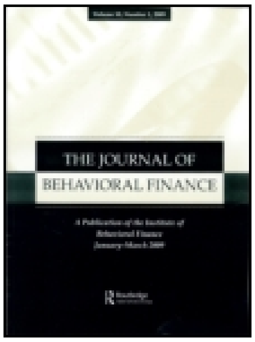

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Wealth Maximization in the Context of Blind Trust – A Neurobiological Research

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This paper reviews the paradigm of financial decision making as being oblivious to sentiments such as blind trust. It is based on a recent neurobiological study in which participants' brains were scanned using functional magnetic resonance imaging (fMRI) technology. The study was devised on the tenets of the consolidated model of financial predation (CMFP). It is shown that participants do not target profit maximization concurrently with cost minimization when put in a situation of blind trust. Trust is revealed as a multidimensional construct having mathematical links with other constructs such as perceived predation, cooperation and reward.

Keywords: Perceived predation, Consolidated model of financial predation (CMFP), Financial predators, Risk, Blind trust, Functional magnetic resonance imaging (*f*MRI)

INTRODUCTION

Scandals after scandals have shaken the trust highly educated or regular investors have had in the financial and banking systems (Rajan [2010]). In fact, these scandals are not new—the 1929 market collapse being an example of past events. White-collar crimes are part of our everyday life (Zwajkowski [1985], McKechnie and Howell [1998]), but not enough is known about the intricate behavioral components of this looming danger (Shapiro and Bruchell [2012]). A salesperson (e.g., a financial expert) can indeed turn out to be a threat (Stratford [1996], see Reimann and Zimbardo [2011]) or generate fear (Verbeke and Bagozzi [2001]). In some cases, potential preys will see their automatic defense mechanism being awakened (Hinds et al. [2010]), while in other cases they will stick to blind trust only to realize later than they have been fooled. Those kinds of sentiments have been the subject of recent discussions in financial literature (Garcia [2013]) and deserve further attention.

Despite the awareness of multiple market bubbles such as the so-called predatory mortgages of 2008 (subprime) whereby people lost their life savings (Hellwig [2009], Lastra and Wood [2010]), jobs, and eventually lifestyles, would-be investors continue to pour into the market, gambling wild sums of money in the hope of making a quick and considerable return on their investment. Often, those people fall prey to smart financial advisors who have designed schemes to lure them and acquire their hard-earned money. Bernard Madoff can be viewed as a case in point (Markopoulos [2005], Sander [2009], Gregoriou and Lhabitant [2009]). Everything suggests that the predator-prey mechanism in financial markets emulates, at a human level, what is seen in the animal kingdom (see Lorenz and Leyhausen [1973], Zimbardo [2007]). The downfall of one by way of life investment losses serves the selfish interest of the other, much like in a Darwinian scenario (see Eyuboglu and Buja [2007]) in order to achieve a global balance in the financial ecosystem. Studies have shown that consumers do indeed perceive themselves as vulnerable and potential or real victims (Fournier et al. [2001], Svensson [2004]) while at times fearing rejection (Pietrzak, Downey, and Ayduk [2005]). Their confidence in the system is shaken (McKechnie and Howell [1998]) yet they keep believing in their good fortune. On the other hand, financial experts can at times hide behind market uncertainty to justify their poor results since external randomness is a key characteristic of financial markets (Vranceanu Sutan, and Dubart [2012]). Indeed, much research remains to be done to better

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understand investors' attitudes and feelings toward investment decisions in terms of blind trust.

Risk has of course been known for decades to be a key determinant of financial decision making (Ayadi [2010], Vartanian, Mandel, and Duncan [2011], Hull [2012]), but the financial clientele rightfully expects its financial advisors to be able to handle risk, not to be part of it. In reality, some financial advisors are indeed part of the risk: they are predators looming their clients' and organizations' wealth.

There is an element of blind trust in the way large and small investors behave. As put forth by Fetchenhauer and Dunning ([2009], p. 264): "People trust others even when there is no guarantee that the trustee will respond benevolently." From a neurobiological point of view, blind trust may be seen as a necessary condition for stability. As pointed out by Raichle ([2011], p. 7): "Operating largely non-consciously, brains seek predictable regularities from impoverished information and implement organized, learned responses while retaining the ability to pause, adapt, and learn anew."

