Incidental emotions and risk-taking: An experimental analysis

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Abstract

In this paper we test in a controlled environment the impact of incidental emotions induced through musical stimuli on individual risk-taking behavior. A modified version of the Multiple Price List method is used to elicit risk preference. We find that both positive and negative stimuli make experimental subjects more risk averse than subjects in the neutral treatment. This result is obtained with respect to the first lottery, while the impact of music on risk-taking is not statistically significant in the subsequent lottery, meaning that its effect vanishes as time elapses.

Keywords: laboratory experiment, music, mood induction, preference elicitation, risk aversion.
JEL classification codes: C91, D81.

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1 Introduction

The analysis of the individual choices under risky decision making is traditionally explained by the Expected Utility Theory. Regarding this theory, the concept of preference represents the key theoretical construct and there is no place for individual cognitive ability, which conversely, according to a behavioral viewpoint, stands for one of the most important determinants in the field of choices under uncertainty. Indeed, this ability could be affected by mood or emotion. Zajonc (1980) first showed that this ability is affected by the mood or emotion experienced at the time of decision making. To give another example, with respect to (Cumulative) Prospect Theory (Kahneman and Tversky (1979); Tversky and Kahneman (1992)), Brandstätter et al. (2002) explained the commonly observed inverse S-shape of the probability weighting function as a result from anticipated emotions concerning the future realization of an uncertain payoff.

In this paper we assume that emotion plays a crucial role during the process of decision making, referring to *emotion* as an intense feeling which lasts for a short time. Our supposition is that the influence of mood or emotions passes through the evaluation of monetary payoff or the estimation of subjective probability, as Fehr-Duda et al. (2011) also state. In this way, the so-called incidental emotion should have an effect on risk attitude, considering some studies by Loewenstein and Lerner (2003) and Pham (2007). Since results in this research area are really heterogeneous, we want to give a contribution in order to understand the impact of specific emotions on playing different lotteries. Furthermore, some emotions can be universally recognized if elicitated through the standards of western music (Fritz et al. (2009), Vieillard et al. (2008)): this is one of the reasons why we use music to induce happy and sad emotions in our experiment. We are also aware of the distinction between emotion felt and emotion perceived (Gabrielsson, 2002), namely, between the emotion that listeners experience from listening to a piece of music and their judgments about what emotion the music expresses. Therefore, in the current work we assume a positive relationship between the two cases, on the basis of some marketing experiments confirming our hypothesis (Milliman (1982), Milliman (1986), North et al. (1999)).

After the so-called musical mood induction procedure, players are supposed to choose among different lotteries with positive or negative expected value. Images are also used to avoid an ineffective induction procedure. Although this is a between subject experiment, we also take into account a measure of risk aversion in order to control for subjects pre-induction risk attitude. Our main novelty is that we measure the risk aversion by using the *Multiple Price List* format in three lotteries: the first one with fixed probability, the second one with fixed certain equivalent and the third one with negative outcome.

The paper is organized as follows. After this Introduction, in Section 2 we provide a discussion on the various definitions of emotion and on the methods to elicit risk aversion. The setting of the experiment is described in Section 3. The results of the laboratory experiment are presented in Section 4, where we put forward two measures of risk attitude and also discuss the relationship between mood and risk aversion. Section 5 concludes.

2 Emotion definition and methods for eliciting risk aversion

Since the last decade, the relation between risk aversion and emotion has caught the attention of many economists, especially in the field of Experimental Economics, and has been widely analyzed, leading some researchers to the formulation of two opposed theories: the Affect Infusion Model (AIM) (Forgas, 1995) and the Mood Maintenance Hypothesis (MMH) (Isen and Patrick, 1983). On the one hand, the former approach suggests that good mood brings to risk seeking behavior, that is people in a good mood perceive the risky choice as more favorable. On the other hand, the latter thesis supports the opposite result, namely people in a good mood are usually more risk averse than people in a bad mood, because they prefer to maintain their own positive mood. Having a look at the experimental evidence, we observe a really mixed context: some authors, like Nygren et al. (1996) and Chou et al. (2007), find positive correlation between good mood and risk taking behavior, instead other works, like Chuang and Lin (2007) as well as Kliger and Levy (2003), show opposite results that support the MMH. Finally there are some works finding no clear results, such as the case of Drichoutis and Nayga Jr (2013) who show both positive and negative emotions increase the willingness to take risk, or Yuen and Lee (2003) finding out that only negative emotion has an effect on risk aversion.

This conflicting evidence is probably due to two main causes, that is the difference in meaning between mood and emotion, and the various elicitation methods. Indeed, we usually use the terms *mood*, *emotion* and *affect* as synonyms, but there is a clear distinction as far as Psychology is concerned. According to Robbins and Judge (2012), *affect* defines a broad range of feelings people experience, including both *emotion* as an intense short feeling coming from a specific stimulus, and *mood*, defined as a less intense feeling which lasts for a long time. It is also a well-known fact that strong emotions turn into a mood. In the research area of decision making under risk there is another important distinction between *anticipated or expected emotion* and *immediate emotion*. As in Rick and Loewenstein (2008), the former refers to predictions about the emotion agents will experience after knowing the outcome of their own choice, whereas the latter refers to the immediate reaction at the time of decision making, and in turn falls into one of two categories. Indeed, even if connected with the consequences of one's decision, *integral emotion* is experienced at the time of decision making and provides individuals with more thorough information about their own tastes. Finally, *incidental emotion* is felt during decision making but totally unrelated to the choice at hand, and represents the object of this paper.

Furthermore, regarding the problem of defining *mood* and *emotion*, it has been shown that taking into account a generic definition like "positive emotion" (or mood) or a specific definition like "happy" brings to different results. For example, Raghunathan and Pham (1999) and Lerner and Keltner (2001) show that fear, anger and sadness, usually classified as "negative emotion", have a different impact on risk aversion with respect to each other. Accordingly, in order to avoid typical ambiguity of the valence-based approach (Zeelenberg and Pieters, 2006), in the current work we prefer to focus on specific feelings, that is, happiness and sadness.

