



An inclusive taxonomy of behavioral biases

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Abstract. This paper overviews the theoretical and empirical research on behavioral biases and their influence in the literature. To provide a systematic exposition, we present a unified framework that takes the reader through an original taxonomy, based on the reviews of relevant authors in the field. In particular, we establish three broad categories that may be distinguished: heuristics and biases; choices, values and frames; and social factors. We then describe the main biases within each category, and revise the main theoretical and empirical developments, linking each bias with other biases and anomalies that are related to them, according to the literature.

Keywords. Behavioral biases; decision-making; heuristics; framing; prospect theory; social contagion.

JEL classification. D03; G02; G11; G14; G30

1. Introduction

The standard model of rational choice argues that people choose to follow the option that maximizes expected utility. However, this ignores the presence of behavioral biases, i.e. the tendency to reason in certain ways that can lead to systematic deviations from a standard of rationality (Shefrin, 2006). Both psychology and behavioral economics have shown that people are vulnerable to biases and use shortcuts in thinking, exhibit biases in decision-making and frame their decisions, exhibit preference reversals and struggle to commit with their decisions in the past, and they are influenced by others' behavior. This leads to anomalies and decision effects, that is, empirical results that are difficult to rationalize within the paradigm (Khaneman, Knetsch and Thaler, 1991).

This paper surveys the main biases in the behavioral economics and finance, leaving aside their behavioral consequences – anomalies, when they refer to market outcomes or competition among firms, and decision effects, when they refer to people's actions - which, given the number of them and extensive literature, deserve a separate review. The literature of behavioral

biases is so vast and boundless that trying to cover them all in detail would be unfeasible. Thus, and in order to make it particularly helpful for non-initiated readers, we contribute in three instances. First, we provide an original taxonomy that is based on the reviews of relevant authors in the field. We then describe the most significant of those biases, and review the main contributions in regards to the theoretical, empirical and experimental developments. The impact of the contributions was filtered by their number of citations in the Scopus database. Finally, we provide a critical discussion in terms of the biases and anomalies that are linked to them, the lines of open debate and research, as well as the policy implications, according to the literature.

The remainder of the article is laid out as follows: Section 2 provides a taxonomy of biases classified in three groups; Section 3 reviews the main heuristics and judgmental biases; Section 4 is dedicated to choices, values and frames; Section 5 surveys the main social factors; finally, Section 6 analyzes some policy implications of the biases described.

2. Searching for an inclusive taxonomy of behavioral

Most taxonomies of behavioral biases available use diverse classification rules and different names for similar concepts, what makes it difficult to provide an inclusive list satisfying all criteria. To circumvent these limitations, we start from some of the reviews provided by the founders of the field, including some Nobel Prize winners, to end up blending their views in a more inclusive taxonomy. They follow in order.

Kahneman, Slovic and Tversky (1982) list heuristics and biases in seven categories: representativeness, causality and attribution, covariation and control, overconfidence, conservatism, availability, and judgmental biases in risk perception. Tversky and Kahneman (1992) see five major phenomena: framing effects, nonlinear preferences, source dependence, risk seeking and loss aversion. Plous (1993) separates perception, memory, and context; heuristics and biases; framing; models of decision-making; and social effects. Kahneman and Riepe (1998) classify heuristics, errors of preference –loss aversion and prospect theory (PT)- and framing. Rabin (1998) distinguishes mild biases (e.g. loss aversion), severe biases in judgment under uncertainty (e.g. confirmatory bias) and those implying a radical critique of the maximizing utility model (framing effects, preference reversals, and self-control).

Shiller (2000a) includes PT, regret and cognitive dissonance, mental accounting, representativeness, and overconfidence. Mullainathan and Thaler (2000) note three deviations from the standard model (bounded rationality, bounded willpower and bounded self-interest). Barberis and Thaler (2003) label beliefs (e.g. representativeness) and preferences (PT and ambiguity aversion). Camerer and Loewenstein (2004) list probability judgments (e.g. heuristics) and preferences (framing, anchoring, loss aversion, reference dependence, preference reversals, and hyperbolic discounting). Akerlof and Shiller (2009) note five aspects of animal spirits, including feedback mechanisms, attitudes about fairness, and social contagion. DellaVigna (2009) separates non-standard preferences, non-standard beliefs, and non-standard

decision-making. Finally, recent surveys separate investor beliefs and preferences (Sahi, Arora and Dhameja, 2013), sources of judgment and decision biases (Hirshleifer, 2015).

Following the above, our taxonomy separates three categories: heuristics and judgmental biases; choices, values and frames; and social factors. This choice requires some clarification in regards to the terminology used. First, we use the generic term behavioral biases –or, simply, biases- to refer to any of them, while judgmental biases are a specific type of systematic errors that are induced by heuristics. Second, the categories are devised following some authors in particular. We initially followed the spirit of Kahneman and Tversky's work, which distinguishes (i) the heuristics that people use and the biases to which they are prone when judging in an uncertain context, (ii) the prospect theory, as a model of choice under risk, and loss aversion in riskless choice, and (iii) the framing effects (Kahneman, 2003a,b). Then, we merged PT (preferences, broadly speaking) and framing in a single category. We do this following Tversky and Kahneman (1981), who consider two phases in the choice process –an initial of framing and a subsequent of evaluation-, and Barberis and Huang (2009), who suggest framing and prospect theory form a *natural pair*. To name this category, we use the term 'choices, values and frames' following the classical article of Kahneman and Tversky (1984). Finally, we include a third category of social factors, which refer to cultural and social influences on individuals' behavior. Plous (1993), Shefrin (2000), and Hens and Bachmann (2008), among many others, advocate for this category.

3. Heuristics and judgmental biases

Heuristics refer to economic shortcuts for information processing, or simple rules that ignore information (Marewski, Gaissmaier and Gigerenzer, 2010). Since information is vast, disperse, changes continuously and its gathering is costly, people develop rules of thumb to make decisions, what often leads them to make some errors (Shefrin, 2000). Griffin *et al.* (2012) provide a historical overview. In its initial conception, heuristics were restricted to the domain of judgment under uncertainty, a scope later broadened (Kahneman and Frederick, 2002) to a variety of fields that share a common process of *attribute substitution*. In other words, "difficult judgments are made by substituting conceptually or semantically related assessments that are simpler and more readily accessible" (Kahneman and Frederick, 2005: 287).

