being delivered to B, any amount transferred is multiplied by 3. In the second stage, B could return part, all or none of the tripled number of tokens received from A. The payoffs are the initial endowment plus the tokens received minus those sent. Note that payoffs reflect money payments, not necessarily utilities. Individual choices may be affected by social preferences (e.g., pangs of guilt, cost-of-lying, emotions, social norm).

We consider two treatments (T1 and T2). T1 and T2 consist of the above investment game and both are preceded by 30 minutes of individual activities.¹⁴ Treatments differ in these (pre-play) activities.

1. Pre-play activity in T1 consisted of writing short comments about nature pictures shown to the participants.¹⁵
2. In treatment T2, subjects participated in 30 minutes of physical activity.¹⁶

After pre-play activities, in both treatments, all of the participants played eight rounds of the investment game. In each round, participants were matched knowing that they would never be paired with the same partner (*stranger-perfect matching*); then, roles were randomly assigned A (investor) or B (trustee) in each pair. At the end, participants were paid according to the outcomes of a randomly drawn round. Dynamics of trust is also investigated by using the outcome of the different rounds in T1 and T2.

¹⁴ A pre-play activity in both groups (experimental and control) has been performed to eliminate a potential bias due to mental pre-training and/or familiarization with the experiment environment.

¹⁵ This kind of treatment has been used by Ulrich *et al.* (1991), Zhang *et al.* (2014), and Piff *et al.* (2015). As discussed in Di Bartolomeo and Papa (2016a). The pre-play activity in T1 is important to avoid some group-membership effects (Bacharach, 1999, 2006; Akerlof and Kranton, 2000; Charness, *et al.*, 2007). However, the robustness of our results has been also successfully tested by comparing T2 to another treatment without any pre-play activity. These results are available upon request.

¹⁶ T1 and T2 pre-play activities will be later discussed in details.

3.2. Hypothesis

Our aim is to test whether and how physical activity affects some aspects of people's behavior. We measure the effects of physical activity in term of trust and trustworthiness. In a simple, investment game, we compare the behavior of subjects exposed to one session of physical activity to that of other participants who are not exposed to it. Formally, we look at trust and trustworthiness by comparing the outcomes to T1 (control group) and T2 (experimental group). Recall that the latter is the treatment involving physical activity, whereas the former does not. Evidence of more trust and trustworthiness on average in T2 compared to T1 could be interpreted as evidence for pro-social behavior induced by physical activity.

A difference in the average amounts sent by A subjects in T2 and T1 provides evidence for the effects of physical activity on trust behavior (against the null hypothesis that there is no effect). This effect, if any, can be positive or negative, supporting the pro-social or selfish motivations induced by physical activity.¹⁷ It is worth noting that if the effect of physical activity is positive, it improves efficiency as it increases the size of the full cake distributed by the experimenter (see Charness and Rabin, 2002). We also test whether the effects of physical activity on trust are long lasting by comparing the outcomes of different rounds. In other words, we look at the dynamics of the choices to verify if potential physical activity effect eventually fades with time.

Regarding trustworthiness, as pointed out by Cox (2004) and Cox *et al.* (2008), tests for reciprocity cannot be based on mean comparisons, but they should be performed using a regression approach that is conditional on the amounts sent (or

¹⁷ We consider trust (and trustworthiness) in accordance with Berg *et al.* (1995). Further treatments (appropriate dictator games) should be introduced to disentangle conditional and unconditional motivations (see Cox, 2004; or Di Bartolomeo and Papa, 2016b).

received by trustees). Specifically, by using a Tobit regression, we estimate following relationship between amounts sent by A (a) and amounts returned by B (b), in the two treatments:

$$b_i = \alpha + \beta D_i a_i + \gamma a_i + \mu_i + \varepsilon_i$$

where b_i is amount returned by the trustee i , a_i is the amount sent by the investor playing with i , where D is a dummy that takes value one if observation i refers to T2 or zero if it refers to T1. The bounds for the Tobit estimation are those imposed by the experiment design: 0 and $3a_i$.¹⁸

The coefficient β measures the effect of physical activity. In fact, it measures the effect of the treatment T2 compared to T1 (control group). The null hypothesis is that β is equal to zero (there are no effects of physical activity on trustworthiness). Instead, if coefficient β is significantly positive (negative), physical activity supports (does not support) trustworthiness by trustees. The coefficient γ measures the correlation between amounts sent by investors and by trustees. The dummy coefficient μ measures the gender effect on trustworthiness, if μ is positive (negative), males (females) reciprocate more than females (males).