However, trust that goes "too far" (Bechara and Gupta [1999], p. 182) has its dangers. From being under the constraints of cognition, it could well be that it turns into an overly emotional construct (so-called affect-based trust—see, e.g., McAllister [1995], Chuaa, Morris, and Mor [2012]) that entices clients to forget about the risks financial advisors can sometimes represent. In fact, research tends to show that "trust decisions are not tightly connected to a person's risk attitudes" (Houser, Schunk, and Winter [2010], p. 72). In other words, people who accept to take risk are not correspondingly changing their trust level toward others with whom they are dealing. According to these same authors (Houser et al. [2010]), trust operates in the extremes (full trust *vs.* no trust) whereas risk taking (which is an appreciation of potential danger, or potential predation) operates in small increments. Hence, it may well be that blind trust follows a natural tendency to trust in full.

Once trust is breached, however, it is very difficult to gain back. The questions therefore are: 1) Do people tend to invest their money on the basis of blind trust? 2) In case the answer to this question is "yes," what can be done to improve trust toward financial and banking institutions? These questions are important because a large part of our daily interactions relate to monetary concerns, and because people's trust toward others varies whether issues at stake involve money or are general. In fact, some studies show that people tend to trust more when money is involved (Fetchenhauer and Dunning [2009]). As can be expected, it has also been found that there is a significant correlation between the trustworthiness rating of a partner in an investment game and the amount of money transferred to that partner (Van't Wout and Sanfey [2008]). Under given conditions, the mere presence of money seems to promote trust and trust fuels monetary exchanges.

The present paper relies heavily on the consolidated model of financial predation (CMFP)[1] and is grounded in neurobiological evidence. Other papers have been proposed along these lines (Venkatraman et al. [2012], Witt and Binder [2013]) and as such, the present effort falls into a new, richer trend of investigation.

There is an inherent drive towards predation in humans (McEllistrem [2003]), which is expressed in the financial world not as a drive to kill but to take unreasonable risks and to betray others for one's own benefits, much like in a war game (Wolfson and Shabahang [1991]). In the case of financial predators, excessive if not malevolent risks are often taken. Research in repeated investment games tends to show that people will sooner or later act in their own self-interest when engaged in ongoing investment decisions, eventually leaving aside some or all sense of fairness; they act in this manner as they discover that the other negotiating party is becoming more confident (Cochard, Nguyen Van, and Willinger [2004]). The present multidisciplinary effort is not new in the financial literature: for example, Shiv et al. [2005] conducted a study in which dysfunctional patients were shown to make more rewarding financial decisions than nondysfunctional participants because they were less conservative, that is, not as sensitive to risk. In the real world of financial experts, taking risks is expected. As expected, high returns, which is what most people want, is unlikely to achieve without taking high risks (Maymin and Fisher [2011]). McClure et al. [2004] conducted an *f*MRI study showing the role of dopaminergic pathways for immediate reward and of the prefrontal cortex for delayed reward; these results are much in line with the CMFP (see the works of Mesly 2010–2013) as "functional psychopaths" are thought to be able to delay reward (Mesly [2013]).

Studies that merge economic behavior and neuroscience are termed "neuroeconomics" and offer to better understand how "the human brain generates decisions in economic and social contexts" (Fehr et al. [2005], p. 346; see also Camerer, Loewenstein, and Prelec [2005]). In short, multidisciplinarity helps reinforcing the strength of conclusions reached once studies are completed (Maxwell [1997]).

However, studies on interpersonal relationships found in the sales literature are few and far between (Liljander and Roos [2002]) and, in fact, may even be altogether lacking in the financial literature when it comes to blind trust. Williamson's theory [1975], which deals with transaction costs and opportunism, is essentially based on contracts (Malhotra and Murnighan [2002]) rather than on blind trust and remains untested to some level (Wathne and Heide [2000]). The majority of agency theory research examines the contractual relationship between a principal and its own agents (Eisenhardt [1989], Santos, Vegas, and Barkoulas [2007]). The present paper is focused on interpersonal relationships rather than on contractual terms, and on blind trust.