Open debate

Researchers focus on whether and when people rely on heuristics (e.g. Cokely and Kelley, 2009) or how accurate they are for predicting uncertain events (e.g. Ortmann *et al.*, 2008). However, two contrary views prevail. Authors like Gigerenzer and Gaissmaier (2011) argue that heuristics are efficient shortcuts for inference, adaptive strategies that evolved in tandem with fundamental psychological mechanisms (Goldstein and Gigerenzer, 2002). No rule is assumed to be rational *per se*; what matters is to understand when a given heuristic performs better –a

concept named *ecological rationality*. Contrariwise, other authors identify two cognitive systems, reason and intuition, being the latter norm. In these dual-process theories (Kahneman and Frederick, 2005), heuristics would be the fast, intuitive, affect-driven and effortless cognitive system. Through the process of attribution substitution, a target attribute of the judged object is substituted by a heuristic attribute, and since the target and heuristic attributes are different, it induces systematic errors in judgment and decision, known as judgmental biases. Currently, the debate stands between those who observe a natural tendency to make errors – e.g. Lacetera, Pope and Sydnor (2014) show heuristics matter even in markets with easily observed information - and those who favor the ecological rationality – e.g. Norman *et al.* (2014) see that encouraging increasing attention to analytical thinking does not improve diagnostic accuracy.

In Table 1 we collect some relevant heuristics and the judgmental biases associated to them. Since both concepts specify how agents form expectations, there are authors who merge them in the same category. Nonetheless, most researchers — e.g. the original approach by Tversky and Kahneman (1974) — consider first the heuristics people use, and then the biases they lead to.

3.1 Availability heuristic

Availability is an information selection bias where the probability of an event is estimated by the ease with which occurrences can be brought to mind (Tversky and Kahneman, 1973). Due to our limited attention, memory and processing capacities, we make decisions based on subsets of information that are easily available. The heuristic contributes to judgmental biases such as attention anomalies and an overreaction to new information (Hens and Bachmann, 2008), and the hindsight bias (Camerer and Loewenstein, 2004).

Related judgmental biases

Attention is a scarce resource and our ability to process information limited. An **attention bias** follows if the attributes that catch our attention are not critical, leading to suboptimal choices. Memory has a limited capacity, too, so it works by reconstruction. A **hindsight bias** may result as a side-effect: in hindsight we exaggerate what we might have anticipated in foresight (Fischhoff, 1982). The availability heuristic contributes to the bias, because events that occurred are easier to imagine than counterfactual ones (Camerer and Loewenstein, 2004). Classic articles include Odean (1999) on the attention bias and the excessive trading in financial markets, Barber and Odean (2008) on three indicators of attention for stock investors, and Pan and Statman (2010), who suggest that the hindsight bias amplifies regret.

Table 1. Heuristics and judgmental biases.

HEURISTIC	JUDGMENTAL BIASES	Related concepts	Literature
AVAILABILITY	ATTENTION BIAS	Overreaction Earnings announcement drift	<i>Availability and overreaction to new info (Hens and Bachmann, 2008)</i> <i>Hirshleifer and Teoh (2003): Attention and earnings drift</i>
	HINDSIGHT BIAS		<i>Camerer and Loewenstein (2004): Availability contributes to hindsight bias</i>
REPRESENTATIVENESS	LAW OF SMALL NUMBERS	Gambler's fallacy	<i>Tversky & Kahneman (1974): Gambler's fallacy and Law of small numbers</i>
		Hot hand fallacy	<i>Rabin and Vayanos (2010)</i>
	Extrapolation bias	Momentum and reversals	<i>Hens and Bachmann (2008): Extrapolation bias and representativeness</i>
	BASE RATE NEGLECT	Cognitive dissonance	<i>Tversky and Kahneman (1982a)</i>
	ILLUSION OF VALIDITY		<i>Tversky and Kahneman (1974)</i>
	CAUSALITY AND ATTRIBUTION		<i>Kahneman et al. (1982)</i>
	CONJUNCTION &		
ANCHORING-AND-ADJUSTMENT	DISJUNCTION FALLACIES	Reference points	<i>Conjunction fallacy firstly considered a consequence of anchoring, but of representativeness after Tversky and Kahneman (1983).</i> <i>Anchoring falls from the heuristics list (Kahneman and Frederick, 2002)</i>
AFFECT	RISK-AS-FEELINGS		<i>Finucane et al. (2000)</i>
FAMILIARITY	AVERSION TO AMBIGUITY	Status quo bias	<i>Familiarity, aversion to ambiguity and status quo bias (Ackert et al., 2005)</i>
RECOGNITION HEURISTIC		Endowment effect	<i>Recognition (Gigerenzer et al., 1991), fluency (Marewski et al., 2010)</i>
FLUENCY HEURISTIC		Home bias, underdiversif.	<i>Seiler et al. (2013): Familiarity and home bias</i>
	(EXCESSIVE) OPTIMISM	Wishful thinking	<i>Barberis and Thaler (2003)</i>
	OVERCONFIDENCE	SELF ATTRIBUTION BIAS	<i>Moore and Healy (2008)</i> <i>Daniel et al. (1998): Self-attribution and cognitive dissonance</i> <i>Odean (1998): Overconfidence and under/overreaction</i>
		CONFIRMATION BIAS	<i>Griffin and Tversky (1992): Illusion of validity and confirmation bias</i>
		ILLUSION OF CONTROL	<i>Shefrin (2000): Illusion of control and overconfidence</i>

Open debate

The clash between the efficient and the inefficient shortcut views stands on whether the availability heuristic is useful to assess probability because instances of large classes are better recalled, or it leads to decision biases since it is affected by factors other than frequency –e.g. imagination, familiarity and salience. Thus, Heath, Larrick and Klayman (1998) argue its effects are ubiquitous because of a lack of experience with unusual events. Instead, the efficient approach suggests that results like the hindsight bias, rather than a reconstruction of the prior judgment, is a by-product of the adaptive process of updating of knowledge after feedback (Hoffrage, Hertwing and Gigerenzer, 2000).

Recent research on the availability heuristic shows its effect on social media (Chou and Edge, 2012). The attention bias might explain the post-earnings announcement drift (Hirshleifer and Teoh, 2003) and the accruals anomaly (Battalio *et al.*, 2012), though Cready *et al.* (2014) criticize the spurious effects attributable to misclassification of transactions. Recent research on the hindsight bias includes theoretical (Roese and Vohs, 2012) and experimental research – Chelley-Steeley, Kluger and Steeley (2015) obtain positive results, Calvillo (2014) highlights individual differences.

3.2 Representativeness heuristic

Tversky and Kahneman (1983) define representativeness as the degree of correspondence between an outcome and a model. It implies a tendency to rely on stereotypes, particularly when it comes to estimating probabilities (Shleifer, 2000). Hence, the representativeness heuristic explains several biases of judgment under uncertainty. We see them next.