The second reason why the previous literature disagrees could be associated with the different experimental methodologies to elicit individual risk aversion. In accordance with Charness et al. (2013), we can cite among them:

- *Balloon Analogue Risk Task* (BART) (Lejuez et al., 2002). In this kind of experiment the only task is to pump a series of virtual balls. For each pump the participant wins 5 cents in a temporary account. At whatever moment of game, the player can decide to move the amount in a permanent account. In this case a new small ball appears. If the balloon bursts before moving the money, then a new balloon appears and the player loses his own amount. On the one hand, the larger becomes the ball, the higher is the amount in the temporary account. On the other hand, the burst probability increases with the dimension of the ball. The measure of risk aversion is the adjusted number of pumps. High number of pumps denotes risk loving people.

- *The Gneezy and Potters method* (Gneezy and Potters, 1997). In this game players receive a certain amount, having to decide how much to invest in a risky option which offers a certain dividend. The difference between the initial amount and the investment in the risky choice is kept by the player. The higher the investment, the lower the risk aversion.

- *Multiple Price List Method* (MPL) (Binswanger, 1980). The task consists in choosing within a list of paired lotteries. Each choice of the list usually includes a safe lottery and a risky gamble. Players choose the preferred option for each row. The sum of the safe choices of each list is used as raw measure of risk aversion. The main feature of this method is that each choice is associated with a specific coefficient of relative risk aversion. This coefficient is computed under the assumption of a specific form of the utility function, namely preferences are modeled according to a Constant Relative Risk Aversion utility function.

Since this is merely an exemplifying list, we refer the reader to Andersen et al. (2006) for a review of the most relevant methods. Even though in the text we are going to use the terms *emotion* and *mood* as interchangeable words, in the current work we are specifically interested in understanding the impact of incidental happiness and sadness on risk aversion, by using a multiple price list method to elicit risk preferences[1].

3 Setting of the experiment

We conduct four different treatments in four different sessions, following the same scheme in each one: (i) an initial stage in which, after a brief socioeconomic questionnaire is handed out, we induce a specific emotion, (ii) then a subsequent stage in which the subjects carry out a self-evaluation of the emotion felt, and (iii) finally the participants make risky choices by using the *Multiple Price List* method.

Since we are interested in analyzing the effect of different kinds of emotion on risk aversion, we use incidental mood as control variable and, according to a communicative theory of emotions (Johnson-Laird and Oatley, 2008), we assume that only four *basic emotions* (happiness, sadness, anxiety and anger) can be evoked through music. Therefore, we try to induce sad or happy emotion in addition to two neutral control treatments, relying on the existence of several techniques to elicit a specific emotion, as Westermann et al. (1996) also highlighted. Indeed, the mood induction procedure can be classified as *simple* if only one of the techniques is used, or *combined* in case more techniques are implemented together. Following some useful advice (Mayer et al., 1995), we combine two of the eleven existent methods, namely, images in addition to music, in order to avoid ineffective induction procedures. In particular, we select a list of musical pieces which are supposed to induce negative, positive or neutral condition; moreover, we choose sad, happy or neutral pictures to be shown during the listening phase of the respective treatments, in order to enhance the wished emotions. Therefore, we run four different sessions:

- *TREATMENT N* in which the participants listen to few minutes of the musical piece "Polymorphia" by Penderecki in order to induce negative mood;

[1]In the same way, we are going to interchange the adjective *happy* with *positive*, as well as *sad* with *negative*.

Table 1: Treatments

	Experimental Treatments		Control Treatments	
	Treatment N	Treatment P	Treatment CM	Treatment C
Participants	32	30	30	28
Mood	Negative	Positive	Neutral	Neutral
Music	Polymorphia	Mambo	Symphony n.40	No music

- *TREATMENT P* in which we select Bernstein's track "Mambo" in order to induce positive mood;
- a control treatment *TREATMENT CM* in which we propose an excerpt from the neutral piece "Symphony n.40" by Mozart[2]; and
- a control treatment *TREATMENT C* without music.

A summary of the whole induction procedure is shown in Table 1.

After the mood induction step, we ask players to report a self evaluation of their own emotion in a scale ranging from 1 to 6 for each of four adjectives, which vary depending on the treatment but always include either *happy* or *sad* to make a comparison with the control treatment.

Finally, the risk aversion elicitation phase consists in three lotteries in which we follow a scheme that is similar to that one proposed by Abdellaoui (2000), Ding et al. (2010) and Abdellaoui et al. (2011), namely a list in which players can choose either a risky option (i.e. a certain probability to win an amount of money), or a safe amount. The main difference between our game and that one proposed by Holt and Laury (2002) lies in the fact that Holt and Laury considered a list of paired choices between two risky options, as shown in Table 2.

[2]This piece of music is contained in a list of pieces that Västfjäll (2002) judges to be suitable for neutral conditions.

Table 2: Ten paired lottery proposed by Holt and Laury

Nr.	Option A		Option B	
1	$p = 1/10$ of 100	$p = 9/10$ of 80	$p = 1/10$ of 190	$p = 9/10$ of 5
2	$p = 2/10$ of 100	$p = 8/10$ of 80	$p = 2/10$ of 190	$p = 8/10$ of 5
3	$p = 3/10$ of 100	$p = 7/10$ of 80	$p = 3/10$ of 190	$p = 7/10$ of 5
4	$p = 4/10$ of 100	$p = 6/10$ of 80	$p = 4/10$ of 190	$p = 6/10$ of 5
5	$p = 5/10$ of 100	$p = 5/10$ of 80	$p = 5/10$ of 190	$p = 5/10$ of 5
6	$p = 6/10$ of 100	$p = 4/10$ of 80	$p = 6/10$ of 190	$p = 4/10$ of 5
7	$p = 7/10$ of 100	$p = 3/10$ of 80	$p = 7/10$ of 190	$p = 3/10$ of 5
8	$p = 8/10$ of 100	$p = 2/10$ of 80	$p = 8/10$ of 190	$p = 2/10$ of 5
9	$p = 9/10$ of 100	$p = 1/10$ of 80	$p = 9/10$ of 190	$p = 1/10$ of 5
10	$p = 10/10$ of 100	$p = 0/10$ of 80	$p = 10/10$ of 190	$p = 0/10$ of 5

