THE POTENTIAL ROLE OF REGRET IN THE PHYSICIAN–PATIENT RELATIONSHIP: INSIGHTS FROM NEUROECONOMICS

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ABSTRACT

Purpose – *The aim of the chapter is to show how two important facts of physicians' behavior, (i) their tendency to ''create'' the demand for medical practices, and (ii) their delay and reluctance in using new treatments and therapies, can be explained with the lens of the neuroeconomics research on the neural and behavioral basis of regret.*

Methodology – *This chapter adopts a neuroeconomics perspective on decision-making, asking how the brain represents values and generates emotional states, which consequently influence choices. In the line of recent work on emotion-based decision-making, we expect to be able to characterize the brain areas underlying the studied processes and to specify the functional relationship between rational decision-making and the emotional influences that modulate these decisional processes.*

Originality – *Neurobiological approaches can contribute significantly to a better understanding of the cognitive and emotional underpinnings of*

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medical decision-making, from how physicians might evaluate and anticipate the effect of alternative therapies, to how patients might anticipate future consequences of their health choice. This can explain some features of the doctor–patient relationship which are not consistent with simple maximization models.

Findings – *Our findings suggest that physicians' behavior can be often explained by regret avoidance. Likewise, they suggest that physicians play as actual agents when they make medical decisions that will affect the future well-being of their patients.*

Research limitations – *We limited our analysis to the potential role of anticipated regret; therefore, this chapter neglects many important factors of the health sector.*

1. INTRODUCTION

The introduction of neuroscience tools, coupled with increasing evidence on the importance of emotional and social states in economic decision-making, is opening new perspectives in the field of neuroeconomics (Camerer, 2003; McCabe, 2003; Glimcher & Rustichini, 2004; Rustichini, 2005). In this chapter we adopt a neuroeconomics approach on decision-making in the health sector. We propose new hypotheses based on the relationship between cognitive and emotional component during medical decision-making.

Our analysis relies on the study of the behavioral and the neural basis of the emotion of regret and its role in complex decision-making processes, such as those involved in health care decisions.

Two important questions regarding physician–patient interaction can be better understood using the lens of neuroeconomics. Specifically, why do physicians tend to induce the demand for medical practices, and why are they reluctant to introduce new treatments and new therapies? We propose that a possible explanation of these contradictory facts can be found in the role of anticipated regret in the decisions made by the patients and the physicians. We present here a formal model of regret-averse physician behavior and (analogical) evidence from recent neuroeconomics studies that support this possible explanation.

The chapter is organized as follows: the second and third sections briefly describe the psychological and economic theories of regret. The final sections present the theoretical model and the neuroeconomics evidence related to the doctor–patient interaction.

2. THE PSYCHOLOGY OF PERSONAL RESPONSIBILITY

The feeling of responsibility for the consequence of our choices has an important role in decision-making (Zeelenberg et al., 1997). This is particularly AU :1 true when our choice might affect the well-being of others. On one hand, we tend to compare factual or imaginative alternatives, engaging in a mental process called counterfactual (Lewis, 1973; Roese & Olson, 1995; Byrne, 2002). On the other hand, we often "prefer not to know" the outcome of the option that we have rejected, if only for the fact that it might be better than the outcome of our choice (Kahneman & Tversky, 1982). Counterfactuals amplify (Kahneman & Miller, 1986) and in some cases even generate emotional responses (Mellers, Ritov, & Schwartz, 1999; Zeelenberg & van Dijk, 2004).

Humans use strategies to avoid intense negative emotions, and can anticipate the effects of future thinking about "how I would have been better if I had chosen differently." This thinking determines the feeling of regret. Regret is a cognitive-based emotion characterized by the feeling of responsibility for the negative outcome of our choice (Gilovich & Melvec, 1994). Disappointment is the emotion related to an unexpected negative outcome independent of the responsibility component (Bell, 1985; Loomes & Sugden, 1986). Anticipation of regret induces changes in behavioral strategies (Ritov, 1996) and characterizes the learning process in decision-making (Zeelenberg, Beattie, van der Pligt, & de Vries, 1996). Regret results from a decision made and the possibility to compare the obtained outcome with better outcomes of rejected alternatives.