THE CONSOLIDATED MODEL OF FINANCIAL PREDATION (CMFP)

The so-called consolidated model of financial predation (CMFP) in its simplified and more complex formats is displayed as follows (Figures 1 and 2). Annex A provides the neurobiological equivalent to this model.

The marketing level corresponds to long-term circumstances[2] (weeks of interactions between clients and financial advisors) whereas the neurobiological level seen in this model is measured from milliseconds to minutes. In the CMFP, the hypothalamic-pituitary-adrenalin (HPA) axis forms the backbone of the predatory experience (see Mesly [2013]).

According to the CMFP, individuals adopt a share of predator and prey positions, which then forms perceived predation. Trust is under the direct influence from perceived predation (a construct used in ethology: see Johnsson, Rydeborg, and Sundström [2004], Smith [1998]). It is under the indirect influence of dependence[3] (Mesly and Lévy-Mangin [2013]). Perceived predation is to interpersonal relations what perceived risk is to consumer-product relationship—it refers to potential "harmful action" (Wangenheim and Bayón [2007]).

The hypothalamus contains encoded (or "encapsulated"—Woody and Szechtman [2011]; "adaptive responses"—Mobbs et al. [2009], p. 12236) behaviors that have been conserved from phylogenetic ancestors (MacLaren, Best, and Bigney [2010]) and that go against the establishment of trust. Those behaviors include (1) predatory aggression[4] (Adams [2006]) as well as (2) defensive rage (Bear et al., 1996), fleeing, and freezing (Siegel and Sapru [2011]). These are respectively referred to as the predatory and the prey positions (from neurobiological and marketing perspectives).

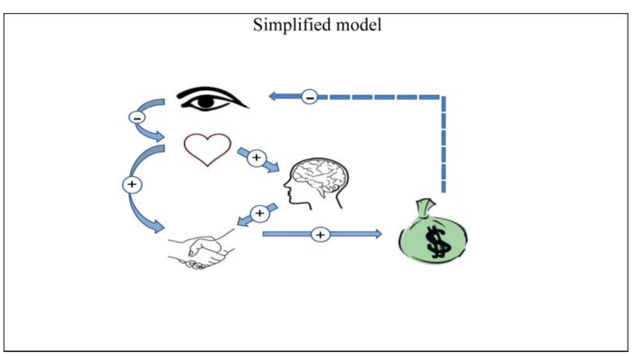

FIGURE 1 The simplified consolidated model of financial predation (CMFP)

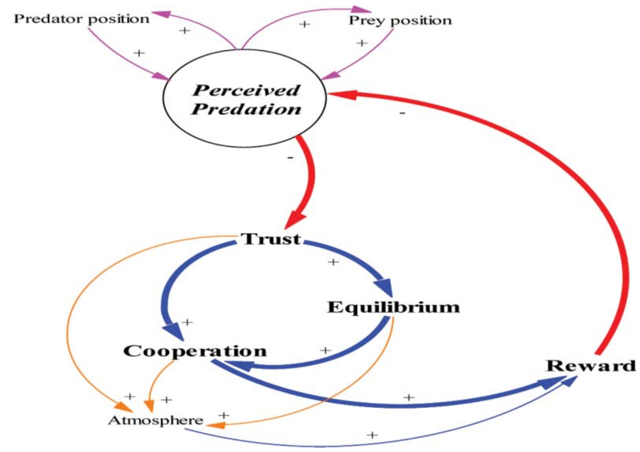

FIGURE 2 The dynamic consolidated model of financial predation (CMFP). *Note.* The CMFP actually unfolds in two ways. The marketing level is expressed in figure 2 using dynamic system modeling (see Sterman [2000]); it has found some similarities in recent studies (see Ayadi [2010], Romani, Grappi, and Dalli [2012]). The CMFP has been tested numerous times using structural equation modeling (SEM–see the works of Mesly 2010–2013) with strong results. Use of SEM in neurobiological science has indeed been found useful (Alvarez et al. [2008]) and has proven to provide additional support to the marketing model, hence the name "consolidated model of financial predation" (CMFP). The neurobiological level is displayed in Annex A.