The MPL format is very simple and it is one of the most used formats to elicit individual risk aversion. Andersen et al. (2006) analyze the use of the MPL in different fields and they highlight the pros and cons of this approach. The main advantage is the simplicity of the structure, while the main disadvantage is the possibility of having multiple switching. Charness et al. (2013) suggest that the problem of multiple switching is due to the misunderstanding of the instruction and, accordingly, of the game.[3] On the contrary, Andersen et al. (2006) argue that this kind of behavior can be considered as indifference between choices. As we will see, we also find a large percentage of inconsistent choices (in the first lottery). In our setting we include an explicit option for indifference between the safe and the risky choices. This means that the inconsistent behavior is probably due to a lack of attention or to a scarce comprehension of the instructions (see below for further details).

[3]For example, Jacobson and Petrie (2009) in a field experiment found 55% of inconsistent choices.

Our lotteries, whose specification is shown in Table 3, Table 4 and Table 5, have the following peculiarities:

- Lottery 1: the safe choice ranges from 100 to 190, while the amount and the win probability of the risky choice are constant.
- Lottery 2: the safe choice is constant and equal to 100, whereas the win probability gradually increases from 0 to 1.
- Lottery 3: whilst the safe choice is a constant loss equal to -20, the risky choice is represented by the increasing probability to lose 100%.

For the sake of simplicity, we call *Option A* and *Option B* the choices in all the three lotteries and, concerning the risky option, we impose the choice between a certain amount of money and zero to make the game as clear as possible and avoid misunderstandings, as suggested in Plott and Zeiler (2005).
Table 3 shows the lottery in which we fix gamble and variable riskless amount: we expect that a risk neutral person will choose *Option A* six times before switching to *Option B*.
Table 4 shows the lottery in which we fix the amount of the safe choice, while the win probability changes in the *Option B*: we expect that a risk neutral person will choose *Option A* four times before switching to *Option B*.
Finally, Table 5 shows the lottery defined in the loss-domain: players have to choose between a small sure loss and a risky option in which they have a certain probability to lose 0. In this case, we expect that a risk neutral person will choose *Option B* two times before switching to *Option A*.

The experiment was conducted in May 2014 in the Laboratory of the Faculty of Economics "Giorgio Fuà", Università Politecnica delle Marche (Ancona, Italy) and involved 120 participants (58 female), paid according to the decisions made during the game in order to increase the incentive to behave correctly and reveal true preferences. Indeed, regarding each participant we randomly drew one of his choices in each lottery and paid him in accordance with the sum of these values. Having randomly assigned participants to one of the four sessions, we read aloud the instructions at the beginning of each turn and then players took place in their own cubicle. After

Table 3: Lottery 1

Choice number	Option A	Option B	
		$p = 1/2$	$p = 1/2$
1	100	300	0
2	110	300	0
3	120	300	0
4	130	300	0
5	140	300	0
6	150	300	0
7	160	300	0
8	170	300	0
9	180	300	0
10	190	300	0

Table 4: Lottery 2

Choice number	Option A	Option B			
1	100	$p = 1/10$	250	$p = 9/10$	0
2	100	$p = 2/10$	250	$p = 8/10$	0
3	100	$p = 3/10$	250	$p = 7/10$	0
4	100	$p = 4/10$	250	$p = 6/10$	0
5	100	$p = 5/10$	250	$p = 5/10$	0
6	100	$p = 6/10$	250	$p = 4/10$	0
7	100	$p = 7/10$	250	$p = 3/10$	0
8	100	$p = 8/10$	250	$p = 2/10$	0
9	100	$p = 9/10$	250	$p = 1/10$	0
10	100	$p = 10/10$	250	$p = 0/10$	0

Table 5: Lottery 3

Choice number	Option A	Option B			
1	-20	$p = 1/10$	-100	$p = 9/10$	0
2	-20	$p = 2/10$	-100	$p = 8/10$	0
3	-20	$p = 3/10$	-100	$p = 7/10$	0
4	-20	$p = 4/10$	-100	$p = 6/10$	0
5	-20	$p = 5/10$	-100	$p = 5/10$	0
6	-20	$p = 6/10$	-100	$p = 4/10$	0
7	-20	$p = 7/10$	-100	$p = 3/10$	0
8	-20	$p = 8/10$	-100	$p = 2/10$	0
9	-20	$p = 9/10$	-100	$p = 1/10$	0
10	-20	$p = 10/10$	-100	$p = 0/10$	0

starting the game, the participants read again the instructions in their own screen, filled in the questionnaire and were invited to put on the headphones to get involved in the feeling suggested by music and images. At this point, we asked them to report their own emotions on a range from 1 to 6. Before Lottery 2 and Lottery 3, they listened to 30 seconds of the musical piece again and looked at a subselection of the same images, in order to avoid the change of the induced mood. The experiment lasted about 40 minutes and the average payment was 8 Euro.

4 Results

In this section we show and comment the results of our experiment. Firstly, we describe the setup and the results of the mood induction procedure. Secondly, we analyze the results of each lottery by providing a rough measure of risk proclivity. Finally, a more refined measure of risk aversion is applied to our experimental results.