Norm theory by Kahneman and Miller (1986) suggests that the norms used in outcome evaluation are evaluated after the outcome occurs. Kahneman and Miller suggest that the norm is an appropriate context point of reference, used in the evaluation processes. This theoretical concept postulates that an outcome automatically evokes alternatives for comparison, in terms of what could/might have been. The recruited alternative plays as a point of reference for the comparison. The norms of "what might have happened if I had chosen differently" evoke a strong affective reaction, namely regret.

3. ECONOMIC MODELS OF REGRET

Classical economic models of regret suggest (Bell, 1982; Loomes & Sugden, 1982) that incorporating regret into the utility function might reconcile the

utility theory with observed behavior (Allais paradox types of behavior) in decision-making under uncertainty. The main point is that many violations of the axioms of Von Neumann and Morgenstern (1944) expected utility AU :2 theory might be explained by the anticipated regret; thus, a decision-maker might incur in a suboptimal choice in order to avoid future regrettable situations. Monetary assets and a measure of regret are incorporated in a multiattribute utility function. Bell emphasizes the decision aspect of regret. Thus, regret arises from a decision and "is measured as the difference in value between the received assets and the highest level of assets produced by other alternatives (cf. Bell, 1982)." Bell gives this formal definition of the multiattribute utility function:

$$U(x, y) = v(x) + f(v(x) - v(y))$$

where x indicates the final asset x and y is the foregone asset. The utility is a function of the asset value ($v(x)$) and of the regret ($v(x) - v(y)$). These two terms are additive. f is decreasingly concave in the case of regret aversion.

Loomes and Sugden (1982) considered anticipated regret as rational, and regret theory as an "alternative theory of rational choice under uncertainty." They introduced the concept of choiceless utility. Choiceless utility is the utility derived from a certain consequence (outcome) without having chosen. Loomes and Sugden focused on two main points of regret theory: first, the fact that regret is commonly experienced; and, second, that people try to anticipate and avoid the experience of future regret.

Anticipated regret is based on considering choosing an alternative and simultaneously rejecting other alternatives. The type of feedback information is indeed crucial to determining the emotional response, and the decisional process is influenced by the knowledge about the future feedback available.

4. THE ROLE OF REGRET IN THE PHYSICIAN–PATIENT INTERACTION

Feedback information about the success or the failure of different therapies and medical practices is increasingly accessible (there are thousands of web pages dedicated to medical information,[1] informative brochures offered by national and international health care organizations, medical information offered by the media in terms of news, health product updates, and chat forums) to both physicians and patients. Thus, the choice of a therapy and

the simultaneous rejection of other practices represent a scenario where the likelihood of future regret might arise.

Here, we show how two important facts of physicians' behavior can be explained with the lens of the neuroeconomics research on the neural and behavioral basis of regret. First (Fact 1), physicians tend to "create" the demand for medical practices; and, second (Fact 2), they are often slow and sometimes reluctant in using new treatments and therapies.

There are several possible explanations for the first fact (Newhouse, 1970; Feldstein, 1970; Evans, 1974). For instance, Evans (1974) modeled the physician–patient interaction as a game of asymmetric information, in which physicians would prescribe excessive (over the optimal level from the patients' perspective) medical treatments with the only purpose of maximizing their own income. Models of this type underestimate the uncertainty effect and the moral (Arrow, 1963) and reputational considerations that characterize physicians' choice behavior.

