UNIVERSITY OF SIENA

LabSi
EXPERIMENTAL ECONOMICS LABORATORY

Valeria Faralla
Alessandro Innocenti
Stefano Taddei
Eva Venturini

Physiological Responses to Stressful Work Situations in Low-Immersive Virtual Environments

July 2013

LABSI WORKING PAPERS

N. 47/2013

Physiological responses to stressful work situations in low-immersive virtual environments[1]

Valeria Faralla
University of Siena

Alessandro Innocenti
University of Siena

Stefano Taddei
University of Firenze

Eva Venturini
University of Siena

July 2013

Abstract. The paper analyzes physiological responses to different visual representations of stressful work activities. A between-subject experiment was conducted to analyze differences in heart rate (HR) and electromyography (EMG) between subjects watching videos featuring real actors and virtual videos with avatars representing the same situation. Findings show that exposure to real videos is associated with greater physiological activations than exposure to virtual videos. This evidence may suggest that, by inducing less emotional involvement, low-immersive virtual environments activate different cognitive mechanisms of stress perception.
Keywords: work stress, physiological activations, perception, virtual reality.

---

[1] This research was supported by the Tuscany Region in the framework of PAR FAS 2007-2013 under grant ALBO project (Fondo per le Aree Sottoutilizzate Delibera CIPE 166/2007).

1. Introduction

The aim of the paper is to investigate physiological reactions to stressful work activities in low-immersive virtual environments. Virtual reality is a technical system composed by hardware and software, which generate artificial environments through an interface which stimulates one or more of individual senses. In this setting, events take place in real time and users are partially or fully immersed in the simulated experience. This condition implies that the stimuli from virtual reality partially or fully dominate users' perception and cognition, although they are typically active and cognitively engaged during the exposure. The experience may influence or modify subject's real-life perception and assessment of the simulated event (Fox et al. 2009). To this purpose, virtual reality technology allows creating two types of environments (Slater and Wilbur 1997). The first are high immersive virtual environments (HIVE), which utilize specialized displays such as CAVE, Head-Mounted Displays, Immersadesk or Augmented Reality to increase the sense of presence, that is the psychological state of feeling that the virtual experience is real (Fox et al. 2009). The second are desktop or low-immersive virtual environments (LIVE) that uses computer screen based applications of virtual reality, such as Second Life or World of Warcraft (Banbridge 2007). While in HIVE users' perception and cognition are dominated by the technical equipment, such as binocular helmet mounted display or enclosed boxes with multiple interior screens, in LIVE users experience a weaker immersive sense of presence. This effect can be pursued through two different methods, by *framing* or by *naturalistic cues*. *Framing* occurs in virtual environments suggesting to subjects as to how to behave. In this respect, social cognitive theory (Bandura 2001) claims that a model demonstrating a behavior can have the effect to endorse the same behavior in the observer. Identification refers to the extent to which an individual relates to the model and feels that he is similar to the model. It has been shown that identification increases the likelihood of performing learned behaviors and that individuals need not experience rewards or punishments to learn a behavior to be encouraged (Fox et al. 2009). *Naturalistic cues* are provided by virtual environments as similar as technically possible to the real ones. In this case, the plasticity of virtual reality allows to focus users' attention on single issues, such as for instance some otherwise neglected context factors, the lack of awareness or the temporal latency of the consequences of present choices (Bailenson et al. 2006). The combination of these techniques makes virtual reality useful to communicate norms and prescriptions, to provide therapeutic treatments and to practice skills in order to improve them. This effect named *vicarious reinforcement* (Bandura 2001) may also represent a powerful tool for the analysis of work stress perception.