Related judgmental biases

One intuition people have about random sampling is the **law of small numbers**, a tendency to exaggerate how closely a small sample will resemble the parent population (Tversky and Kahneman, 1971). Linked to representativeness after Tversky and Kahneman (1974), it leads to a gambler's fallacy (Rabin, 1998), a belief in the hot hand fallacy (Rabin, 2002), and the extrapolation bias (Shefrin, 2000). The **gambler's fallacy** is a classic misconception of what regression to the mean implies: a belief that random sequences should exhibit systematic reversals (Rabin and Vayanos, 2010). Similarly, a **hot hand fallacy** implies a failure to appreciate statistical independence, but involves instead the belief in an excessive persistence rather than reversals. Related to that, the **extrapolation bias** suggests that people bet on trends (Shefrin, 2000).

The lack of expertise in probability assessment is related to two other biases. Prior probabilities (base-rate frequencies) play a key role in probability assessment but none on

representativeness, implying a **base rate neglect** (Tversky and Kahneman, 1974). Prendergast and Stole (1996) relate it to a cognitive dissonance reduction, where individuals overweight their own information. Moreover, a **conjunction fallacy** appears when people believe the probability of a conjunction of two events is greater than that of one of its constituents. Bar-Hillel (1973) set an antecedent, though the fallacy is original of Tversky and Kahneman (1982b) and their classic *Linda experiment*. Finally, two additional judgmental biases related to the representativeness heuristic are an **illusion of validity**, when the confidence people have in their predictions depends on the degree of representativeness (Einhorn and Hogarth 1978), and **causality and attribution**, when people attempt to infer the causes of the effects observed and incur in errors related to salience, availability and representativeness –after attribution theory by Weiner (1985).

Open debate

Recent advances in the study of representativeness include a memory-based model of probabilistic inference by Gennaioli and Shleifer (2010), and empirical evidence of a Bayesian updating failure (Alós-Ferrer and Hügelschäfer, 2012). There is also consistent evidence of most judgmental biases in different instances. Thus, Huber, Kirchler and Stöckl (2010) obtain experimental evidence of a gambler's fallacy effect in investment decisions, while Rieger (2012) and Erceg and Galic (2014) perform experimental tests of the effects of conjunction and disjunction fallacies on markets. Liberali *et al.* (2012) explore the mechanisms underlying how individual differences in numeracy lead to these biases.

Notwithstanding, a controversial judgmental bias today is the base rate neglect (Gigerenzer, 1991). First, it seems in contradiction to the widespread belief that judgments are affected by stereotypes (Landman and Manis, 1983). Besides, in regards to the efficient shortcuts debate, Cosmides and Tooby (1990) rephrased in a frequentist way the questions in the experimental research of Tversky and Kahneman (1982a), and found the base-rate fallacy disappeared. A recent contribution by Pennycook *et al.* (2014) offers a mixed interpretation: though base rates are indeed neglected, they may be accessible through intuitive reasoning. Other minor sources of disagreement include whether men (Suetens and Tyran, 2012) or women (Stöckl *et al.*, 2015) are more prone to display a hot hand fallacy.

3.3 Affect heuristic

The list of heuristics changed after the concept of attribution substitution was introduced by Kahneman and Frederick (2002). On one hand, anchoring did not fit as a heuristic anymore, as it does not work through the substitution of one attribute for another. Ever since, most authors (e.g. Camerer and Loewenstein, 2004) label it as an *error of preference* that derives from the existence of reference points (see Section 4). On the other hand, it put the *affect heuristic* (Finucane *et al.*, 2000) on the list. The heuristic is driven by affect, a natural assessment,

automatically computed and always accessible, so the basic evaluative attribute (e.g. good/bad, like/dislike) is a candidate for substitution in any task that calls for a favorable or unfavorable response.

Open debate

Failing to identify the affect heuristic “reflects the narrowly cognitive focus that characterized psychology for some decades. There is now compelling evidence that every stimulus evokes an affective evaluation” (Kahneman and Frederick, 2002: 55). Affect provides a faster intuition than retrieving from memory. Recent contributions include theoretical (Haack, Pfarrer and Scherer, 2014) and experimental (Pachur and Galesic, 2013; Jaspersen and Aseervatham, 2015). A sideline theory is the model of **risk-as-feelings** (Loewenstein et al., 2001, Slovic et al., 2002), an alternative to cognitive theories of choice under risk that emphasizes the role affect plays: beliefs about risk would be expressions of emotion that often diverge from cognitive assessments. Lupton (2013) further elaborates the theory, arguing that both emotion and risk judgments are collectively configured via social and cultural processes.

3.4 Familiarity

Familiarity is the most common name in the literature to refer to a set of emotionally and cognitively driven heuristics. On one hand, there is evidence we make decisions based on the degree of closeness we feel about different alternatives. Thus, familiarity is related to fear of change and the unknown (Cao et al., 2011) and to ambiguity aversion. On the other, the recognition (Gigerenzer, Hoffrage and Kleinbölting, 1991), and fluency heuristics (Marewski et al., 2010) show that the reasons for familiarity may be cognitive as well.

Heuristics and related judgmental biases

Two processes govern the **recognition heuristic**, recognition and evaluation. Recognition is the capacity to make inferences in cases of limited knowledge (Goldstein and Gigerenzer, 2002: 75): “If one of two objects is recognized and the other is not, recognition heuristic infers that the recognized object has the higher value with respect to the criterion”. Evaluation judges the heuristic as ecologically rational whenever the recognition validity for a given criterion is much higher than chance. It allows people to benefit from ignorance by making inferences from memory and patterns of missing knowledge. In case two alternatives are recognized, the **fluency heuristic** fills the gap: if one alternative is recognized faster than another, the heuristic infers the one with the higher value (Schooler and Hertwig, 2005). Schwikert and Curran (2014) analyze the memory processes that contribute to the recognition and fluency heuristics.

Related to familiarity is an **aversion to ambiguity** (Ackert et al., 2005). If ambiguity is the uncertainty about uncertainties (Einhorn and Hogarth, 1986), ambiguity aversion describes a

preference for known over unknown risks, as shown in the Ellsberg paradox (Thaler, 1983). Early papers include Fellner (1961), who introduced decision weights.

Open debate

Recent advances to understand how familiarity and ambiguity aversion operate include neurogenetic studies (Chew, Ebstein and Zhong, 2012). They would help explain anomalies such as the status quo bias (Ackert *et al.*, 2005), underdiversification (Boyle *et al.*, 2012), and their implications on insurance (Alary, Gollier and Treich, 2013) and asset pricing (Füllbrunn, Rau and Weitzel, 2014). However, this is an open field of research, as contradictory results were obtained. Roca, Hogarth and Maule (2006) show that the status quo bias could lead to ambiguity seeking, and Einhorn and Hogarth (1986) specify some conditions for ambiguity seeking and avoidance. Etner, Jeleva and Tallon (2012) provide a review on advances in the field.