We can reasonably assume that even fully opportunistic physicians would not profit from the negative consequences of their choice in terms of reduction of well-being of their patients (which would negatively affect physicians' reputations, careers, and self esteem). We suggest that they might offer more than the optimal level of medical practices in order to avoid possible regret for "not having done enough." The action–inaction effect is an important factor related to the psychology of regret. As shown in Gilovich and Medvec (1994–1995), inaction generates more long-term regret than action. In this specific case, the physician would prescribe more practices than the ones presumably needed in order to avoid the regret of not having done enough for the patient's health. Another important consideration in this context is the fact that patients tend to negatively evaluate (wrongly assuming that the quantity of the offered practices is perfectly correlated with the effort and the skills of their physicians; see Tversky & Kahneman, 1973) physicians that do not prescribe enough medical products according to the patient's perspective. This is often more than what patients really need. In this sense, over-offering is a strategy that matches both the physician and the patient's regret avoidance behavior.

The second fact, the reluctance of physicians to prescribe innovative and more risky medical practices, is highly related to the uncertainty on the efficacy of novel products. Uncertainty on the efficacy of different treatments is a main component of medical choices. Models that consider the uncertainty in the productivity of medical practices better explain physicians' behavior than models based merely on the asymmetric information between physicians and patients and the resulting moral hazard from the physicians' side.

From a different perspective, we can actually consider the asymmetric information, in terms of physicians' (compared to patients) better knowledge of possible consequences of different medical products, as more important for explaining the reluctance of offering new products (Fact 2) than the tendency to create their own demand (Fact 1). In this sense, "knowing that you know more" might induce a higher sense of responsibility. In this chapter we argue that the uncertainty in the efficacy of novel medical products and therapies affects the physician's behavior, inducing regret avoidance choices, such as avoiding practices that might be extremely risky for the patients' health.

Put in these terms, there is an analogy between the physicians' behavior described by Facts 1 and 2, and the behavior of investors during the choice of their pension plan. Both agents, the physicians and the investors, "hedge away from the extremes" in order to minimize their future regret. The "extremes" for the investors are to invest all in the risk-free assets (bonds) or all in the risky assets (stocks). The investors that try to avoid regret would choose a riskier portfolio if the equity premium is low, and a more moderate portfolio if the equity premium is high, compared to the behavior of a risk-averse investor. In other words, the regret-averse investor will hold a positive amount of stocks even if the equity premium is close to zero, and will always hold a positive amount of bonds even though the equity premium is quite large. Similarly, following our interpretation, regret-averse physicians will offer more than optimal levels of standard practices (Fact 1) and at the same time they will be reluctant to offer innovative practices (Fact 2). However, a purely risk-averse physician will offer less-standard practices to avoid the risk of prescribing products that might be dangerous for the patients (e.g., allergy reactions), and he/she will offer a higher level of innovative (low risk) practices compared to a regret-averse physician.

4.1. Formal Model of Regret-Averse Physician Behavior

Formally, we can describe a physician's choice between combinations of levels of standard and innovative therapies, following the model of Muermann, Mitchell, and Volkman (2005) on portfolio selection. We call γ the proportion of standard therapies chosen by the physician. The objective of the physician is to maximize the patient's health level h. The standard therapies give a deterministic return (in terms of health level), while the innovative therapies give a stochastic return. Ex ante, a regret-averse physician would choose the level of γ that maximizes the following equation

(adapted from Maccheroni, Marinacci, & Rustichini, 2006):

$$E[u(h_\gamma) - k\rho(u(\max\ H) - u(h_\gamma))]$$

where, $\rho(u(\max\ H) - u(h_\gamma))$ is the regret term, measured as the difference between the ex-post optimal level of health (max H) and the final level given the choice of $\gamma(h_\gamma)$, with $\rho' > 0$ and $\rho'' > 0$ for regret aversion; k indicates the relative importance of anticipating regret with respect to the mere risk avoidance behavior (described by a $u' > 0$ and $u'' < 0$). Thus, if the physician does not anticipate regret, $k = 0$, he/she will behave as a risk-averse expected utility maximizer.