The scientific debate on stress in working activities focuses on the argument that responses to stressful environments are not due to the nature of the stimulus, but rather to their cognitive-emotional evaluation (Karasek 1979, Siegrist 1996, Bakker et al. 2012). In accordance with the Job Demands-Resources (JD-R) model (Demerouti et al. 2001), job strain is defined as the individual assessment of balance between job demands and personal resources to cope with them. This implies that individuals are actively involved in the person-environment relation, which becomes a dynamic interaction based on causal reciprocity, a continuous process of stimulus appraisal and adjustment reactions. This practice also leads to goal confrontation and work engagement (Hobfoll 1989). Insight into these processes may be gained by exploring individual perceptions of work stressful situations. The measurement of job-related stress is usually done through checklists, aiming at assess the objective aspects of work activities, and questionnaires, which are self-report tools containing open or close-ended questions on respondent's personal experience. Some of these questions concern the presence or absence of specific behaviors, while others the frequency of experienced stressful events. The validity of this approach strictly depends on respondents' self-awareness, which can be critically affected by various sources of distortion, such as personal expectations, search for coherence, social desirability or framing effects. In particular, implicit association theory (Greenwald and Krieger 2006, Sriram and Greenwald 2009) questions the effective reliability of self-report tools by highlighting the unintentional and unconscious elements of judgment and behavior based on mental processes automatically and instinctively activated (Nosek 2007). The role of automatic processes in stress perception, which are parallel, effortless, reflexive and without introspective access, are strictly related to that of risk perception. A key assumption on how people take decisions in risky settings, such as insurance and financial markets, is that not only perception but also information processing is generally affected by a number of cognitive biases. According to Kahneman and Tversky's (1979) prospect theory approach and Slovic's (1987) psychometric paradigm people are generally myopic in assessing risks. They tend to be over-concerned with minor risks having an immediate impact on their daily life, while they practically neglect the long-term effects of unfamiliar risks. This attitude explains why non-experts tend to rank certain risks as more severe than experts and to overestimate the magnitude of the same risks. Slovic (1987) identifies two sources of lay people's risk misperception: the degree to which risk is dreaded, defined as the combination of having a catastrophic potential, perceived lack of control, the unequal distribution of risks and benefits, and the degree to which it is unknown, that is the condition of being unobservable, novel, and with a long latency period. This explains because reactions to risks are triggered emotionally and not determined by rational scrutiny as assumed by economic decision theory. The concept of somatic marker proposed by Damasio (1994) postulates the existence of automatic and unaware affective reactions, discerning what is risky or not independently from a careful weighing of pros and cons.

Since it has been argued that both risk and stress perception are influenced by similar components, particularly by the background context, Schonberg et al. (2011) propose to study risky decision-making in more realistic and evocative environments, where motivational, emotional and idiosyncratic aspects can be taken into account. Low-immersive virtual environments represent very suitable tools for this kind of analysis, by allowing the simulation of a wide range of real life situations, while gaining the ability to strictly control the experimental setting (Harrison et al. 2011). In this respect, Riva (2005) underlines the usefulness of the use of avatars, since this modality allows the creation of a simulated agent with essential requisites (Bonda et al. 1996) such as for instance the body schema, so that the user can partially identify him/her with the virtual environment, without losing the ability of rationally screening the simulated event. It has also been shown by Perani et al. (2001) that the observation of actions made by an avatar or a real person triggers different activations of physiology and cerebral areas. They argue that actions made by virtual agents are not understood through the typical human body schemas, since their action seems not to have the feature of intentionality and therefore activate different brain areas from *in-vivo* exposure. Recent studies (Biocca et al. 2003, Bailenson et al. 2006) highlight the positive effects of the use of hybrid realism, obtained by means of the use of avatars instead of physical subjects and it gives a high sense of co-presence, without inhibiting the self's openness toward the interlocutor. Virtual reality has also been utilized in treating anxiety, thanks to the possibility provided by this tool to express a marked sense of presence joined with a diminished sense of fear during exposure (Brinkman et al. 2010, Price et al. 2011).

To provide evidence on the usefulness of this tool for the analysis of stress perception, our experiment analyzes how people respond to low-immersive virtual representations of stressful work situation and if these reactions are different from exposure to videos featuring real actors. Individual responses were measured by recording physiological activations, which are considered a byproduct of the emotional reactions to stressful and fearful events (Cacioppo et al. 1993, Wiederhold et al. 2002, Wilhelm et al. 2005, Fox et al. 2012). In particular, heart rate (HR) and trapezius muscle activity, as measured by surface electromyography (EMG) have been considered reliable indexes of arousing involvement during exposure to virtual representation of real environments (Krantz et al. 2004, Slater et al. 2006, Kotlyar et al. 2008, Groenegress et al. 2010). In our study, we hypothesized that the weaker sense of presence experienced in low-immersive virtual environments may attenuate the anxiety caused by watching stressful work activities. This outcome would support emotional processing theory (Foa and Kozak 1986) that virtual reality exposure enables users to assess critically the simulated situations, modify real life perceptions and consequently improve mental readiness to adjust work stress misperceptions.