Regarding recognition, being the most frugal heuristics (Goldstein and Gigerenzer, 1999), the debate centers around its efficiency: if ignorance is systematically distributed, recognition and criterion are correlated and the heuristic leads to efficient results. Schooler and Hertwig (2005) suggest a beneficial forgetting, where loss of information aids inference heuristics that exploit mnemonic information, while Ortman *et al.* (2008) get mixed results when analyzing how the heuristic performs in portfolio management. Gigerenzer and Goldstein (2011) survey the literature.

3.5 Excessive optimism and Overconfidence

Excessive optimism and overconfidence are two of the most relevant heuristic-driven biases. However, they are often confounded in the literature. Indeed, overconfidence may refer to different concepts, what added more noise to the debate. Optimists overestimate favorable outcomes and underestimate unfavorable ones (Shefrin, 2006). Overconfidence, instead, may refer to three different concepts (Moore and Healy, 2008): *overestimation* in estimating our own performance; *overplacement* (better-than-average effect) in estimating our own performance relative to others; and *overprecision*, an excessive precision to estimate future uncertainty, what entails a miscalibration of subjective probabilities.

Open debate

Behaviorists suggest it is heuristics and cognitive biases that cause the overconfidence phenomenon. However, two alternative views are the Brunswikian or ecological models (Gigerenzer *et al.*, 1991), according to which people are good judges of the reliability of their knowledge as long as such knowledge is representatively sampled, and Thurstonian or error models (Erev, Wallsten and Budescu, 1994), which interpret overconfidence as merely an

illusion, created by unrecognized regression. Despite its popularity, the behaviorist interpretation does not provide a clear answer on which heuristics or biases drive excessive optimism and overconfidence. Some authors suggest they may have evolved under natural selection, while others allege drivers such as the illusion of validity (Rabin and Schrag, 1999), the hindsight bias (Fischhoff, 1982), and a confirmation bias (Koriat, Lichtenstein and Fischhoff, 1980) for overconfidence, and affect (Bracha and Brown, 2012), self-attribution bias (Lovallo and Kahneman, 2003), as well as wishful thinking and overconfidence itself (Barberis and Thaler, 2003), for overoptimism.

Many models in finance use overconfidence to explain over and underreaction (Daniel, Hirshleifer and Subrahmanyam, 1998), asset bubbles (Scheinkman and Xiong, 2003) and excessive trading volume (Odean, 1998). It also helps explain the forward premium puzzle (Burnside *et al.*, 2011) and sensation seeking (Grinblatt and Keloharju, 2009). Research on managerial overconfidence is a classic as well, causing excessive business entry (Camerer and Lovallo, 1999) and high rates of MandAs (Malmendier and Tate, 2005).

Related judgmental biases

People exhibit a **self-attribution bias** when they attribute to their ability events that validate their actions, while attribute contrary evidence to external noise or sabotage (Bem, 1965). Daniel *et al.* (1998) relates it to cognitive dissonance. A **confirmation bias** is observed when, once formed a strong hypothesis, people pay attention to news that support their views and ignore those that contradict them. Griffin and Tversky (1992) link it to the illusion of validity to induce overconfidence. Finally, people exhibit an **illusion of control** when they behave as though chance events were subject to their control (Langer, 1975).

Some anomalies attributed to be consequence of a biased self-attribution are feedback effects that may cause over and underreaction (Daniel *et al.*, 1998), and the spread of *stories* that is essential in the formation of speculative bubbles (Shiller, 2003). Recent literature includes Libby and Rennekamp (2012) and Troye and Supphellen (2012). Empirical tests on the confirmation bias include Duong, Pescetto and Santamaria (2014) on investors' use of financial information. Finally, recent research on the illusion of validity includes Cowley, Briley and Farrell (2015).

4. Choices, values and frames

The second group of behavioral biases follows Tversky and Kahneman (1981, 1992), who consider two phases in the choice process: an initial of framing and a subsequent of evaluation. Regarding framing, behaviorists have shown that people do not choose in a comprehensively inclusive context as the rational-agent model predicts. In particular, invariance –i.e., the fact that preferences are not affected by inconsequential variations in the description of outcomes (Kahneman, 2003a)- is violated, since alternative descriptions lead to different choices by only

altering the salience of different features. Framing effects include a variety of biases related to two classics in the literature: frame dependence and mental accounting (Thaler, 1985).

In regards to evaluation, we have prospect theory (PT) on one hand (Kahneman and Tversky, 1979), a descriptive theory of choice that explains how individuals evaluate the outcomes of risky prospects and choose in consequence. On the other, the empirical evidence that people make inconsistent choices in decisions over time led to the literature on intertemporal preferences, which started with problems of self-control (Thaler and Shefrin, 1981). Framing, PT, intertemporal preferences, and the biases related to them are listed in Table 2, and reviewed below.

Table 2. Choices: Framing and preferences.

FRAMING & PREFERENCES		Related Concepts	Literature
Framing	FRAME DEPENDENCE	Narrow framing	Equity premium puzzle Loss aversion Money illusion <i>Barberis and Huang (2007): Narrow framing, equity premium puzzle</i> <i>Tversky and Kahneman (1986)</i> <i>Kahneman et al. (1986a)</i>
		Context dependence	<i>Tversky and Simonson (1993)</i>
		Repeated gambles	<i>Kahneman and Riepe (1998)</i>
	MENTAL ACCOUNTING	Hedonic editing	House money effect Self-control <i>Thaler (1999)</i> <i>Thaler and Shefrin (1981)</i>
	Choice bracketing	<i>Choice bracketing (Read et al. 1999)</i>	
Prospect Theory	REFERENCE DEPENDENCE	ANCHORING-AND-ADJUSTMENT	Conservatism <i>Anchoring not heuristic, related to reference points (Rabin, 1998)</i> <i>Conservatism: Chan et al. (1996)</i>
	LOSS AVERSION	Myopic loss aversion	<i>Benartzi and Thaler (1995)</i>
	DIMINISHING SENSITIVITY	Risk seeking	Aversion to a sure loss Favorite longshot bias <i>Shefrin (2006)</i> <i>Tversky and Kahneman (1992)</i>
Intertemporal preferences	PREFERENCE REVERSALS	Projection bias	<i>Projection bias: Loewenstein et al. (2003)</i>
		Self control	Precommitment <i>Self-control: Loewenstein (1996)</i>
		Hyperbolic discounting	Present bias <i>Frederick et al. (2002)</i>

4.1 Frame dependence

Framing, defined as a decision-maker’s conception of the acts, outcomes and contingencies associated with a particular choice (Tversky and Kahneman, 1981), may produce predictable shifts of preference when the problem is framed differently — a result known as frame dependence. A basic principle is the passive acceptance of the formulation given (Rabin, 1998). Framing influences loss aversion and diminishing sensitivity – see PT below. Thus, a frame that highlights losses makes a choice less attractive, while if it makes them small relative to the scales involved it exploits diminishing sensitivity, making the choice attractive (Tversky and

Kahneman, 1986). Besides, related to frame dependence are the concepts of narrow framing, context effects, repeated gambles and hedonic editing. We see them next.