3.3. Procedures

The experiment was conducted in May 2014. Participants were recruited by e-mail using lists of voluntary potential candidates, from the undergraduate student

¹⁸ We used the *CNREG* Stata module to estimate our Tobit model. We also test the result robustness for multiplicative heteroscedasticity by using the *TOBITHEM* model.

population at the Sapienza University of Rome, Italy.¹⁹ All the participants had some experience on this kind of physical activity.²⁰

We ran two sessions for each treatment. Each session involved 30 subjects (15 pairs). Therefore, the total number of participants was 120: 60 were randomly assigned to the two T1 sessions and 60 to the two T2 sessions. As explained, the two treatments differ only in their pre-play activity, which was guided by an assistant in both cases.

It is worth noting that laboratory pre play-activities and treatments were performed in the same place, but in different time. In fact, all participants were randomly placed in front of separate computer workstations in a large room.²¹ At the beginning of each session—before playing eight rounds of the investment game—participants were asked to complete certain tasks (pre-play activities). These lasted 30 minutes.

1. In T1, the task consisted of writing short comments about some pictures that portrayed male and female faces, children, nature, trees and stylized or more complex images. Some of these pictures could have been interpreted as images that represent, e.g., the union between Man and the Nature or perhaps friendship—possibly leading to calm and positive feelings. Other pictures could have stimulated attention and the brain (e.g., Rubin’s vase). The pictures were drawn with the assistance of a psychologist.
2. In T2, guided by an expert sport trainer from the Italian Navy, the tasks consisted of a sequence of exercises based on two physical activities.²² The

¹⁹ Lists were compiled in advance using University mailing lists and advertisements placed on the University’s notice boards.

²⁰ Ex-post questionnaires show us that almost all subjects had experienced physical activity before.

²¹ In order to perform pre-play activities without pressure, computer workstations were placed in a 350 square-meters room.

²² Exercises are briefly described. A technical appendix available upon request provides full details about them.

first based on speed and reaction activities: skipping (3 minutes),²³ single-leg kick behind (3 minutes), motor optimization of the postural control associated with rapid arm movements, (6 minutes), motor responses to fast stimuli (3 minutes). The second one based on strengthening activities: squats (6 minutes);²⁴ skipping (3 minutes), squats (3 minutes), skipping (3 minutes). This sequence of exercises is made to simulate a physical activity program even if it is a short-term practice.

Participants spent time in the same environment (350 square-meters room) in order to execute pre-play activities (pictures observation or physical activities). It is worth noting that participants performed the above activities (T1 and T2) individually, in front of their computer workstations.

After 30 minutes, controllers with electronic timers informed all participants of a treatment that the second stage of the experiment was to begin. Shortly after, they played the investment game described above. Each subject played eight rounds. All participants were randomly re-matched at the beginning of each round and assigned to group A (investor) or B (trustee). The experiment was programmed and conducted using z-Tree software (Fischbacher, 2007).

All decisions made during the experiment were anonymous; anonymity was guaranteed by using identification codes, and the participants' names remained unknown to all—including the experimenters and controllers. During the experiment, two controllers checked that participants correctly followed the instructions. However, the controllers could not answer any questions from the participants because they had no additional information. Therefore, if participants

²³ Movement in a light, springy manner by bounding forward with alternate hops on each foot.

²⁴ In strength training, the squat is a compound, full body exercise that trains primarily the muscles of the thighs, hips and buttocks, quadriceps, hamstrings, as well as strengthening the bones, ligaments and insertion of the tendons throughout the lower body.

had questions, their only option was to read the instructions again. Participants were not allowed to talk to each other during the entire experiment.

After each round, subjects were informed of their earnings. Only one round of eight was randomly paid; subjects were aware of this from the beginning of the experiment. At the end of the experiment, all participants were paid according to the outcomes of a randomly drawn round.²⁵

4. Results

This section describes our results. First, we report differences in trust by comparing the outcomes of the first round of our experiment. In Section 4.2, we use the full sample to investigate trust (by mean difference) and trustworthiness (by Tobit regression). Section 4.3 looks at the dynamics of trust by considering the averages of all the rounds to control for temporary effects stemming from physical activity.

4.1 Round 1

Table 1 reports the results from the first round of our experiment. The first two columns display the average amounts sent in T2 (experimental) and T1 (control) respectively.