2. Method

Materials

Each participant was shown a video representing the same stressful work situation. The video script was developed in collaboration with experts in job-related stress. It was first realized in the virtual version with avatars and then in the version with real actors with exactly the same length and storyline. Representative snapshots from the videos are shown in Figure 1.

Fig. 1 Snapshot from the videos with avatars (left) and with actors (right).

Physiological signals were recorded using the Modulab 800-Satem, a multi-purpose biosignal acquisition device with electrodes. Customized analysis software (Panda) was applied to the two variables, heart rate (HR) and electromyography (EMG). For both variables, mean values were calculated for the 120-s intervals during the exposure time.

At the end of each session, all participants were submitted the following self-report questionnaires.

1. Locus of control questionnaire (Rotter 1966; trad. it. Nigro, 1983) that comprises twenty-nine items regarding individual perception of the underlying causes of real life events.

2. Generalized Self-Efficacy Scale (GSES) Jerusalem & Schwarzer (1981; It. tr., Sibilia, Jerusalem & Schwarzer, 1995), which investigates people's beliefs about their own sense of self-efficacy through 10 items.

3. A questionnaire for the assessment of cognitive and emotional states of the participants designed by the team of research, which comprises sixteen items assessing participants' emotional state during the experimental task on a ten point scale from 0 (no emotion) to 10 (highest level of emotion).

Participants and Procedure

The participants were 10 undergraduate students, 5 males and 5 females, recruited at the Psychology Faculty of the Florence University, ranging in age from 19-22 (M=20.9).

The between-subjects procedure was followed. Half of subjects, randomly chosen, was shown the video with virtual avatars (video 1) and the other half the video featuring real actors (video 2).

Participants were welcomed in the lab and told they were going to watch videos related to work activities. During the experiment they were seated in front of a computer screen, connected to the physiological equipment. In each session, equal in duration, physiological indices were first measured in a relaxed condition (baseline condition) and then while watching the movie (input condition). After the experiment, participants filled out the self-report questionnaires.

To analyze and compare data across the two conditions we selected the same three short extracts from the two videos. The selection was made through a process of external evaluation carried out independently by three judges. The judges were shown 10 clips and attributed them scores from 0 to 10 (0= not significant 10= extremely significant) in relation to their emotional relevance. The selected clips were the following ones.

Clip 1 (12 seconds) refers to a young mother (YM) carrying a baby in her arms and explaining her housing problems to a municipal employee (ME). The scene points out the impossibility of the employee to fulfill mother's needs and the determination of the latter. (ME: "I'm sorry lady, but how could we help you?" YM: "We don't have money for the rent and we must leave our house, we don't know where to go.")

Clip 2 (14 seconds) shows the ongoing dialogue in which the employee adopts a defensive strategy with an irritated tone, while the young mother, in tears, insists (YM: "but we are poor, the Municipality must give us a house!" ME: "lady, I understand your difficult situation but the municipality must not do anything, a list has been redacted…all regular…and you are not found to be eligible" U: "I don't understand…what you mean?")

Clip 3 (8 seconds) shows the strategies put into action by the employee to end the conversation by making appeal to the rules of housing allocation. The mother keeps on answering in a low and heartbroken voice. (E: “Next year another list will be done…you can participate!” U: “yes but where shall we go, we have to live outdoors? And where shall we eat?!”)

The two versions of the three clips were used to compare different physiological responses in terms of heart rate (HR) and trapezius muscle activity, measured by surface electromyography (EMG).

Hypotheses

Hypothesis 1. There are significant differences of physiological activation (HR and EMG) in the three key moments of the videos (clip 1, clip 2, clip 3) between the two experimental conditions. Specifically, real video generates average higher values of HR and EMG than virtual video.

Hypothesis 2. The self-report questionnaires for the assessment of cognitive and emotional state do not show any significant difference between the two experimental conditions. Specifically, scale rating does not differ statistically between the two experimental conditions