Related concepts

Narrow framing (Kahneman and Lovallo, 1993) is the tendency to analyze problems in a specific context without reflection of broader considerations (Hirshleifer and Teoh, 2003), such as evaluating risks in isolation, apart from others they already face (Barberis and Huang, 2009). **Context dependence** (Tversky and Simonson, 1993) appears when an individual's preferences among options depend on which other options are in the set (Camerer and Loewenstein, 2004), in a way that adding or subtracting options in a menu may affect the choice. The literature review of Rooderkerk, van Heerde and Bijmolt (2011) observes a robust evidence of three types of context effects. Kahneman and Riepe (1998) show that most people do not distinguish between one-time choices and **repeated gambles**, setting the same cash-equivalent in both cases despite the fact that statistical aggregation reduce the relative risk of a series of gambles. Benartzi and Thaler (1999) relate the bias to myopic loss aversion.

Open debate

Recent articles include lab experiments (Schlüter and Vollan, 2015) as well as field research (Hossain and List, 2012), both with positive results. However, Cason and Plott (2014) identify four aspects that contribute to the tension between standard preference theory and the theory of framing. Some asset pricing models incorporate narrow framing, such as Barberis and Huang (2009) and De Giorgi and Legg (2012). In addition, it help explain market anomalies such as the equity premium puzzle (Barberis and Huang, 2007). Finally, Cornelissen and Werner (2014) reviews framing in the management literature.

Evidence of choice effects includes empirical (Hu and Li, 2011) and experimental research (Carlsson and Martinsson, 2008). In addition, Bordalo, Gennaioli and Shleifer (2012, 2013) analyze the effects of salience in context-dependent consumer choice and choice under risk. Finally, regarding repeated gambles, Liu and Colman (2009) compare them with ambiguity aversion, and Lejarraga and Gonzalez (2011) observe that decision makers neglect descriptive information when they can learn from experience.

4.2 Mental accounting

Closely related to framing, mental accounting refers to the implicit methods that individuals use to code and evaluate transactions, keeping track of and evaluating them like financial accounting in firms (Thaler, 2008). Statman (1999: 19) puts it briefly that people think "some money is retirement money, some is fun money, some is college education money, and some is vacation money". Thaler (1985, 1999) explains people engage in mental accounting activities in

three instances: how outcomes are perceived and decisions are made, how activities are assigned to specific accounts, and the frequency with which accounts are evaluated.

Related concepts

Related to both frame dependence and mental accounting, **hedonic editing** refers to the evidence that people code combinations of events in a way it makes them happier (Thaler, 1999). Thaler and Johnson (1990) provided a theory. **Choice bracketing** refers to the grouping of individual choices into sets (Read, Loewenstein and Rabin, 1999). Narrow bracketing leads to myopic risk seeking (Haisley, Mostafa and Loewenstein, 2008) and myopic loss aversion (Hardin and Looney, 2012).

Open debate

Positive empirical results of mental accounting include consumption, when it is temporally separated from purchase (Shafir and Thaler, 2006), and experimental evidence about inventory decisions (Chen, Kök and Tong, 2013). Models based on the mental accounting principle include the behavioral portfolio theory (Shefrin and Statman, 2000; Das *et al.*, 2010). Pan and Statman (2010) obtain empirical evidence of risk attitude changing across mental accounts of growth and value investments. Finally, recent research includes Sul, Kim and Choi (2013), who compare hedonic editing to subjective well-being, and Koch and Nafzinger (2016), who develop a model of endogenous bracketing where people set either narrow or broad bracketing to tackle self-control problems.

4.3 Prospect theory

Prospect theory is the best known descriptive theory of decision-making under risk. For a closest insight in such an extensive literature we recommend Barberis (2013). In short, according to PT, individuals evaluate the outcomes of risky prospects through a value function, where the carriers of value are changes in wealth compared to a reference point rather than final assets, and a probability weighting function, where probabilities are replaced by decision weights –in accordance with the empirical fact that people tend to put much weight on rare events.

Tversky and Kahneman (1992) developed an extended version, cumulative prospect theory. It accounts for a fourfold pattern of risk attitudes confirmed by experimental evidence: people tend to exhibit risk aversion for gains but risk seeking for losses of high probability, and risk seeking for gains but risk aversion for losses of low probability. In addition, a value function that is steeper for losses than for gains implies loss aversion. Thus, three features are essential: reference dependence (the carriers of value are gains and losses defined relative to a reference point), loss aversion (the value function is steeper in the negative than in the positive domain)

and diminishing sensitivity (the marginal value of both gains and losses decreases with their size). This results in a value function that is kinked at the reference point, concave above and convex below, and represents investor's loss aversion. Moreover, diminishing sensitivity applies to the weighting function as well. These three features are analyzed separately in what follows.

4.3.1 Reference dependence

In PT, it is not final states what carries utility and matters for choice, but changes relative to a reference point. Reference dependence is closely related to diminishing sensitivity and loss aversion, and induces two classic behavioral biases, namely, anchoring and conservatism.

Related concepts

Anchoring-and-adjustment is a key judgmental bias in risk perception. Tversky and Kahneman (1974: 1128) first described it as "people make estimates by starting from an initial value that is adjusted to yield the final answer", an adjustment that is often insufficient. Anchoring and reference dependence help to explain decision effects such as the classic status quo bias (Tversky and Kahneman, 1991). Besides, **conservatism**, defined as the slow updating of models in face of new evidence (Shleifer, 2000), explains why markets often respond gradually to new information, what might explain the profitability of momentum strategies (Chan, Jegadeesh and Lakonishok, 1996).

Open debate

Though there is extensive evidence that perception is reference dependent, the debate continues in different instances. First, in terms of how reference points are set. Common candidates include the buying price in stock markets (Shefrin and Statman, 1985) and the subject's rational expectations given the economic environment (Kőszegi and Rabin, 2006). However, Koop and Johnson (2012) provide experimental evidence of multiple reference points in risky decision-making, and Schmidt and Zank (2012) provide a model of endogenous reference points. Second, reference points may change over time, following gains and losses. Arkes *et al.* (2008) observe an asymmetric adaptation that suggests hedonic editing: the magnitude of the adaptation is significantly greater following a gain than after a loss of equivalent size. Baucells, Weber and Welfens (2011) find reference points are not recursive, in the sense that the new one is not a combination of the previous one and the new information. Arkes *et al.* (2010) analyze how cultural differences influence reference point adaptation.