Table 1 – First-and second-mover data in the first round

	Experimental	Control	Difference	Mean tests	Wilcoxon
<i>Trust</i>	3.40	2.23	1.17	2.39	2.52

²⁵ We use a double-blind procedure. Using their codes, participants were paid by an administrative office located in a separate building (the central administration of the university), and a payment summary from the examiners by email. Participants were aware that officers were unaware of the details and reasons for the payments or anything concerning the experiment.

<i>(obs. 30)</i>	[2.19]	[1.52]		(.009)	(.006)
<i>Sent back</i>	3.23	1.50	1.73		
<i>(obs. 30)</i>	[3.06]	[1.53]			

Notes: The column reports the means (and standard deviations between square brackets), and one-tail difference mean test based on a *t*-test assuming dependent sample and non-parametric Wilcoxon sum-rank test.

The average amount sent by A subjects was 3.40 tokens in T2 compared to the 2.23 tokens in T1. Therefore, we observe a positive effect of physical activity on trust; the effect is large (1.17) and significantly different from zero. In the first round, participants in T2 sent on average approximately 52% more than in T1. This result demonstrates that physical activity has an effect on behavior. It is worth noting that the return ratios are smaller than one in both treatments. However, the results on return ratios are not highly significant in our small sample; since they may be sample dependent because the inequality faced by second movers is endogenously determined by the investors’ actions (see Di Bartolomeo and Papa, 2016b).²⁶

4.2 Full sample results

The results from the full sample are described in Table 2 that reports the average amounts sent in T1 and T2. Means are based on 240 observations. Trustworthiness is evaluated by a Tobit regression approach – as explained, we estimate the amounts sent conditionally on the amounts received (evidence for trustworthiness is related to β).

Table 2 – Parametric and nonparametric tests of first-and second-mover data

Trust

²⁶ Results on return ratios are mixed, as supported by Glaeser *et al.* (2000), Capra *et al.* (2008), Cardenas and Carpenter (2008), and Johnson and Mislin (2011).

	Experimental	Control	Difference	Mean tests	Wilcoxon	2-sample
<i>Sent</i> (obs. 240)	3.94 [2.87]	2.25 [2.18]	1.68	7,24 (.000)	6,78 (.000)	7,05 (.000)
<i>Returned</i> (obs. 240)	3.10 [3.97]	1.30 [2.18]	1.80			

Trustworthiness

<i>Tobit analysis for second mover data (obs. 480)</i>					
	α	β	γ	μ	LR test
	-2.16 (.000)	.13 (.067)	1.13 (.000)	-0.69 (0.01)	79.61 (.000)

Notes: The column reports the means (and standard deviations between square brackets), and one-tail difference mean test based on a *t*-test assuming dependent sample, non-parametric Wilcoxon rank-sum test and median 2-sample test (*p*-values are reported between brace brackets). In the Tobit model, we drop 38 observations associated with individuals who received zero from the investors, because they are both left- and right-censored.

Source: Author calculations.

The average amount sent by A subjects was 3.94 tokens in T2 compared to the 2.25 tokens in T1. Therefore, we observe an effect of physical activity on trust (T2 vs. T1) that is large (1.68) and statistically different from zero—as shown by the *t*-test on the mean, Wilcoxon and median 2-sample non-parametric test.

It is worth noting that, in the full sample subjects who were trusting made fewer tokens on average than those that were not trusting, by looking to the amount sent back. In fact, the return ratio was always smaller than one in both treatments.

The physical activity is associated with more trust and cooperation compared to the control sample. Therefore, our results are consistent with the idea that the practice of physical exercises induces pro social behaviors by, e.g., their effects on the psychological well-being.

Regarding trustworthiness, comparing the average paybacks of participants involved in physical activity and those of control treatment, the former are higher. However, the higher amounts sent can depend either on more trustworthiness or the higher amounts received before send back. As explained, the effects of physical activity on trustworthiness cannot be inferred from average comparisons.

Following Cox (2004), to measure this, we need to use a Tobit regression approach, which accounts for the initial endogenous conditions.

Looking at the Tobit estimates, we observe more trustworthiness under physical activity because β is positive and significantly different from zero at 10% level. As expected, the larger paybacks sent by trustees are related to the larger amounts sent by investors (γ is significantly different from zero); moreover, trustworthiness is more likely to be observed by females than males (μ is significantly smaller than zero), as documented by experimental literature.²⁷

The physical activity matters. It is consistent with an increase of the incidence of trust and trustworthiness, by increasing the incidence of social preferences on people's behavior.