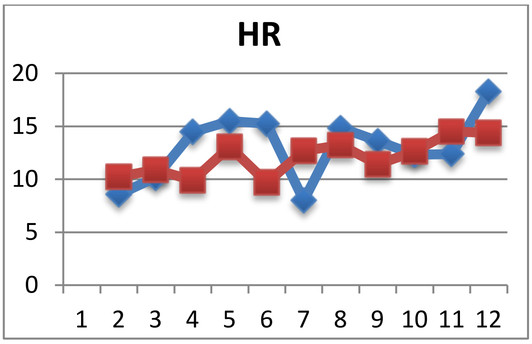
3. Results

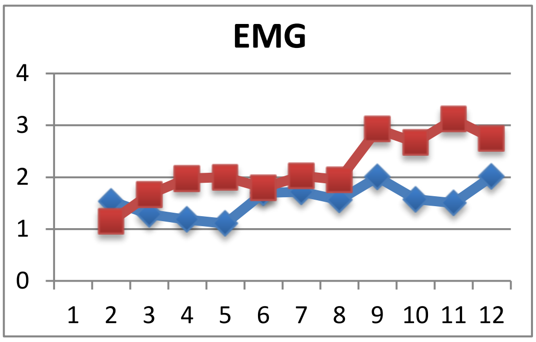
To obtain significant values of physiological activation, we subtracted the values recorded in the baseline condition (rest) from those recorded in the input condition (watching videos). As described above, in order to make the comparison, virtual and real videos, and consequently the three clips, have exactly the same length and content. Two subjects with artifacts in the acquisition of physiological indices were eliminated and data analysis was performed on 8 subjects.

Findings show significant differences in heart rate (HR) and electromyography (EMG) across conditions. Figure 1 displays data for each of three clips. By visual inspection, although subjects watching real videos exhibit greater activation than subjects watching virtual videos with clip 3 than with clips 1 and 2, the same trend is nearly confirmed for all the clips. Watching virtual videos only triggers greater standardized values of HR between seconds 3 and 7 of clip 1 and greater values of EMG between seconds 8 and 12 of clip 2, which are two moments of the videos in which the municipal employee is talking. Overall, it should also be noted that differential activations with respect to the baseline do not show peaks, confirming that the clips were emotionally engaging.

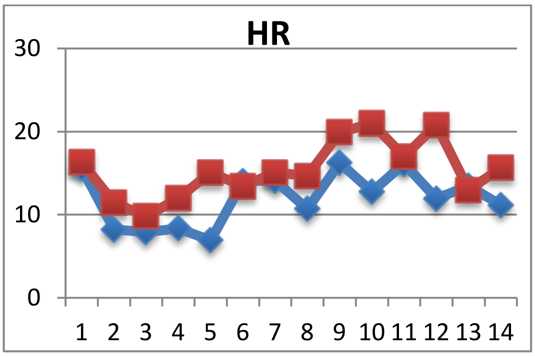
Fig. 2 HR and EMG standardized values with virtual (blue line) and real videos (red line).

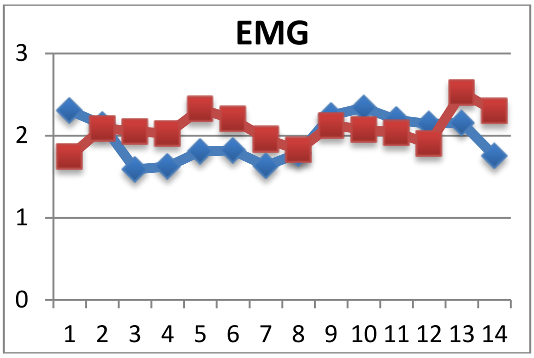
CLIP 1



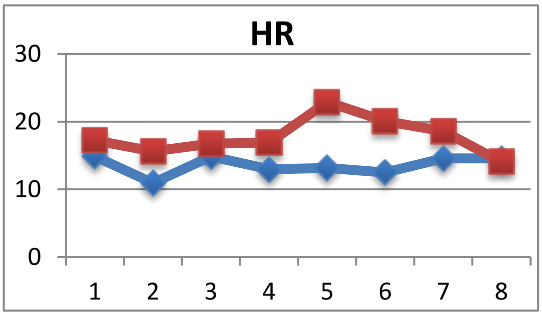


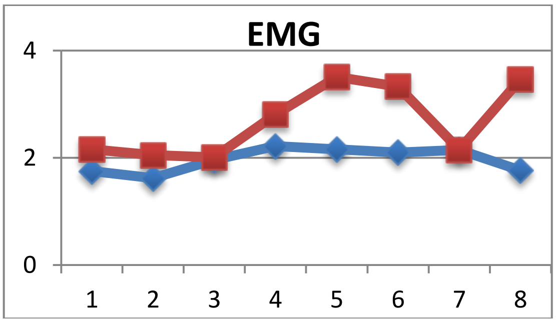
CLIP 2





CLIP 3





A simple paired *t-test* on data was applied to detect statistical significance of differences of physiological activations between the two videos. Results are shown in Table 1.