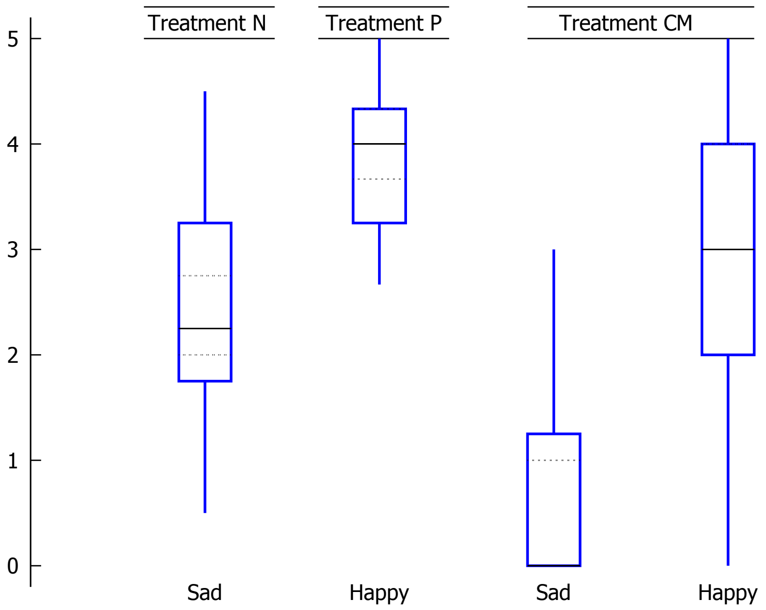


Figure 1: Positive and negative mood in all treatments

4.1 Mood induction

Moving to the first part of the analysis which concerns the validation of the mood induction procedure, first of all we compare the moods elicited in the control treatments and we find no significant differences.[4] Thanks to this result, from this moment on we are able to take into account only the TREATMENT CM. In Figure 1 we show the boxplot of the reported emotion in the considered treatments.

At this point we run a Wilcoxon rank sum test in order to check for validity of the mood induction, comparing the control treatment with the experimental treatments. As we can notice through the results shown in Table 6, the non parametric test rejects the null hypothesis, so the median of the control treatment and those ones of the experimental treatments are significantly different.

[4]Neither as for the adjective *sad* ($z = 0.599$; p-value $= 0.549$), nor as for *happy* ($z = 0.202$; p-value $= 0.839$) the Wilcoxon rank sum test finds significant differences between the two control treatments.

Table 6: Median comparison of inducted moods

	Statistics test	
	Treatment N vs Treatment CM	Treatment P vs Treatment CM
Wilcoxon	z= -4.96	z= 1.97
p-value	(0.00)	(0.05)

Having proved the validity of the mood induction procedure, we can go on to the second step of our analysis, in which the results of choices under risk are presented separately for each lottery. Data related to Lottery 3 will not be exploited in this analysis, due to incompatibility of the loss domain structure with the measures of risk attitude that we are going to use.[5]

4.2 Rough indicator of risk proclivity

As stated in the previous section, in this phase of the experiment we use a tweaked version of the MPL format due to its simplicity and appropriateness for eliciting individual risk aversion. When highlighting the pros and cons of this approach in different fields, Andersen et al. (2006) stress such an understandability of the structure as main advantage, whereas indicate the possibility of having multiple switching as chief drawback.[6] On the one hand, the same authors argue that this kind of behavior could be seen as indifference between choices, but on the other hand Charness et al. (2013) suggest that the problem of multiple switching could be due to the misunderstanding of the instructions.

As said before, we find large percentages of inconsistent choices, notably in the first lottery. Since we included an explicit option for indifference between the safe and the risky choices, our conclusion is that inconsistent

[5]These data will be used for future investigations focused on loss aversion.

[6]For example, Jacobson and Petrie (2009) n a field experiment found 55% of inconsistent choices.

behavior is arguably due to lack of attention or scarce grasp of instructions. In confirmation of this, after the first lottery the number of inconsistent choices seems to decrease in all treatments, thanks to learning effect.

In the first lottery the probability of the risky choice is held constant and equal to 50%, while the amount of the certain lottery gradually increases from 100 to 190.

As Holt and Laury (2002) pointed out, the total number of safe choices can be used as rough indicator of risk aversion. In Figure 2, we show the proportion of risky choices made by players in each treatment. Having drawn a grey dotted line to indicate the prediction under the hypothesis of risk neutrality, in the graph the percentage of risky choices falls very quickly after the fifth choice in TREATMENT P and in TREATMENT N. Whereas, in the control treatment nearly 40% of people still prefer the risky option until the last choice.

Since the players in a neutral mood seem to be more risk lovers than the others, such a result could suggest that the induction of positive or negative emotions increased risk aversion.

In order to check if our graphical analysis is significant, we compare such choices by running parametric and nonparametric tests, whose results are shown in Table 7. In both cases the tests reject the null hypothesis, underlining that the participants in a positive or negative mood actually were more risk averse than individuals in a neutral mood.

Furthermore, no noteworthy results come out of the comparison between Treatment P and Treatment N.[7]

The second lottery differs from the previous one with respect to two peculiarities: in this case the safe choices are held constant and equal to 100, while the probability of winning in the risky choices increases from 0.1 to 1. Moreover, in such a lottery the rational behavior predicts that risk neutral individuals choose the safe choice four times before switching to the risky choice.

Like for the previous lottery, in Figure 3 we illustrate the risky choices

[7] We tested if the difference between the risky choices in Treatment P and in Treatment N is significant, but both test are not able to reject the null hypothesis (t = 0.97; p-value = 0.166; z = 1.051; p-value = 0.29).

