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Risky choices and emotion-based learning

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ABSTRACT

The paper offers a comprehensive analysis of causes and consequences of the accumulation of emotional experience, measured via skin conductance response, when taking risky choices. A large experimental data set was obtained from a psycho-physiological task conducted with 645 bank customers and financial professionals. With respect to causes, we found that the individual emotional response to gains/losses is trend-dependent and influenced by habituation, as well as by anchoring/framing due to the external layout of risky alternatives. With respect to consequences, we found evidence that the somatic reinforcement experience is able to guide asset picking, but within a long-term strategy. Consequently, selection behaviors were observed in a portfolio mean–variance framework, revealing that somatic markers lead individuals to pursue a long-term 'psycho-economic' efficiency that integrates factual information (monetary outcomes) with the implicit subjective experience.

1. Introduction

A vast literature assigns a role to emotions in human decision-making, as suggested, among others, by Damasio (1994) and Loewenstein (2000). But few studies offer a comprehensive analysis, supported by a large experimental data set, of causes and consequences of the accumulation of emotional experience when taking risky choices, as in the intention of this paper.

At the individual level, any gain or loss obtained after a financial investment is 'subjectively' perceived because each person experiences a unique emotional arousal in response to returns. We propose an algorithm that models this 'money-emotions' relation, controlling for some behavioral features/biases suggested by the literature. We hypothesize that

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the individual emotional response can differ in the gains/losses domain, as a tribute to the prospect theory of Kahneman and Tversky (1979); emotion is trend-dependent and influenced by habituation (Thompson & Spencer, 1966); emotion is also altered by anchoring and framing (Kahneman & Tversky, 1979; Tversky & Kahneman, 1974), due to the external layout of risky choices. This model has been empirically validated thanks to a psycho-physiological task conducted with 645 bank customers and financial professionals (Caucasians, average age 44, range 18–82; 509 males and 136 females); they were asked to take a sequence of 100 risky choices, among four risky assets, while their emotional response to returns was measured via their Skin Conductance Response (SCR). Our experimental data allows validation of the 'money-emotions' relation within dynamic fixed-effects panel estimations.

In the second part of the paper we investigate how emotion shapes investment behaviors and we explore where the emotion-based learning leads, from both asset picking and portfolio perspectives. First, we run probit models to understand how the somatic reinforcement experience is able to induce individuals to select a specific asset, relative to the available alternatives. Evidence that asset selection is driven by a long-term strategy justifies interpreting behaviors within a portfolio framework. In order to overcome the duality of factual information (i.e., the value of money) and the implicit emotional experience marked by physiological arousal, we propose a computation of 'emotional values', intended as emotionally balanced payoffs. They are an attempt to signify the interaction of dual/multiple processes intervening in human decision-making. By applying the mean variance theory (MVT) proposed by Markowitz (1952) to these 'emotional values', we observe the role of somatic markers in mediating risky decisions.

2. Decision-making, emotions and physiological arousal

The idea of 'subjective' perception of returns is grounded in neuroeconomics (among others, Glimcher, 2010; Rustichini, 2005), according to which subjective values are assumed in a cardinal and physiological sense (i.e., numbers); they originate by jointly considering monetary outcomes and the neurophysiological substrate which is experienced when making decisions.

Since the 2000s, exploration of human decision-making has involved neuroscience, which offered support for the existence of several brain systems interacting within a network synchronization, inducing scholars to revisit standard paradigms of choice (Brocas & Carrillo, 2014). The neurophysiology of human decision-making is still under investigation and often relates to monetary rewards and risk (Levy, Snell, Nelson, Rustichini, & Glimcher, 2010).

Knowledge from neuroscience and neurobiology that sketches individuals as organizations of ('as if') cooperating/competing systems (Brocas & Carrillo, 2014) resembles a wide and variegated conceptual framework that outlines human behavior within a 'dual-processes' paradigm. Terms of duality have been differently coined by literature, over the years, according to various disciplines (economics vs. psychology), setting numerous models and/or theories (Gawronski & Creighton, 2013), and based on several criteria (Alós-Ferrer & Strack, 2014; Brocas & Carrillo, 2014): typology of thinking (controlled/reflecti ve/rational vs. impulsive/reflexive/experiential), speed of time-response (slow vs. fast), visibility of information processing (explicit vs. implicit), degree of awareness (conscious, deliberative, effortful vs. unconscious, automatic, effortless), consideration of emotions ('cold' cognitive vs. 'hot' affective).

Within this debate, our paper roots its underpinnings in the evidence of the role of emotions while taking risky choices (among others, Damasio, 1994; Loewenstein, 2000). It stems from the so-called emotion revolution in decision-making studies (Johnson & Weber, 2009), that raised interest in indicators of affective processes, and in measures of emotional arousal, especially for large-scale experiments.

Change in electrodermal activity, and precisely the SCR, is an inexpensive, unobtrusive and reliable measure that serves as a proxy for neural and brain activation (Figner & Murphy, 2011), due to the network synchronization between central and peripheral systems, further evidence of multiplicity of processes involved in human decision-making. Varela, Lachaux, Rodriguez, and Martinerie (2001) uncover a synchronization process that solves a problem called 'large-scale integration' and describe neural mechanisms that select and coordinate this distributed brain activity to produce a flow of adapted and unified cognitive moments. Further studies integrate fMRI (Functional Magnetic Resonance Imaging) with psycho-physiological measures, in particular skin conductance (Wong, Xue, & Bechara, 2011). These authors suggest that psycho-physiological data would complement fMRI findings in providing a more comprehensive understanding of the physiological and neural mechanisms of decision-making.

Even if it is a multifaceted phenomenon, SCR is considered a valuable tool, in judgment and decision-making research, for studying psychological processes related to sympathetic arousal, and affective processes (Figner & Murphy, 2011). SCR is used in this paper to summarize the emotional experience after risky choices. It is a *neutral* measure of the intensity of activation, and it allows a valence-based interpretation (as in Lopes, 1987) only in relation to the sign of the stimulus: e.g., activations after gains should unfold positive emotions (happiness, joy), and after losses should reveal negative emotions (soreness, annoyance), or even a feeling of thrill.

Here, we consider emotions as 'immediate emotions' involved in the act of decision-making (Loewenstein & Lerner, 2003). We point out that our emotion-based learning is assumed in general terms, and it is not directly related to the Somatic Marker Hypothesis (SMH) of Damasio (1994), which would imply the consideration of anticipatory SCR, i.e. the emotional activation *before* risky choice. We disregarded anticipatory SCR, on the one hand, because it is difficult to manipulate emotion affecting judgments or decisions when observing acts before decisions. For example, as indicated by Dunn, Dalgleish, and Lawrence (2006), the physiological marker generated before the choice may not reflect attention to