This model predicts different patterns of behavior according to the level of k. If $k > 0$, thus the physician tries to avoid future regret, he/she will choose to prescribe respectively a larger level of standard practices and less innovative therapies, compared with a risk-averse physician (see Proposition 2 in Muermann et al., 2005).

Behavioral data from Mellers et al. (1999), Camille et al. (2004), and Coricelli et al. (2005) show that anticipated regret is the main determinant of subjects' choice behavior in situations where the subjects know, prior to making a decision, that they will get information about the outcomes of the rejected alternatives (complete feedback). Risk aversion prevails, however, in situations where the feedback on the foregone alternative is not provided (partial feedback). These findings suggest the empirical plausibility of a $k > 0$, and of its theoretical predictions (i.e., excessive standard practices and reduced level of innovative therapies).

4.2. What Might Happen in the Brain of a Regret-Averse Physician?

As we mentioned above, the explanation of the Facts 1 and 2 in terms of physicians' regret avoidance behavior is analogous to the interpretation of the investors' behavior of "hedging away from the extremes" in a pension plan. Given this interpretation, we can conclude that the physicians play as actual agents when they take a medical decision that will affect the future well-being of their patients. The results from a brain imaging study (Coricelli et al., 2005[2]) showed that physiological responses (heart rate) and brain activity are modulated as a function of whether the subject is involved in an actual choice (that is, whether the subject is agent) or is following a computer program choice (where choice is computer-selected, meaning the subject had no agency). Brain structures (many portions of the prefrontal cortex) usually involved in decision-making, and specifically involved in regret processing

(orbitofrontal cortex,[3] anterior cingulated cortex and hippocampus) activated only when the subjects were agents. The influence of personal responsibility on the processing of the outcomes was evident in contrasting outcome-related activity for choose trials (where the subject selected which gamble to ''play'') with follow trials (where ''choice,'' i.e., follow, was computer-selected) (Fig. 1 The effect of agency). Thus, outcome evaluation is influenced by the level of responsibility in the process of choice (agency) and by the available information regarding alternative outcomes (complete or partial feedback).

The explanation of Facts 1 and 2 in terms of anticipated regret supports the hypothesis that physicians might play as ''perfect agents'' during choices that might affect the future health of the patients. Thus, we could expect the physicians' brain activity during medical decision-making to look like the neuronal activity related to agency (i.e., when a subject is taking a decision that will affect his future well-being). We expect a ''transfer'' between patient and physician in terms of actual emotional and cognitive processes. Indeed, just ''following'' patients' directions would not induce the feeling and the anticipation of regret (see Fig. 1), and therefore would not explain the coexistence of Facts 1 and 2.

5. SUMMARY AND CONCLUSIONS

This chapter uses recent findings from neuroeconomics on the neural and theoretical basis of the emotion of regret to explain behavioral facts observed in physician–patients interactions. Regret is an emotion associated with a decision that turns out badly. It is usually elicited by a comparison (counterfactual) between the outcome of choice and the better outcome of rejected alternatives. In the context of medical decision-making, the feedback on the efficacy of different medical practices is almost unavoidable; thus, the prospect of future regret is always present. The behavioral impact of regret is expressed by the fact that people often try to avoid the likelihood of future regret even when this conflicts with the prescription of decision based upon rational choice.

Here we suggest, with the support of neuroeconomics findings, that regret aversion is a good predictor of physicians' behavior. The studies on the neural basis of regret show the involvement of a brain circuitry (orbitofrontal cortex, anterior cingulate, and temporal areas) in the experience and in the anticipation of this cognitive-based emotion. The orbitofrontal cortex is found to play an important role during the entire process of decision-making