We tested the robustness of our Tobit results against heteroskedasticity correction (as Cox, 2004) and to a possible bias in our point estimates due to that fact that our 387 observations are not independent, because individuals play more than one round. Following Carpenter (2007), we assess the magnitude of the potential bias by comparing the outcomes of the Tobit model to those from the random effects Tobit estimates (XT-Tobit).²⁸ The difference in the coefficients obtained from the two models is not statistically significant. As Carpenter (2007) argues, this provides indirect evidence that the coefficients of our estimates are unbiased.²⁹

²⁷ See Croson and Buchan (1999) and Buchan *et al.* (2008).

²⁸ Results are available upon request.

²⁹ Results are available upon request. We also compare the outcomes from generalized least squares (GLS) with individual random effects, which are not able to capture the bias, to those of generalized linear latent and mixed models (GLLAMM). We obtain the same results. Note that, unfortunately, a GLLAMM model has not been developed for the Tobit model.

Gender differences on trust between and within treatments are reported in Table 3 (based on observations of 104 males and 136 females in T2; 128 males and 112 females in T1).

Table 3 – Gender effects on trust between and within treatments.

Trust	Males	Females	Difference within
<i>Physical activity</i>	5.08	3.07	2.01***
<i>Control</i>	2.66	1.79	0.86**
Difference between	2.42***	1.28***	

Note: In the last row and column, asterisks indicate that the one-tail Wilcoxon significantly different from zero at *** 1%, ** 5% and * 10%.

Table 3 reports the average amounts sent by A subjects distinguished by gender, in the two treatments. The outcomes reported in the last row refer to specific gender effects between treatments. The outcomes in the last column refer to gender differences within each treatment.

As expected, comparisons within treatments provide evidence in favor of an often-documented gender effect. Males trust significantly more than females on average (0.86 tokens). Our results are in line with experimental literature that evidences that, although results may depend on methodologies and experimental designs, trust is more likely to be observed by males.³⁰ It is worth noting that gender differences are increased by 5% (2.01 tokens) in T2. Therefore, the physical activity exacerbates the initial gender bias of trust as its effectiveness to induce trust in males is stronger compared to its effects on females.³¹

³⁰ See, e.g., Charness and Gneezy (2012); however, results may depend on methodologies and experiment designs (see, Buchan *et al.*, 2008; Eckel and Grossman, 2008; or Croson and Gneezy, 2009).

³¹ Our results are consistent with the exercise literature that documents differences on the effects of physical activity between males and females. See García *et.* (2011), Trost *et al.* (2002) and the references therein.

By looking at between treatments, we observe the effect of the physical activity on both genders, who send an average amount of tokens significantly larger in physical activity respect to the control treatment. These differences are statistically different from zero (2.42 and 1.28 tokens for males and females, respectively). The physical activity practice had a positive effect on trust for both genders.

To summarize, short-term practices of the physical activity improve efficiency by promoting trust and cooperation. In the treatment with the physical activity, people send and receive more compared to the control group—more trust and trustworthiness are observed. Males invest higher amounts compared to females in the control group and this gender effect grows within the physical activity treatment.

4.3 Dynamics

Finally, to verify whether the effects of the physical activity on trust are or not temporary, we look at the dynamics of our outcomes during the eight rounds. The results are illustrated in Figure 1 and Table 4.

Table 4 – Average amounts sent by random investors in each round.

Trust	1 round	2 round	3 round	4 round	5 round	6 round	7 round	8 round
Physical activity	3.40	3.83	3.83	4.17	4.57	4.63	3.20	3.87
Control	2.23	2.33	1.97	2.37	2.17	2.67	2.43	1.87
Difference	1.17**	1.50**	1.87***	1.80***	2.40***	1.97***	0.77	2.00***

Note: The column reports the means in the physical activity and control treatments for each round. Differences and one-tail Wilcoxon are significantly different from zero at *** 1%, ** 5% and * 10%.