Tab. 1 Student's t-test for significance of difference between real and virtual videos

	HR	EMG
CLIP 1	**.329 (N.S)**	**.003****
CLIP 2	**.001*****	**.216 (N.S)**
CLIP 3	**.008****	**.014***

*p<.05; **p<.01; ***p<.001

Statistical analysis confirms that, with the exceptions of clip 1 for HR and clip 2 for EMG, our hypothesis 1, that is real videos trigger greater values of HR and EMG than virtual video, is supported by experimental data.

We also analyzed the results of the self-report questionnaire assessed participants' emotional state but no statistical difference emerged between subjects watching virtual and real videos.

4. Discussion

Our experiment intended to analyze the physiological reactions to stress by simulating work activities in low-immersive virtual environments. The overall purpose was to detect which kind of visual representations, virtual or real, induces greater emotional involvement. To this purpose, we recorded physiological data while exposing subjects to virtual reality simulations and videos with real actors.

The analysis of differences in heart rate (HR) and electromyography (EMG) across conditions shows that participants experienced greater physiological arousal during the exposure to real videos than to virtual videos, thus confirming our main hypothesis. Findings can be ascribed to the type of visual representation and not to individual differences in the attribution of emotional content to the videos, which was not detected by self-report questionnaires.

We interpret these findings as if participants experienced a lower level of anxiety due to the weaker sense of presence caused by low-immersive virtual environments. This explanation supports the claim that the use of low-immersive virtual environments allows a better understanding of the unconscious reaction to stressful situations than other kinds of visual representation. By inducing less emotional involvement, exposure to low-immersive virtual environments may also trigger cognitive restructuring mechanisms of stress perception and enhance the ability of removing heuristics and biases commonly activated in real life. Our result allows to speculate that high immersive virtual environments do not trigger the same impersonal attitude to simulated events and this conjecture provides a significant opportunity for future research.

References

Bailenson, Jeremy N., Nick Yee, Dan Merget, and Ralph Schroeder. (2006) "The Effect of Behavioral Realism and Form Realism of Real-Time Avatar Faces on Verbal Disclosure, Nonverbal Disclosure, Emotion Recognition, and Copresence in Dyadic Interaction." *Presence* 15: 359–372.

Bainbridge, William S. (2007). The scientific research potential of virtual worlds. *Science* 317: 472–476.

Bakker, Arnold B., Maria Tims, and Daantje Derks. (2012) "Proactive personality and job performance: The role of job crafting and work engagement." *Human Relations* 65: 1359–1378.

Bandura, Albert. (2001). "Social cognitive theory: An agentic perspective." *Annual Review of Psychology* 52: 1–26.

Biocca, Frank, Chad Harms, and Judee K. Burgoon. (2003) "Toward a more robust theory and measure of social presence: Review and suggested criteria." *Presence: Journal of Teleoperators and Virtual Environments* 12: 456–480.

Bonda, Eva, Stephen Frey, and Michael Petrides. (1996) "Evidence for a dorso-medial parietal system involved in mental transformations of the body." *Journal of Neurophysiology* 76: 2002–2048.

Brinkman, Willem-Paul, Charles van der Mast, Guntur Sandino, Lucy T. Gunawan, and Paul M.G. Emmelkamp. (2010) "The therapist user interface of a virtual reality exposure therapy system in the treatment of fear of flying." *Interacting with Computers* 22: 299–310.

Cacioppo, John T., David J. Klein, Gary G. Berntson, and Elaine Hatfield (1993) "The Psychophysiology of Emotion." In: Michael Lewis and Jeannette M. Haviland (Eds.), *Handbook of Emotions*. The Guilford Press, New York, pp. 119–142.

Damasio, Antonio R. (1994) *Descartes' error: Emotion, Reason, and the Human Brain*. Putman, New York.

Demerouti, Evangelista, Arnold B. Bakker, Frank Nachreiner, and Wilmar B. Schaufeli. (2001) "The Job Demands - Resources model of burnout." *Journal of Applied Psychology* 86: 499–512.

Foa, Edna B., and Michael J. Kozak. (1986) "Emotional processing of fear: Exposure to corrective information" *Psychological Bulletin* 99: 20–35.