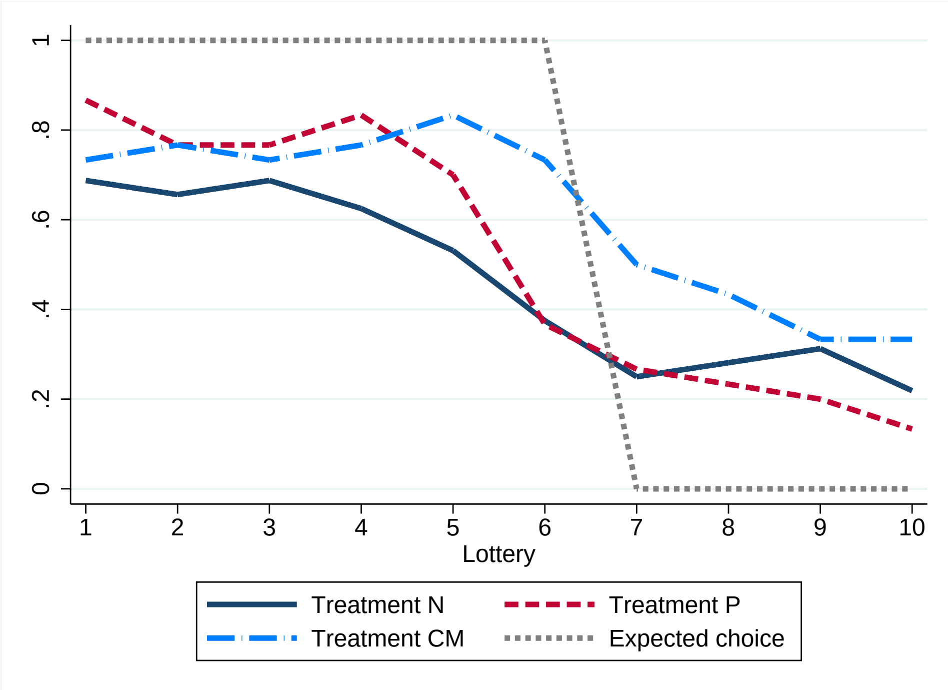


Figure 2: Percentage of risky choices by treatment - Lottery 1

Table 7: Mean/median comparison of risky choices - Lottery 1

	Statistics test	
	Treatment N vs Treatment CM	Treatment P vs Treatment CM
t-test	t= -2.89	t= -1.92
p-value	(0.00)	(0.06)
Wilcoxon	z= 3.20	z= -2.51
p-value	(0.00)	(0.01)

Table 8: Mean/median comparison of risky choices - Lottery 2

	Statistics test	
	Treatment N vs Treatment CM	Treatment P vs Treatment CM
t-test	t= -0.37	t= 0.23
p-value	(0.71)	(0.82)
Wilcoxon	z= -0.21	z= 0.62
p-value	(0.83)	(0.53)

made by players in each treatment, considering the fact that any risk neutral individual should switch to the risky option at the fifth choice. This time, at first sight nothing can be said about potential divergent patterns of behavior among treatments, since no line seems to stand out from the maze. Such an impression is confirmed by parametric and nonparametric tests in Table 8, where no differences between groups have been found.

Summing up, in Lottery 1 both participants in a good mood and those ones in a bad mood were more risk averse than people in a neutral mood, but this evidence disappeared in Lottery 2.

In addition, in the two lotteries we have found plenty of inconsistent choices. In order to depict this tendency, we generate a dummy which is equal to 1 if the choice made is consistent, namely if the switching point is unique: Figure 4 shows that, on average, nearly 40% of players made a mistake in Lottery 1. Due to the size of such a phenomenon, we have decided to analyze the data by considering only the consistent choices. Anyway, Figure 5 reveals that the percentage of consistent choices increases to nearly 90% in Lottery 2, thanks to learning effect.

4.3 Arrow-Pratt index of relative risk aversion

In the previous subsection we have taken into account a rough index of risk proclivity, namely, the sum of risky choices per subject. Since the preliminary