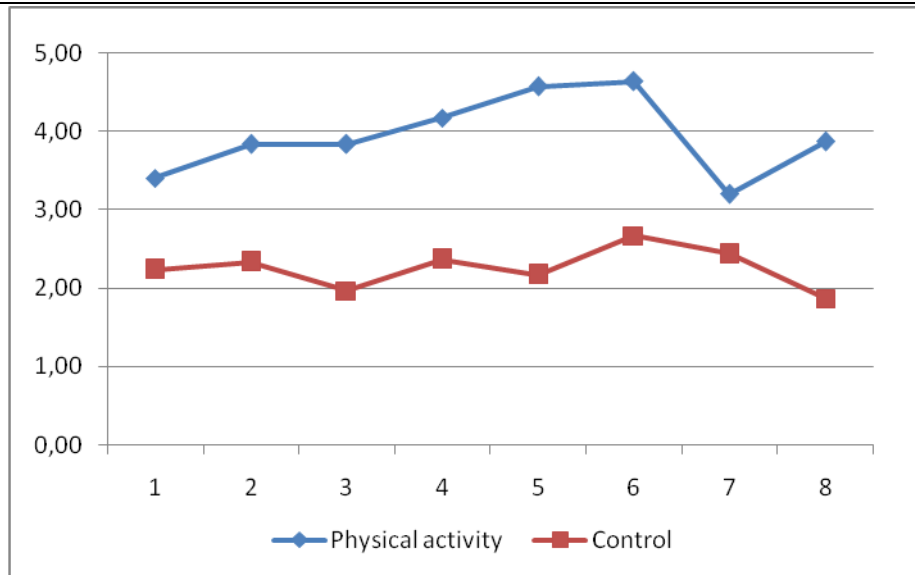


Figure 1 – Average amounts sent by random investors in each round.

Comparing the outcomes of each round, physical activity always leads to a significantly higher level of trust. Those effects seem to be permanent. Looking at the path of the two treatments separately, the two lines in Figure 1 do not converge. In all the rounds, each average obtained under physical activity is significantly higher than the corresponding average of the control group (see Table 4). An exception is round seven, where the average outcomes of the physical activity and control treatments are not significantly different. This round represents an outlier, which is caused by the higher prevalence of females as investors in the physical activity sample. As we said in the previous section, genders behave statistically different within treatments.

5. Conclusions

The existing literature shows that sports activities can be relevant for social capital formation, and therefore, they can induce pro-social behaviors. The evidence is based on surveys and its rationale is that sports participation consists in associational activities; therefore, in a Putnam's perspective, it naturally generates social capital. Additionally, sports participation in teams supports pro-social behaviors also creating social identity and a sense of belonging among team members, which sometimes also extends to non-members. However, this pro-social behavior evidence associated with sport activities is not intrinsic, but it stems from well-known general channels (social capital and association, social identity and a sense of belonging to a group, with a common task, and so on). In this paper, we attempted to fill a gap in the literature by testing specific effects of physical activities on behavior. Specifically, our research tried to test whether physical activity has a *per se* effect on pro-social behaviors.

We evaluated the impact of short-term physical activities on trust and trustworthiness by using a randomized-controlled lab experiment. In an investment game, participants previously exposed to physical activity are more likely to invest and reciprocate. Physical activity thus enhances trust and trustworthiness. Several sessions played allowed us to look at the dynamics of physical activity on pro-social behaviors. We found that positive effects seem not to be temporary. We also found a gender effect. Physical activity is relatively more effective inducing trust in males, exacerbating an often-documented gender bias.

Our results are consistent with two feasible explanations. First, the idea that physical activity reduces anxiety and stress promoting cooperation and secondly, that people who share the same, even individual, experience enhance the pro-

social behavior through the emphatic channel, which seems to be stronger when people have been stressed by similar tiring experiences.

Our results have several implications at different levels. As long as physical activities improve cooperation among individuals, they also improve efficiency in society. In the kind of interactions considered by us, in fact, cooperative solutions Pareto dominate other outcomes. Thus, local policies should be designed to incentivize sport activities, e.g. by tax exemptions or subsidies, because not only do they positively affect single individual well-being and health, but they also increase collective welfare by supporting cooperative behaviors among people in daily life.

The potential link between sports activities and attitudes for cooperative behaviors also has interesting implications for the design of training programs in team sports, where trust and pro-social attitudes are important psychological processes because they enhance team cohesion, which is an important determinant of better sports performance. Training programs should be designed to optimize the physical status of team members to improve their performance. However, our results imply that in their design the effects on team cohesion should also be taken into account, programs based on physical targets might result suboptimal.

Our experiment is a first attempt to explore a new issue with a new methodology in Sports Economics. Several implications thus require future investigations and methodology need some qualifications.

Further experiments are needed to disentangle the potential theoretical channels that link physical activities and pro-social behavior. Large-scale studies are requested (such as field experiments), on the one hand to evaluate the external validity of our results, and on the other, to measure their practical impact, e.g., on training design in team sports or social capital formation promoted by sports policies in society.

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