Fox Jesse, Jeremy N. Bailenson, and Tony Ricciardi. (2012) "Physiological Responses to Virtual Selves and Virtual Others." *Journal of CyberTherapy & Rehabilitation* 5: 69–72.

Fox Jesse, Arena Dylan, and Jeremy N. Bailenson. (2009) "Virtual Reality: A survival guide for the social scientist." *Journal of Media Psychology* 21: 95–113.

Greenwald, Anthony G., and Linda H. Krieger. (2006) "Implicit bias: Scientific foundation." *California Law Review* 94: 945–967.

Groengress, Christoph, Bernhard Spanlang, and Mel Slater. (2010) “The physiological mirror-a system for unconscious control of a virtual environment through physiological activity.” *The Visual Computer* 26: 649–657.

Harrison, Glenn W., Ernan Haruvy, and E. Elisabet Rutström. (2011) “Remarks on Virtual World and Virtual Reality Experiments.” *Southern Economic Journal* 78: 87–94.

Hobfoll, Stevan E. (1989)“Conservation of resources: A new attempt at conceptualizing stress.” *American Psychologist* 44: 513–524.

Kahneman, Daniel, and Amos Tversky. (1979) “Prospect Theory: An analysis of decision under risk.” *Econometrica* 47: 263–292.

Karasek, Robert A. (1979) “Job demands, Job decision latitude, and Mental Strain: Implications for Job design.” *Administrative Science Quarterly* 24: 285–308.

Kotlyar, Michael, Christopher Donahue, Paul Thuras, Matt G. Kushner, Natalie O’Gorman, Erin A. Smith, and David E. Adson. (2008) “Physiological response to a speech stressor presented in a virtual reality environment.” *Psychophysiology* 45: 1034–1037.

Krantz, Gunilla, Mikael Forsman, and Ulf Lundberg. (2004) “Consistency in physiological stress responses and electromyographic activity during induced stress exposure in women and men.” *Integrative Psychological and Behavioral Science* 39: 105–118.

Nigro, Giovanna. (1983) “Contributo alla taratura italiana della Scala di Controllo Interno-Esterno (I-E) di Rotter. / Contribution to the Italian calibration of Rotter's Internal–External (I-E) Control Scale.” *Bollettino di Psicologia Applicata* 168: 29–41.

Nosek, Brian A. (2007) “Implicit-explicit relations.” *Current Directions in Psychological Science* 16: 65–69.

Perani, Daniela, Ferruccio Fazio, Nica Borghese, Marco Tettamanti, Stefano Ferrari, Jean Decety, and Maria C. Gilardi. (2001) “Different brain correlates for watching real and virtual hand actions.” *NeuroImage* 14: 749–758.

Price, Matthew, Natasha Mehta, Erin B. Tone, and Page L. Anderson. (2011) “Does engagement with exposure yield better outcomes? Components of presence as a predictor of treatment response for virtual reality exposure therapy for social phobia.” *Journal of Anxiety Disorders* 25: 763–770.

Riva, Giuseppe. (2005) “Virtual Reality in Psychotherapy: Review.” *Cyberpsychology & Behavior* 8: 220–240.

Schonberg, Tom, Craig R. Fox, and Russell A. Poldrack. (2011) “Mind the gap: Bridging economic and naturalistic risk-taking with cognitive neuroscience.” *Trends In Cognitive Sciences* 15: 11–19.

Sibilia, Lucio, Ralf Schwarzer, and Matthias Jerusalem. (1995) “Italian Adaptation of the General Self-Efficacy Scale: Self-Efficacy Generalizzata.” Retrieved from http://userpage.fu-berlin.de/~health/italian.htm.

Siegrist, Johannes. (1996) “Adverse health effects of high-effort/low-reward conditions.” *Journal of Occupational Health Psychology* 1: 27–41.

Slater, Mel, Christoph Guger, Robert Leeb, Angus Antley, Maia Garau, Andrea Vorgni, and Dorno Friedman. (2006) “Analysis of Physiological Responses to a Social Situation in an Immersive Virtual environment” *Teleoperators and Virtual Environments* 15: 553–569.

Slater, Mel, and Sylvia Wilbur. (1997) “A Framework for Immersive Virtual Envirionments (FIVE): Speculations on the Role of Presence in Virtual Environments.” *Presence: Teleoperators and Virtual Environments* 6: 603–616.