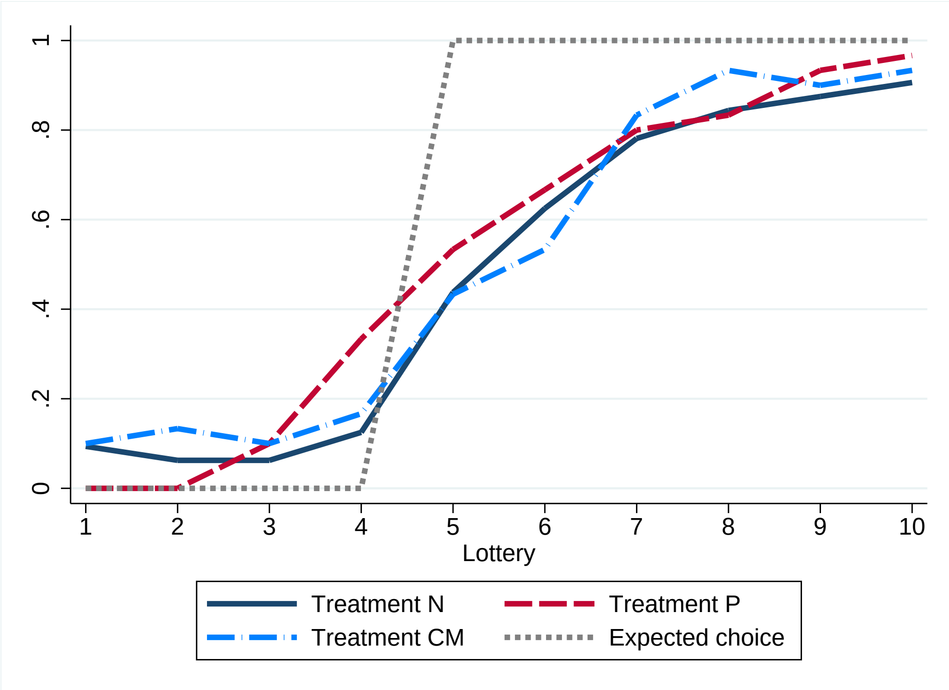


Figure 3: Percentage of risky choices by treatment - Lottery 2

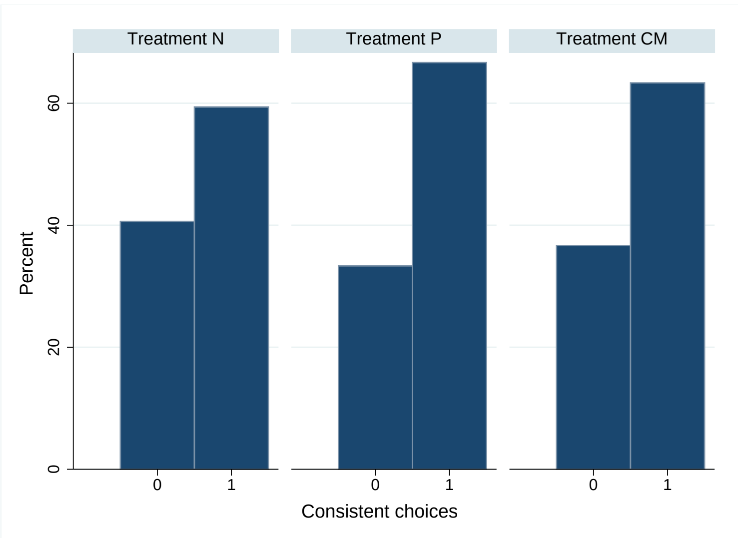


Figure 4: Percentage of consistent choices by treatment - Lottery 1

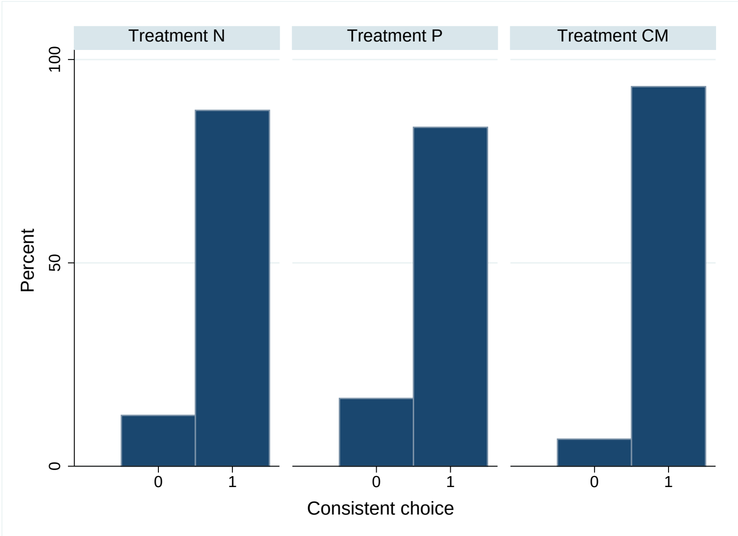


Figure 5: Percentage of consistent choices by treatment - Lottery 2

result suggests that both positive and negative emotion lead to less risk-taking behavior, in this paragraph we try to enhance such an outcome by introducing a more complex measure of risk aversion. Unlike Holt and Laury (2002), who constructed their price list under the hypothesis that preferences should be represented by a Constant Relative Risk Aversion (CRRA) utility function, we do not make any assumption about the utility function, only supposing that it is a concave function such that:

$$\frac{\partial u}{\partial m} > 0 \qquad\qquad \frac{\partial^2 u}{\partial m^2} < 0$$

Following Guiso and Paiella (2008) approach, we calculate the Arrow-Pratt index of relative risk aversion by considering a second-order Taylor expansion of the utility function around the initial value m. The generic expected utility function is given by:

$$Eu = pu(x_1) + (1-p)u(x_2) = Eu(\tilde{X})$$

where p is the probability to win the prize x_1 and $(1-p)$ is the probability to win x_2, with $\tilde{(X)}$ as expected payoff of the lottery.

The Taylor expansion is given by:

$$Eu(\tilde{X}) \simeq u(m) + u'(m)E(\tilde{X}) + 0.5u''(m)E(\tilde{X})^2 \tag{1}$$

We consider the certain utility $u(m)$ as the utility of receiving the certain amount in the lottery. Taking into account the certain utility and the expected utility we obtain the following specifications for Lottery 1 (Equation 2) and Lottery 2 (Equation 3):

$$u(m) = \frac{1}{2}u(300) + \frac{1}{2}u(0) \qquad m \in (100, 190) \tag{2}$$

$$u(100) = pu(250) + (1-p)u(0) \qquad p \in (0.1, 1) \tag{3}$$

The Arrow-Pratt index (Pratt) is equal to:

$$\pi = -\frac{u''(m)}{u'(m)}$$

which is a measure of the concavity of the utility function. Then we combine equation 1 and equations 2 and 3, obtaining:

$$\pi_1 = \frac{2(150-m)}{150^2 + m^2} \tag{4}$$

$$\pi_2 = \frac{2(p(250) - 100)}{(p(250))^2 + 100^2} \tag{5}$$

Using Equations 4 and 5 we get two series of ten values for the Arrow-Pratt coefficient of risk aversion which correspond to each possible switching point. The latter is (i) equal to 0 and such that the certain amount is equal to the expected value of the risky choice, if the player is risk neutral; (ii) negative if the player is risk lover, or (iii) positive if the player is risk averse.

Considering the values of the Arrow-Pratt coefficient in Table 9, we assign a measure of risk aversion to each player in all the treatments and show the results for Lottery 1 and Lottery 2 respectively in Figure 6 and Figure 7.

Table 9: Arrow-Pratt coefficient of risk aversion

	Lottery 1	Lottery 2
N. of safe choice	γ	γ
1	0.0031	-0.0141
2	0.0023	-0.008
3	0.0016	-0.0032
4	0.0010	0
5	0.0005	0.0020
6	0	0.0031
7	-0.0004	0.0037
8	-0.0008	0.004
9	-0.0011	0.0041
10	-0.0014	0.0041