The debate on anchoring is even better. A first wave of research, which assumed that the reference point was given in the formulation of the problem, is over (Epley and Gilovich (2010). Epley and Gilovich (2001, 2006) found anchoring effects for self-generated anchors, hence a second wave of research searched the psychological mechanisms that produce them.

Frederick, Kahneman and Mochon (2010) provide a theory. Finally, a third wave makes predictions on the consequences of anchoring. Furnham and Boo (2011) provide a review. Regarding conservatism, recent research relates return predictability in stock markets to GAAP conservatism principle (Ball, Kothari and Nikolaev, 2013).

4.3.2 Loss aversion

Subjects assign more significance to losses than to gains with respect to the reference point. This asymmetry in the value function implies loss aversion: people suffer a loss more acutely than they enjoy a gain of the same magnitude. However, this represents a contradiction to rational choice, because the basic property of expected utility theory that two indifference curves never intersect no longer holds (Knetsch, 1989). The influence of loss aversion in choices is observed in different contexts (see Novemsky and Kahneman, 2005), and it may explain empirical findings like the disposition effect (Shefrin and Statman, 1985) and why consumers and managers may take fewer risks (Rabin, 2000).

Related concepts

The combination of loss aversion and the investors' common habit of evaluating their portfolios frequently is known as **myopic loss aversion** (Benartzi and Thaler, 1995). Thaler *et al.* (1997) provided empirical evidence. Langer and Weber (2005) extend the concept to *myopic prospect theory*: when myopic loss aversion combines with diminishing sensitivity and probability weighting, the effect of myopia might increase the willingness to invest.

Open debate

There is plenty of literature, including Kahneman and Tversky's research, exposing the impact of loss aversion. Moreover, Cesarini *et al.* (2012) show loss aversion is moderately heritable. However, some limits were identified. Three examples follow. First, exchange goods given up as intended, like money paid in purchases, do not exhibit loss aversion (Novemsky and Kahneman, 2005). Second, there is mixed evidence of loss aversion on feelings, because judging feelings does not necessarily require comparison (McGraw *et al.*, 2010). Third, Polman (2012) shows loss aversion is lessened when we choose for others. Finally, regarding myopic loss aversion, Gneezy, Kapteyn and Potters (2003) provide experimental evidence, and Fellner and Sutter (2009) discuss debiasing techniques.

4.3.3 Diminishing sensitivity

Marginal effects in perceived well-being are greater for changes close to the reference level than for changes further away (Rabin 1998). This third essential feature of prospect theory

applies to both the value and weighting functions. Noting diminishing sensitivity is a pervasive pattern of human perception, Kahneman and Tversky (1979) conjectured the value function would be concave for gains and convex for losses –the latter implying risk seeking to avoid losses. Regarding the weighting function, diminishing sensitivity entails that the impact of a given change in probability diminishes with its distance from two natural boundaries, certainty and impossibility, the endpoints of the scale (Tversky and Kahneman, 1992). Consequently, risk-seeking choices are observed in two instances: the aversion to a sure loss, which stems from the shape of the value function, and the favorite-longshot bias –a miscalibration of probabilities often related to the weighting function.

Related concepts

The aversion to a sure loss is a risk-seeking choice in the negative domain. Most people are risk averse, but only when confronted with the expectation of a financial gain. Instead, when facing the possibility of losing money, they behave as risk lovers, choosing to accept an actuarially unfair risk in an attempt to avoid a sure loss (Shefrin, 2006). The *favorite-longshot bias* is commonly observed in betting markets. Bettors put too much weight on rare events (longshot bets) and underestimate the probability of favorites, making the expected return on longshot bets systematically lower than on favorite bets (Ottaviani and Sorensen, 2007).

Open debate

The favorite-longshot bias is one of the most studied biases. Firstly documented in horse-race betting (Griffith, 1949), recent studies include derivatives markets (Hodges, Tompkins and Ziemba, 2008), prediction markets (Page and Clemen, 2013), and sports (Lahvicka, 2014). The debate centers around its rationale, including misestimation of probabilities, informational asymmetries (Shin, 1992), and limited arbitrage (Ottaviani and Sorensen, 2007). Regarding the aversion to a sure loss, researchers are more focused on its interpretation. Adam and Kroll (2012) suggest decision makers perceive lotteries as dynamic processes where emotions may lead to attraction to chance, while Schwager and Rothermund (2013) provide evidence on the effects of framing and attention bias.

4.4 Preference reversals

Intertemporal preferences are rational if they are time consistent. However, empirical evidence shows people do exhibit reversals, have problems to commit with decisions they took in the past, and exhibit present-biased preferences. We see these concepts together under the epigraph of preference reversals, which include problems of self-control, and a present bias in intertemporal decision-making.

Related concepts

Standard models compare preferences over time with exponential discounting, implying time consistency and 100% short-term patience. However, there is evidence that people exhibit a **present bias or hyperbolic discounting**, as preferences typically reverse with changes in delay (Kirby and Herrnstein, 1995). Related to such reversals is a **projection bias**: people exaggerate the degree to which their future tastes will be similar to their current ones, what makes them save less than originally planned as time passes (Loewenstein, O'Donoghue and Rabin, 2003). **Self-control (and precommitment)** relates to that, as being aware in advance that our preferences may change, we sometimes make certain decisions to restrict our own future flexibility (Loewenstein, 1996).

Open debate

A classic review by Frederick, Loewenstein and O'Donoghue (2002) observes cross-study differences in discount rates, against the assumption of a single rate under exponential discounting. However, the debate continues today. Andersen *et al.* (2008) showed that a joint estimation of risk and time preferences is required, so the discounting anomalies previously observed had to be re-tested. Andersen *et al.* (2014) find no evidence favorable to hyperbolic discounting. Recent advances include a model of preference reversals (Tsetsos, Chater and Usher 2012), and the work of Stevens (2016), who suggests people do not discount, rather they compare within attributes (amounts and delays). Recent research includes Zeisberger, Vrecko and Langer (2015) about the projection bias, and on self-control an experimental research by Burger, Charness and Lynham (2011) and an interpretation of the cash-credit co-holding puzzle (Gatherwood and Weber, 2014).

5. Social factors

The last category compiles the items that refer to the impact of cultural and social factors on individual's behavior. This is the least developed and structured body of literature in the behavioral economics and finance, but according to Hirshleifer (2015: 133): "the time has come to move beyond behavioral finance to social finance, which studies the structure of social interactions, how financial ideas spread and evolve, and how social processes affect financial outcomes.". The social factors are shown in Table 3 and reviewed below.

Table 3. Social factors.