Slovic, Paul. (1987) “Perception of Risk.” *Science* 236: 280–285.

Sriram, Natarajan, and Anthony G. Greenwald. (2009) “The Brief Implicit Association Test.” *Experimental Psychology* 56: 283–294.

Wiederhold, Brenda K., Dong P. Jang, Sun I. Kim and Mark D. Wiederhold. (2002) “Physiological Monitoring as an Objective Tool in Virtual Reality Therapy” *CyberPsychology & Behavior* 5: 77–82.

Wilhelm, Frank H., Monique C. Pfaltz, James J. Gross, Iris B. Mauss, Sun I. Kim, and Brenda K. Wiederhold. (2005) “Mechanisms of Virtual Reality Exposure Therapy: The Role of the Behavioral Activation and Behavioral Inhibition Systems.” *Applied Psychophysiology and Biofeedback* 30: 271–284.

LabSi Working Papers

ISSN 1825-8131 (online version) 1825-8123 (print version)

Issue	Author	Title
n. 1/2005	Roberto Galbiati Pietro Vertova	Law and Behaviours in Social Dilemmas: Testing the Effect of Obligations on Cooperation (April 2005)
n. 2/2005	Marco Casari Luigi Luini	Group Cooperation Under Alternative Peer Punishment Technologies: An Experiment (June 2005)
n. 3/2005	Carlo Altavilla Luigi Luini Patrizia Sbriglia	Social Learning in Market Games (June 2005)
n. 4/2005	Roberto Ricciuti	Bringing Macroeconomics into the Lab (December 2005)
n. 5/2006	Alessandro Innocenti Maria Grazia Pazienza	Altruism and Gender in the Trust Game (February 2006)
n. 6/2006	Brice Corgnet Angela Sutan Arvind Ashta	The power of words in financial markets:soft versus hard communication, a strategy method experiment (April 2006)
n. 7/2006	Brian Kluger Daniel Friedman	Financial Engineering and Rationality: Experimental Evidence Based on the Monty Hall Problem (April 2006)
n. 8/2006	Gunduz Caginalp Vladimira Ilieva	The dynamics of trader motivations in asset bubbles (April 2006)
n. 9/2006	Gerlinde Fellner Erik Theissen	Short Sale Constraints, Divergence of Opinion and Asset Values: Evidence from the Laboratory (April 2006)
n. 10/2006	Robin Pope Reinhard Selten Sebastian Kube Jürgen von Hagen	Experimental Evidence on the Benefits of Eliminating Exchange Rate Uncertainties and Why Expected Utility Theory causes Economists to Miss Them (May 2006)
n. 11/2006	Niall O'Higgins Patrizia Sbriglia	Are Imitative Strategies Game Specific? Experimental Evidence from Market Games (October 2006)
n. 12/2007	Mauro Caminati Alessandro Innocenti Roberto Ricciuti	Drift and Equilibrium Selection with Human and Virtual Players (April 2007)
n. 13/2007	Klaus Abbink Jordi Brandts	Political Autonomy and Independence: Theory and Experimental Evidence (September 2007)
n. 14/2007	Jens Großer Arthur Schram	Public Opinion Polls, Voter Turnout, and Welfare: An Experimental Study (September 2007)