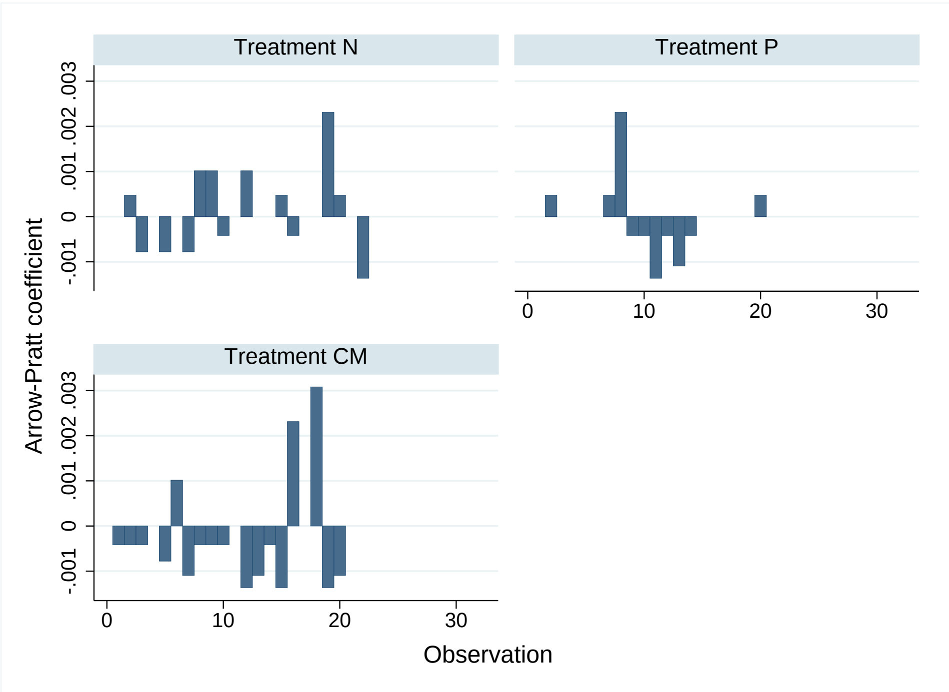


Figure 6: Arrow-Pratt coefficient of risk aversion - Lottery 1

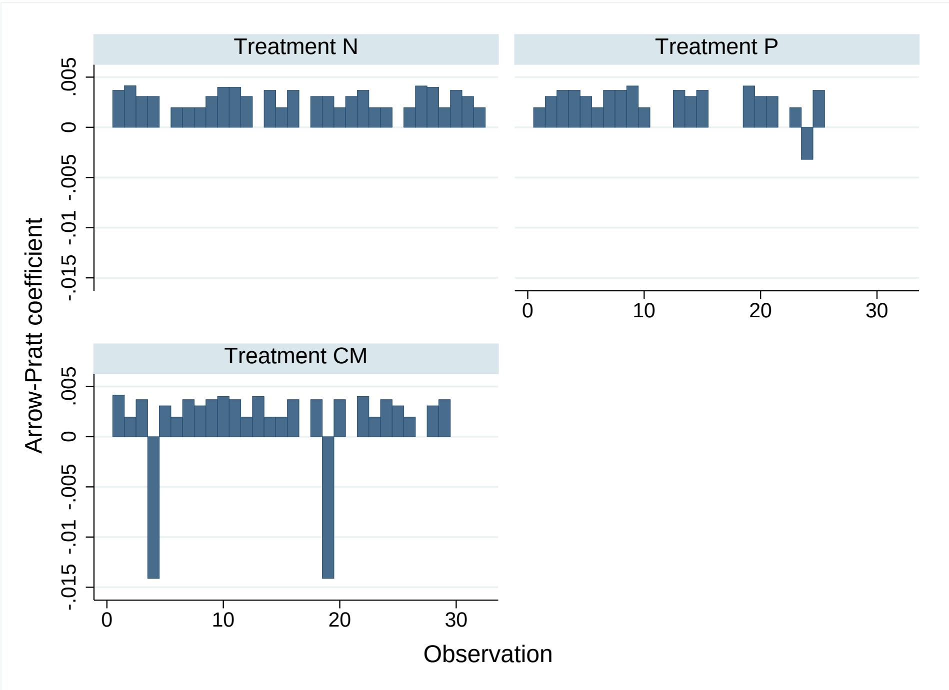


Figure 7: Arrow-Pratt coefficient of risk aversion - Lottery 2

It is worth pointing out that, albeit to different extents, both lotteries display the highest percentages of risk lover individuals in Treatment CM. In order to get a clear-cut visual impact, we summarize such an outcome in Figure 8, where we assign the labels -1, 0 and 1 respectively to the negative, null and positive values of the Arrow-Pratt coefficient. Observing the graph, the percentage of risk lover players in Lottery 1 is smaller than 30% if we consider either Treatment N or Treatment P, whereas this percentage is much bigger in Treatment CM, exceeding 70%. A similar tendency comes out of Lottery 2, the percentage of risk lover individuals does not even reach 10% in all treatments.

At this point we run the nonparametric test in order to check for statistically significant differences and show the results in Table 10. As far as Lottery 1 is concerned, the Wilcoxon rank sum test rejects the null hypothesis of no differences between the compared median values, indicating that both the subjects in a bad mood (Treatment N) and the individuals in a good mood (Treatment P) revealed themselves as more risk averse than the players in a

Table 10: Median comparison of Arrow-Pratt coefficients

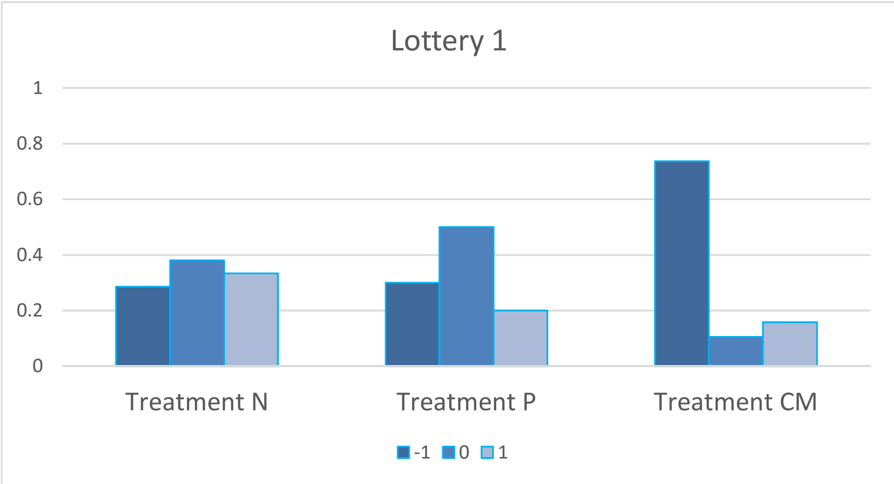
Statistics test

		Treatment N vs CM	Treatment P vs CM
Lottery 1	Wilcoxon	t= -2.10	t= -2.06
	p-value	(0.03)	(0.04)
Lottery 2	Wilcoxon	z= 0.27	z= -0.79
	p-value	(0.79)	(0.43)