SOCIAL FACTORS		Related Concepts	Literature
GLOBAL CULTURE	Cultural differences		<i>Guiso et al. (2006); Statman and Weng (2010)</i>
SOCIAL CONTAGION	Obediency to authority Communal reinforcement & Groupthink	Herd behavior (Collective) Confirmation bias	<i>Social contagion: Asch (1952). Herding: Shiller (2000b)</i> <i>Shiller (1984); Janis (1972)</i> <i>Shefrin and Cervellati (2011)</i>
STATUS, SOCIAL COMPARISON		Self esteem, Pride, Prejudice Cooperation, altruism	Rabin (1998)
FAIRNESS AND JUSTICE			Kahneman et al. (1986a,b)
GREED AND FEAR		Familiarity Status quo bias	<i>Fear of the unknown and familiarity bias (Cao et al., 2011)</i> <i>Fear of change and status quo bias (Samuelson & Zeckhauser, 1988)</i>
INFORMATIONAL CASCADES	Availability cascades	Asset bubbles Herding	<i>Shiller (2002b): Cascades and bubbles</i> <i>Bikhchandani et al (1998): Cascades and herding</i>

5.1 Global culture

Culture is the values that ethnic, religious, and social groups transmit across generations (Statman and Weng, 2010). Shiller (2000a) notices the emergence of a global culture in a convergence of fashions across countries separated by physical and language barriers, and suggests these cultural factors help explain the dot-com bubble. Stulz and Williamson (2003) claim culture may affect finance through the country values, institutions, and how resources are allocated.

Related social factors

Though a global culture might be emerging, **cultural differences** are also ubiquitous. The best studied case is perhaps the differences between East Asians and Americans. Thus, East Asians exhibit a broader perceptual and conceptual view of the world and live in more complex social networks (Nisbett and Masuda, 2003), and they exhibit different patterns in terms of overconfidence and the disposition effect (Chen *et al.*, 2007).

Open debate

Culture has had a significant influence on social psychology (e.g. Miller, 1984), but economists were reluctant to use it as an explanatory factor because of the vague and ubiquitous ways it can enter the economic discourse, making it difficult to design testable hypotheses (Guiso, Sapienza and Zingales, 2006). Recent techniques and data made it possible to identify

systematic differences in people's beliefs, and relate them to their cultural legacy (e.g. Levinson and Peng, 2007). Some authors have analyzed how it affects expectations and preferences. These include Henrich *et al.* (2001) on variations across tribes in the ultimatum and dictator games, and Hoff and Priyanka (2004) who show the effects of social inequality linger: beliefs that are the legacy of extreme inequality for generations determine individual's expectations that reproduce the inequality.

Studies on cultural differences in economic and financial variables include Statman and Weng (2010), who find different borrowing and investing patterns of immigrants long after they settled in their new countries, and Beugelsdijk and Frijns (2010), who show that the degree of cultural distance between two countries affects foreign asset allocations. Recent literature analyzes the effects on corporate structure (Bloom, Sadun and van Reenen, 2015), innovation rates (Taylor and Wilson, 2012), and corporate MandAs (Ahern, Daminelli and Fracassi, 2015).

5.2 Social contagion

Research on cultural differences focuses on inherited, slow-moving components of societies, while social interaction focuses on peer group effects that can be viewed as the fast-moving component of culture (Guiso *et al.*, 2006). The antecedents in the study of social contagion are the experiment of Sherif (1937) on the *autokinetic effect*, and the classic experiments of Asch (1952).

Related social factors

A classic in the literature is **obedience to authority**. The experiments of Milgram (1963) showed few people have the initiative to resist authority, to the point of performing acts that violate their deepest moral beliefs. Years before, Festinger (1957) analyzed the effects of forced compliance, showing that a person forced to do something contrary to her opinion may change her view in order to avoid cognitive dissonance. **Communal reinforcement** is a type of social dynamics related to social learning and the psychology of individual suggestibility (Katona, 1901). Shiller (1984) gives the example of investors who follow gurus, read magazines, discuss investments with other investors... and through this process, market psychology influences markets. **Groupthink** is the tendency of cohesive groups to reach consensus without offering, seeking or considering alternative hypotheses (Lunenburg, 2010). Janis (1972) identifies some symptoms, like an excessive risk-taking, and members imposing themselves a self-censorship to avoid appearing as a dissenter. Shefrin and Cervellati (2011) interpret it as a form of collective confirmation bias.

Open debate

Likewise other social factors, there is an increasing interest in the recent decades for the study of social contagion. Nonetheless, the literature review by Manski (2000) suggests that the neoclassical view, where non-market interactions are not of interest, ended by the 1970s with the adoption of non-cooperative dynamic game theory. Recent contributions include empirical research by Rapp *et al.* (2013), and experimental studies on viral marketing (Aral and Walker, 2014). In regards to obedience to authority and social contagion, there are two opposite views. The classic one highlights the negative impact they have in financial markets, like herding and asset bubbles (e.g. Shiller, 2000b). Contrariwise, Ent and Baumeister (2014) observe that obedience to legitimate authority may be positive, encouraging individuals to set aside their selfish desires for the good of the group. Recent research includes Mayo-Wilson, Zollman and Danks (2012) on individual and group rationality, and the model by Nofsinger (2012) on asset bubbles fueled by groupthink.

5.3 Status, envy and social comparison

A field of social psychology relevant to economics is the self-perception compared to others, and the feelings of jealousy, self-esteem, pride and prejudice such comparison provokes. We denote this category *status, envy and social comparisons* following Rabin (1998). Not all feelings stemming from social comparisons are negative, as cooperation (Argyle, 1991) and reciprocal altruism (Trivers, 1971) may be included here.

Open debate

Early literature already suggested that social comparison occurs in many forms of human interaction, including social status (Ball and Eckel, 1998), reciprocity and altruism (Gilbert, Price and Allan, 1995), and consumer dissatisfaction, when they compare themselves with the idealized advertising images (Richins, 1991). More recently, researchers have focused on testing, whether in the lab or in the field, motivations and effects of social comparison and cooperative behavior. These include experimental tests of the effects of social status (Ball *et al.*, 2001), and the motivations for pro-social behavior (Carpenter and Myers, 2010).

5.4 Fairness and justice

Fairness and justice were recurrently absent from standard economic theory, a striking contrast when compared to other social sciences (Kahneman, Knetsch and Thaler, 1986b). We first find fairness in the literature of efficiency wages, as well as in the literature of customer markets (Okun, 1981). Three reasons related to fairness why people are willing to spend money are in order to punish others who have harmed them, to reward those who have helped, or to make

outcomes fairer (Camerer and Loewenstein, 2004). Fairness and justice are related to behavioral effects like money illusion (Kahneman, Knetsch and Thaler, 1986a) and helps to determine people's reference prices (Thaler, 1985).