n. 15/2007	Nicolao Bonini Ilana Ritov Michele Graffeo	When does a referent problem affect willingness to pay for a public good? (September 2007)
n. 16/2007	Jaromir Kovarik	Belief Formation and Evolution in Public Good Games (September 2007)
n. 17/2007	Vivian Lei Steven Tucker Filip Vesely	Forgive or Buy Back: An Experimental Study of Debt Relief (September 2007)
n. 18/2007	Joana Pais Ágnes Pintér	School Choice and Information. An Experimental Study on Matching Mechanisms (September 2007)
n. 19/2007	Antonio Cabrales Rosemarie Nagel José V. Rodrìguez Mora	It is Hobbes not Rousseau: An Experiment on Social Insurance (September 2007)
n. 20/2008	Carla Marchese Marcello Montefiori	Voting the public expenditure: an experiment (May 2008)
n. 21/2008	Francesco Farina Niall O'Higgins Patrizia Sbriglia	Eliciting motives for trust and reciprocity by attitudinal and behavioural measures (June 2008)
n. 22/2008	Alessandro Innocenti Alessandra Rufa Jacopo Semmoloni	Cognitive Biases and Gaze Direction: An Experimental Study (June 2008)
n. 23/2008	Astri Hole Drange	How do economists differ from others in distributive situations? (September 2008)
n. 24/2009	Roberto Galbiati Karl Schlag Joël van der Weele	Can Sanctions Induce Pessimism? An Experiment (January 2009)
n. 25/2009	Annamaria Nese Patrizia Sbriglia	Individuals' Voting Choice and Cooperation in Repeated Social Dilemma Games (February 2009)
n. 26/2009	Alessandro Innocenti Antonio Nicita	Virtual vs. Standard Strike: An Experiment (June 2009)
n. 27/2009	Alessandro Innocenti Patrizia Lattarulo Maria Grazia Pazienza	Heuristics and Biases in Travel Mode Choice (December 2009)
n. 28/2010	S.N. O'Higgins Arturo Palomba Patrizia Sbriglia	Second Mover Advantage and Bertrand Dynamic Competition: An Experiment (May 2010)
n. 29/2010	Valeria Faralla Francesca Benuzzi Paolo Nichelli Nicola Dimitri	Gains and Losses in Intertemporal Preferences: A Behavioural Study (June 2010)

n. 30/2010	Angela Dalton Alan Brothers Stephen Walsh Paul Whitney	Expert Elicitation Method Selection Process and Method Comparison (September 2010)
n. 31/2010	Giuseppe Attanasi Aldo Montesano	The Price for Information about Probabilities and its Relation with Capacities (September 2010)
n. 32/2010	Georgios Halkias Flora Kokkinaki	Attention, Memory, and Evaluation of Schema Incongruent Brand Messages: An Empirical Study (September 2010)
n. 33/2010	Valeria Faralla Francesca Benuzzi Fausta Lui Patrizia Baraldi Paolo Nichelli Nicola Dimitri	Gains and Losses: A Common Neural Network for Economic Behaviour (September 2010)
n. 34/2010	Jordi Brandts Orsola Garofalo	Gender Pairings and Accountability Effect (November 2010)
n. 35/2011	Ladislav Čaklović	Conflict Resolution. Risk-As-Feelings Hypothesis. (January 2011)
n. 36/2011	Alessandro Innocenti Chiara Rapallini	Voting by Ballots and Feet in the Laboratory (January 2011)
n. 37/2012	Alessandro Innocenti Tommaso Nannicini Roberto Ricciuti	The Importance of Betting Early (January 2012)
n. 38/2012	Azzurra Ruggeri Konstantinos V. Katsikopoulos	More Does Not Always Lead to Better: Mothers, Young Women, and Girls Generating Causes of a Baby Crying (February 2012)
n. 39/2012	Lory Barile	Does tax evasion affect firms’ internal control? Some evidence from an experimental approach (February 2012)
n. 40/2012	Luigi Luini Annamaria Nese Patrizia Sbriglia	Social Influence in Trustors’ Neighborhoods (July 2012)

n. 41/2012	Simon Halliday	Taking, Punishment and Trust (August 2012)
n. 42/2012	Enrica Carbone Gerardo Infante	Are Groups Better Planners Than Individuals? An Experimental Analysis (December 2012)
n. 43/2012	Enrica Carbone Gerardo Infante	The Effect of a Short Planning Horizon on Intertemporal Consumption Choices (December 2012)
n. 44/2012	Francesco Feri Alessandro Innocenti Paolo Pin	Is There Psychological Pressure in Competitive Environments?(December 2012)
n. 45/2012	Jeffrey V. Butler Enrica Carbone Pierluigi Conzo Giancarlo Spagnolo	Reputation and Entry (December 2012)
n. 46/2013	Valeria Faralla Alessandro Innocenti Eva Venturini	Risk Taking and Social Exposure (July 2013)
n. 47/2013	Valeria Faralla Alessandro Innocenti Stefano Taddei Eva Venturini	Physiological Responses to Stressful Work Situations in Low-Immersive Virtual Environments (July 2013)

LABSI WORKING PAPERS
ISSN 1825-8131 (ONLINE VERSION) 1825-8123 (PRINT VERSION)

LABSI EXPERIMENTAL ECONOMICS LABORATORY
UNIVERSITY OF SIENA
PIAZZA S. FRANCESCO, 7 53100 SIENA (ITALY)
http://www.labsi.org labsi@unisi.it