Equilibrium refers to a sense of win-win (Anderson and Weitz [1989]; see also Bolton and Ockenfels [2000]), which acts as a mediating variable[5] between trust and cooperation (see Baron and Kenny [1986], Gneezy [2005]). Inasmuch as predatory contexts lead to four pre-programmed behaviors (predation, rage, flight, or freeze), the search for equilibrium also involves four key behavioral patterns: 1) reciprocating good deeds, 2) rejecting unfair proposals, 3) enforce obedience to social norms of reciprocity even at costs (Wischniewski et al. [2009]); and 4), tit-for-tat (Friedman and Singh [2009]).

Brain activation related to trust also includes areas dedicated to reward processing and calculation of fairness[6]. Trust is inferred in the case of positive reciprocity (win-win) whereas fear is more likely to be experienced in tit-for-tat games, that is, in case of negative reciprocity (Cox, Sadiraj, and Sadiraj [2008]). Weighing the pros and cons of a relationship presents the advantage of offering better protection in the event that the relationship turns unexpectedly sour (Petty, Unnava, and Strathman [1991]).

Equilibrium reinforces the willingness to cooperate as an equal amount of benefits and costs is shared between dyadic actors (Lengnick-Hall and Wolff [1999]) and eventually works towards establishing trust. It has been found that perceived predation has an indirect influence on cooperation (see Rosebloom et al. [2007]) and that trust and cooperation tend to work hand-in-hand (Anderson and Narus [1990], Larson [1992], Wiener and Doescher [1994], Palmatier et al. [2006], Brooks and Rose [2008]). Even when facing difficult situations, clients often continue to trust their financial advisers and to cooperate with them, when in fact common sense would tell them otherwise (Wiener and Doescher [1994])—once blind trust is gained, it is hard to undo. When financial success (as a form of reward) is part of the equation between clients and their financial advisors, trust tends to develop even more strongly (Jones and George [1998]).

Numerous studies (see the works of Mesly 2010–2013) have shown that trust, equilibrium and cooperation work together to form the interactional atmosphere in which clients and financial advisors behave. This atmosphere can be positive, thus rewarding, or else go sour and lead to conflict.

The Mathematics of Blind Trust

The CMFP model, which is anchored in neurobiological mechanisms, shows that as perceived predation increases, trust, cooperation and equilibrium diminish, leading to a lower sense of reward, which in turn increases the sense of perceived predation (the feeling that there is a potential for being abused, by surprise).[7,8] On the opposite side, as perceived predation decreases, levels of trust, cooperation and equilibrium improve, leading to a more rewarding experience.

Trust has been defined in the literature by four so-called "structural" variables[9,10] (see Ganesan [1994], Ravald and Grönroos [1996], Doney and Cannon [1997], Smith [1998], Nicholson, Compeau, and Sethi [2001], Svensson [2001], Bell, Oppenheimer, and Bastien [2002], Gurviez and Korchia [2002], Wood, Boles, and Babin [2008], Mallalieu and Nakamoto [2008]), the most salient one being integrity. It is part of a complex neurobiological structure that involves an emotional component[11] which is also known to be activated when an individual is confronted to an untrustworthy face (Winston, Strange, and O'Doherty Dolan [2002]). Emotions, indeed, "move markets and market events have an emotional impact on traders" and interact with cognitive and behavioral functions, as well as with perception (Fenton-O'Creevy et al. [2012], p. 227).

The neurobiological structure thus also involves a cognitive component,[12] including measurement of fairness[13]. Finally, the structure has a behavioral/social component.[14,15]

Trust cannot merely be built by running ads on TV praising how friendly financial or banking institutions are. It is a complex construct that connects with many constructs, an expression of brain areas that connect to other specific brain areas. In addition, the establishment of trust between a client and her/his financial advisor requires the partial mobilization of inputs such as essential and nonessential resources (e.g., money or a computer) and some levels of effort (e.g., understanding complex financial terms) and know-how (e.g., how to generate trust)[16].