Open debate

The classic approach to trace evidence of decisions based on fairness and justice analysis is using dictator and ultimatum games (Güth, Schmittberger and Schwarze, 1982). Camerer and Thaler (1995) provide a review on ultimatum games and List (2007) on dictator games. Researchers focus on topics like moral values (Sen, 1995), equity and competition (Bolton and Ockenfels, 2000), perceptions of fairness (Nguyen and Klaus, 2013), and inequality and preferences for redistribution (Durante, Putterman and van der Weele, 2014).

5.5 Greed and fear

Being emotional factors, greed and fear might indeed be related to the affect heuristic in Section 3. However, we opt to classify them as social factors because these biases tend to appear when individuals interact with each other. Two related biases are fear of the unknown, an explanation for the familiarity heuristic (Cao *et al.*, 2011), and fear of change, a possible explanation for the status quo bias (Samuelson and Zeckhauser, 1988).

Open debate

The effects of greed and fear are particularly pervasive in financial markets, where they are alleged to play a key role in concepts like market sentiment, bubbles and crashes, and others. Indeed, Shefrin (2000) identifies human emotions as determinants of risk tolerance and portfolio choice. Pan and Statman (2010) show risk tolerance varies with test conditions and the emotions associated to them. Lo, Repin and Steenbarger (2005) offer experimental evidence of a negative correlation between successful trading and emotional reactivity. Despite these results, the effects of emotions over market efficiency are far from being widely accepted. For instance, Shleifer (2004) asserts that the unethical behavior blamed to stem from greed is often a consequence of market competition. Recent research on greed and fear includes Lee and Andrade (2011), who show social projection explains why fear leads to early sell-off in a stock market simulation, and Cohn *et al.*(2015), who provide experimental evidence that fear may play an important role in countercyclical risk aversion.

5.6 Informational cascades

We learn by observing what others do, and then we imitate them. Imitation would be an evolutionary adaptation for survival, allowing individuals to take advantage of the hard-won information of others. Significant market events only occur if large groups of people think the same, and news media might act as precipitators of attention cascades and the spread of ideas. Some phenomena such as herding, fads, asset bubbles and crashes might be consequence of informational cascades (Bikhchandani, Hirshleifer and Welch, 1998).

Related social factors

Availability cascades are self-reinforcing processes of collective belief formation that have a combination of informational and reputational motives as driving factors (Kuran and Sunstein, 1999). By the availability heuristic, people judge the importance of a theme according to their ability to remember examples of it. Then, as a chain reaction result, the more people talk about an issue the more relevant it seems due to its rising availability in public discourse, leading to a self-reinforcing cycle (Hirshleifer, 2008).

Open debate

A line of research today in process focuses on theoretical modeling of the disruptive or corrective nature of informational cascades. For instance, Wu (2015) suggests that the probability of wrong cascades decreases if laymen are among a group of experts, while the model of Rubin (2014) suggests that cascades inducing larger shocks are more likely to happen in regimes with centralized coercive power.

6. Conclusions and policy implications

The impact of behavioral biases in financial and consumer markets has many implications for the way in which these markets work. However, there is no consensus on how to address this issue from a public policy intervention perspective. There are three basic approaches –namely, debiasing techniques, liberal paternalism, and active policy-making- and all of them have supporters and detractors.

The logic behind **debiasing** is, if people make biased decisions (positive economics) from what is standard rationality (normative economics), perhaps we may help them to choose better. Croskerry, Singhal and Mamede (2013) provide a recent discussion on several approaches towards debiasing. The idea itself makes no sense for some authors, either under the interpretation of the ecological rationality of the heuristics (Gigerenzer and Gaissmaier, 2011), or the contrary: when the limitations of the normative model have become so obvious, it is nonsense to insist upon changing humanity to conform to it (Frankfurter, McGoun and Allen,

2004). Others advocate for improving financial literacy (e.g. Altman, 2012), while for other authors there is evidence that learning and expertise may do little to eliminate biases (Rabin, 1998) or even might exacerbate errors (Griffin and Tversky, 1992). In any case, debiasing would require intervention, since there are many reasons to doubt individuals can debias themselves (Kahneman, 2003b). Two approaches are trying to increase motivation to perform well, and setting strategies that are closer to normative standards –known as prescriptive decision making.

Liberal paternalism (Thaler and Sunstein, 2003) is a smoother approach for prescriptive debiasing. It criticizes the assumption that people always make choices that are in their best interest, and explores different methods to help consumers and investors improving their decision making and enhance their well-being (see Ratner *et al.*, 2008). While being paternalistic in the sense that it seeks to help people make *better* choices, it is liberal in the sense that it also respects freedom of choice. For such purpose, it exploits the passive acceptance of the formulation given (e.g. the status quo bias) or it uses some behavioral traits by the decision maker to reduce other biases –for instance, mental accounting and framing to mitigate self-control problems (Thaler and Shefrin, 1981).

Although behavioral biases may affect consumer decisions or lead to anticompetitive behavior by firms, some authors discredit paternalism and oppose **public intervention**. Cooper and Kovacic (2012) provide a model that depicts how greater state intervention, especially if oriented to correct firm biases, is likely to lead regulators to adopt policies closer to the preferences of political overseers, either intentionally, or accidentally (due to bounded rationality). The same interpretation would follow in financial markets. Behaviorists such as Daniel, Hirshleifer and Teoh (2002) observe that the same psychological biases that affect investors would affect regulators. Rather than correcting market pricing errors, for which they do not have a competitive advantage, they advocate for regulators establishing *ex ante* rules to improve efficiency, such as default-option-setting regulations.

To conclude, some examples of recent literature of behavioral biases and policy implications follow in order. Briley, Shrum and Wyer (2013) analyze representativeness and its effect on public policy. Some theoretical models interpret excessive optimism as a key factor behind credit booms (e.g. Peón, Antelo and Calvo, 2015), and observe a similar bias in governments' official forecasts (Frankel and Schreger, 2013). Givoni *et al.* (2013) offer a heuristic framework to improve the effectiveness of policy interventions. The empirical analysis of Hossain and List (2012) suggests some alternatives to increase productivity in factories through simple framing manipulations, while Bao *et al.* (2015) draw policy lessons from mental accounting: authorities often overestimate the traffic of high tolled roads because travelers with low out-of-pocket travel budget perceive a much higher cost. Finally, research on social factors includes the effects of culture on innovation rates (Taylor and Wilson, 2012) and of social contagion: Pacheco (2012) models how public opinion influences policy diffusion. Besides, altruism and volunteering may be negatively affected by public policies: Ariely, Bracha and Meier (2009) show that extrinsic incentives can reduce charitable donations and volunteering as they dilute the signaling value of

pro-social behavior. Finally, Shleifer (2004) observes ethics and efficiency go together when ethical norms promote cooperative behavior, helping for the successful functioning of social institutions.

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