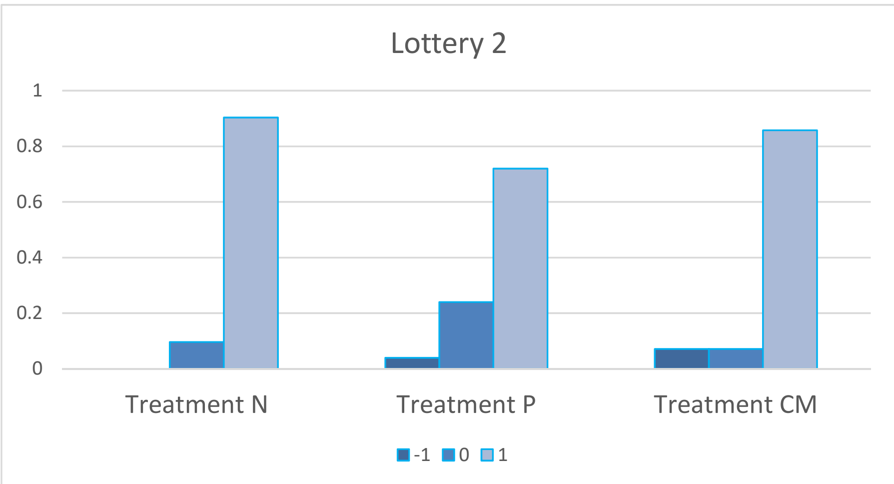
neutral mood (Treatment CM). Instead, in Lottery 2 the test fails to reject the null hypothesis, suggesting that the participants followed similar behavioral patterns regardless of the treatment of origin. Basically, such results reflect those ones coming out previously by using the rough indicator of risk proclivity, namely the total number of risky choices per subject. Therefore, players not in a neutral mood (i.e., both happy and sad ones) made more conservative choices, leading to results that are a mixture of the predictions by the Affect Infusion Model (AIM) and the Mood Maintenance Hypothesis (MMH).

We justify such a behavior in Lottery 1 by supposing that people are aware of their own scarce mental alertness and, accordingly, prefer not to take risks. Such an explanation is coherent with the view that choice behavior is the joint product of a *deliberative system* focused on broader goals and an *affective system* driven by emotions and motivational states (Loewenstein et al., 2015). In addition, since we classified the *affect* arising from the musical stimulus as *emotion*, that is, an intense temporary feeling, we actually do not observe the same effect on players during Lottery 2. In other words, the emotional status tends to vanish as time elapses.

In order to understand whether our findings can actually be attributed to the musical stimulus, by resorting again to the Arrow-Pratt index we check for the initial level of risk aversion, that we had elicited through the following question before broadcasting the music:



(a)



(b)

Figure 8: Fraction of risk averse, risk neutral and risk lover players

Table 11: Mean/median comparison of Arrow Pratt coefficients - Initial question

	Statistics test	
	Treatment N vs Treatment CM	Treatment P vs Treatment CM
t-test	t= 0.59	t= 0.73
p-value	(0.56)	(0.47)
Wilcoxon	z= -0.85	z= 0.98
p-value	(0.39)	(0.33)

- "You are given the opportunity to buy a financial product which with the same probability allows you to win 1000 Euro or to lose the invested sum. How much are you willing to pay for such a financial product?"

This time we calculate the Arrow-Pratt coefficient in the ensuing way:

$$\pi_3 = 2(1000 - z_i)/(1000^2 + z_i^2) \tag{6}$$

where z_i is the amount invested by the single participant.

As depicted in Table 11, both parametric and nonparametric test find no differences between groups, namely the subjects in the treatment groups seem to be initially as risk-averse as those ones in the control group. Accordingly, as it emerges from the question preceding the musical procedure, after the mood induction the subjects exposed to "positive" or "negative" stimuli exhibit more risk averse choices than the subjects exposed to a "neutral" stimulus. This fact enhances the results of the study.

5 Conclusions

In this paper we analyzed the results of a laboratory experiment on the effect of incidental emotions on risk-taking behavior. In particular, we tested in a controlled environment the potential of musical stimuli to induce “positive”, “negative” or “neutral” moods that, in turn, may affect the behavior of individuals when facing risky choices. A modified version of the well-known *Multiple Price List* method is used to elicit individuals’ risk preferences.

The main finding of the paper is that individuals are more risk averse after both the positive and negative musical mood inductions than those exposed to a neutral treatment. Images are also used during mood induction to avoid an ineffective treatment. This result is statistically significant for the first lottery the experimental subjects were given, while the effect gets lost in the second lottery, meaning that the musical stimulus induces a temporary mood with vanishing effects on risk-taking behavior. A further confirmation of our findings is that we observe individuals’ risk behavior before and after the experimental treatments, noticing that all the participants are *ex-ante* characterized by similar risk attitude, while greater risk aversion is detected *ex-post*.

Our results basically confirm a deducible fact, namely, that music is able to affect our mood. Indeed, sometimes we need some music to be “in the mood”. Interestingly enough, musical mood induction may have some relevant implications on economic and financial decision-making, but even this fact is not new, as marketing operators know. For instance, think about the effect that Mendelssohn’s or Wagner’s wedding march broadcast in a shop can have on the buying decision during the wedding dress fitting, perhaps while walking on a red carpet surrounded by mirrors. We show that music can also affect risk-taking, thus adding new findings to a literature which is still in its infancy. Given that we find a similar effect on individual risk-taking of both the irresistible joy infused by the Orquesta Sinfónica Simón Bolivar conducted by Gustavo Dudamel and the distressing atmosphere instilled by Penderecki’s Polymorphia, a possible interpretation is that musical stimuli which are able to influence positively or negatively our mood lead us to improve concentration and focus more on the subject, that in our experiment results in greater risk aversion. Definitely, additional research is needed to further assess the emotional impact of music on individual risk-taking.

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