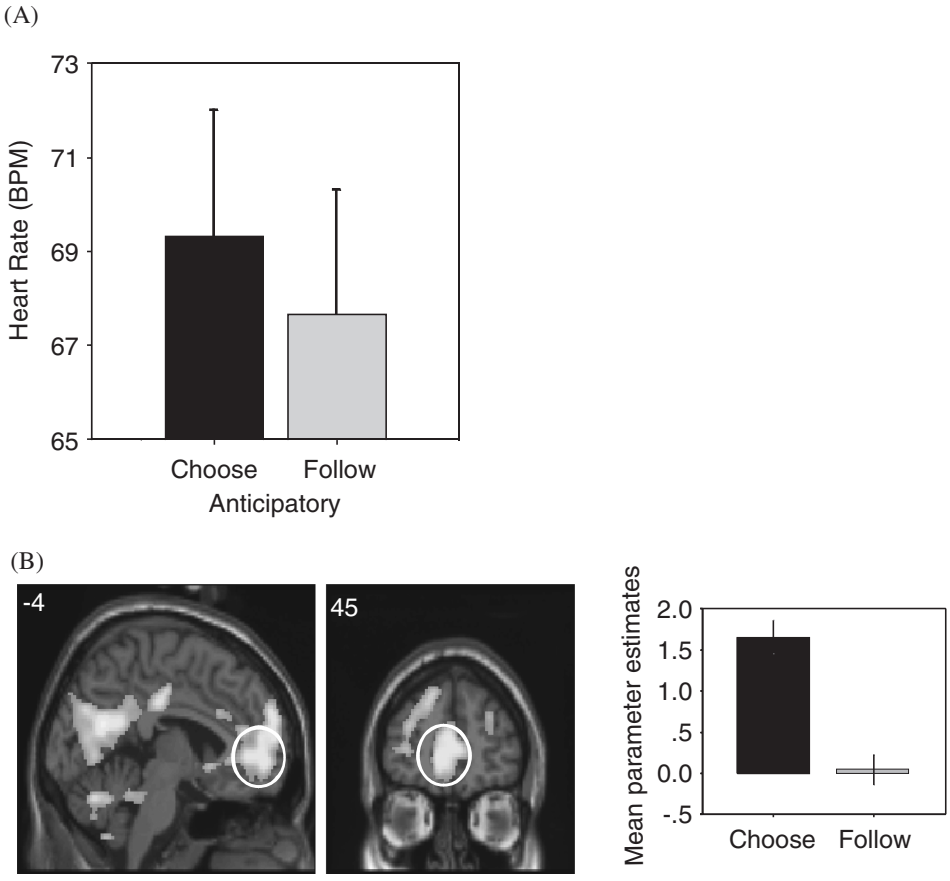

Fig. 1. The Responsibility (Agency) Effect. In Coricelli et al. (2005) Subjects Participated in the Regret Gambling Task. Regret Was Induced by Providing Information Regarding the Outcome of the Unchosen Gamble (Complete Feedback Condition). Half of the Trials Were "Choose" Trials, Where the Subject Had a Choice; the Other Half Were "Follow" Trials, Where the Subjects Were Informed That the Computer Would Randomly Choose One of the Two Gambles. The Follow Trials Were Introduced in Order to Remove Any Feeling of Responsibility. (A) During Task Performance, Subjects' Physiological Responses (Heart Rate) Were Significantly Higher in "Choose" Trials Than in "Follow" Trials ($P = .001$). (B) Irrespective of Whether the Subject Experienced Financial Gain or Loss on a Particular Trial, Responsibility for Selecting the Initial Gamble Influenced the Pattern of Outcome-Related Brain Activity. Notably, Initial Selection between the Gambles (in Contrast to "Following" the Computer-Selected Gamble) Was Associated with Enhancement of Activity in Themedial Prefrontal Cortex (Including Genual Cingulate, Paracingulate, and Mediodorsal Prefrontal Cortices) and the Primary Visual and Anterior Superior Temporal (STG) Cortices. In Contrast, Following Computer-Selected Choices Was Associated with Relative Enhancement of Activity in Thalamus, Supplementary Motor (SMA) and Bilateral Superior Parietal Cortices. This Pattern is Similar to That Observed During Passive Anticipation (Nagai, Critchley, Featherstone, Trimble, & Dolan, 2004). The Agency Effect Was Significant Only for Choose Trials Where the Subject Was Responsible for the Choice, i.e., When the Subject (Rather Than the Computer) Selected between Two Gambles. Group Data (Thresholded at $P<0.001$, Uncorrected) Is Plotted on Sagittal and Coronal Sections of a Normalized Canonical Template Brain. In the Right Panel We Plot the Average Parameter Estimates ($\pm$s.e.m.) for Relative Difference in BOLD Activity at Outcome in Choose and Follow Trials.

in contexts where regret might arise. This particular portion of the prefrontal cortex integrates cognitive and emotional components of decision-making. Results from a recent neuroimaging study (Coricelli et al., 2005) demonstrate how the activity of the regret circuitry is found only when the experimental subject is actually an agent, meaning that he/she is actually taking a decision. It is not activated when the subject is merely following the choice of another agent (the patient). We use this result to suggest that physicians actually play as agent when they are taking decisions that might primarily have consequences for the future of their patients. With this interpretation, we can reconcile apparently contradictory facts of the physicians' behavior, such as their tendency to offer more than the optimal level of standard practices and less than the optimal level of innovative therapies. Thus, we suggest that these less-than-rational medical choices are made in order to avoid the prospect of future regret.

Many important factors of the health sector, such as the effect of different institutions and the health insurance system (Arrow, 1963; Cutler et al., 1998), have been neglected in this chapter. We limited our analysis to a single and specific factor (anticipated regret) that we suggest (see also Thaler, 1980) might explain some features of the doctor–patient relationship which are not consistent with simple maximization models.

UNCITED REFERENCES

Bell (1995); Cutler & Reber (1998); Dolan (2002); Dreher, Kohn, & Berman (2006); Elliott, Friston, & Raymond (2000); Zeelenberg & Beattie (1997).

NOTES

1. For instance, these are the top ten most useful websites listed (in alphabetical order) by the Medical Library Association: Cancer.gov, Centers for Disease Control and Prevention (CDC), familydoctor.org, healthfinder, HIV InSite, Kidshealth, Mayo Clinic, MEDEM: an information partnership of medical societies, MEDLINEplus, and NOAH: New York Online Access to Health.

2. Coricelli et al. (2005) measured brain activity using functional magnetic resonance imaging (fMRI) while subjects selected between two gambles wherein regret was induced by providing information about the outcome of the unchosen gamble. Increasing regret enhanced activity in the medial orbitofrontal region, the dorsal anterior cingulate cortex, and hippocampus. Both, the dorsal portion of the cingulate cortex and the hippocampal activities reveal an underlying cognitive-based declarative process of regret. The portion of the anterior cingulate which was

activated in our task during regret has been identified (meta-analysis) to be a purely cognitive area. And the observed hippocampus activity suggests the presence of a declarative memory activity (the lesson to remember is: ''in the future pay more attention at the consequences of your choice'').

3. The orbitofrontal cortex represents the relative values of different rewards (Rolls, 1999; Rolls, 2000; Breiter, Ahron, Kahneman, Dale, & Shizgal, 2001; O'Doherty, Krigelbach, Rolls, Hornak, & Andrews, 2001; Dreher et al., 2005), and the subjective pleasantness of reinforcers (primary reinforcers, such as food, sex; and secondary, abstract reinforcers, such as money). Neurons in this region of the brain encode the relative values of different choice alternatives (Padoa-Schioppa & Assad, 2006). Tremblay and Schultz (1999) demonstrated how OFC neurons fire when the relatively preferred available reward, between pairs of rewards, is delivered, thus ''revealing'' the monkey preferences. Corroborating results come from a more recent study (Padoa-Schioppa & Assad, 2006), where monkey is asked to choose between combinations of amounts of different rewards. Also in this case, the OFC neurons fire according to the monkey's preference structure and actual choices. This activity of the OFC corresponds to a high-level representational function of the values of external stimuli.

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