There are mathematical links serving as tenets between all constructs pertaining to the consolidated model of financial predation (CMFP), including trust, which are expressed as follows (Table 1):

TABLE 1
Summary of Key Mathematical Functions in the Consolidated Model of Financial Predation (CMFP)

Constructs links Type of link	Mathematical functions related to trust	S.
Perceived predation (PP) and trust: *I-*	PP = 1/**Trust** = 1/ (1-vulnerability) or more exactly PP = P(x) = k/x	1
Dependence and perceived predation-trust: *moderator I±*	**Trust**(x) = – i + k x if i ≤ x ≤ 50 **Trust**(x) = (100−i) – k x if 50 ≤ x ≤ (100−i) Trust(x) = 0 Otherwise x = predator profile	2
Trust and cooperation: *I+*	Cooperation = 0.3 + 0.9 **Trust** + ε (given set conditions) Or Cooperation = (k−1) + (k−0.1) **Trust** + ε (given set conditions)	3
Equilibrium and **trust**-cooperation: *I+, I+*	Mediating variable (in a statistical sense)	4
Cooperation and atmosphere (satisfaction): *C+*	Atmosphere = $\alpha + \beta$ Cooperation + ε Or Atmosphere = $\alpha + \beta$ * (((k−1) + (k−0.1) **Trust** + ε) + ε) And:Atmosphere$_{t+1}$ (≈ Satisfaction $_{t+1}$) = trust$_t$ + β Cooperation $_{t+1}$ + ε $_{t+1}$	5
Satisfaction (an expression of reward) and perceived predation: *t*	Anger $_{t+1}$ = k anger$_t$ (1-anger$_t$) where anger is considered to be a proxy for the reverse of satisfaction, within set minimum and maximum thresholds, so that: Anger $_{t+1}$ = (k/Satisfaction$_t$)* (1−(1/ Satisfaction$_t$)) Or Anger $_{t+1}$ = (k/ ($\alpha + \beta$ * (((k−1) + (k−0.1) **Trust**$_t$ + ε) + ε))* (1−(1/ ($\alpha + \beta$ * ((k−1) + (k−0.1) **Trust**$_t$ + ε)) + ε))	6
Inputs mobilization (M)	**PP** = f (F($_{R-T}$), F($_{Rn-Th}$))Where:M($_{R-T}$) = $k\, R^{\alpha}\, T^{(1-\alpha)}$, And:M($_{Rn-Th}$) = $k\, R_n^{\alpha}\, T_h^{(1-\alpha)}$	7
K constant	1.3	8
Predation function	P(x)= k/x	9
Budget function	B(x) = −x or more exactly the reverse of (Cooperation = (k−1) + (k−0.1) Trust + ε, trust being replaced by the concept of negative trust) Or B(x) = (k− 1) – ((k−0.1) (1−**Trust**)) + ε	10
Satisfaction function	S(x) = x + 2k/x – 2$k^{1/2}$	11

Legend: I+: positive influence; I-: negative influence; I± moderating variable; I+, I+: positive mediating influence; C: causal influence; t+ loop back function; t+1= time after.

As can be seen, the constant k (with $k = 1.3$ being the functional value, that is, the ideal ratio predator/prey–see Annex B) forms the basis of the consolidated model of predation (CMFP). It can be observed that all constructs in the model of financial predation are directly or indirectly linked to trust, and obviously to k.

Blind trust occurs only within certain parameters among these functions. Research has shown that blind trust develops when the ratio of predator/prey[17] is essentially between the values of 1.2 and 1.8 and when the values of trust, cooperation, equilibrium, and reward are above 85% (Mesly [2010], Mesly and Lévy-Mangin [2013a]). Within those parameters, the client believes she/he is in good hands and lets her/his guard down, falling therefore into blind trust.

A NEUROBIOLOGICAL RESEARCH STUDY ON BLIND TRUST

In 2012 and 2013, a neurobiological experiment funded by a University of Québec in Outaouais (UQO) special fund was set up to examine the neural bases of fear, a key factor in the consolidated model of financial predation due to its effect on many of its constructs (see Timmann et al. [2010]). We wanted to check participants' behaviors and neural activity as recorded during fMRI (functional magnetic resonance imaging) tests when they were given a chance to earn money or else when facing the prospect of losing money (see Annex C for preliminary fMRI results). The use of fMRI is widely accepted in neuroscience in particular with respect to the roles of emotions and cognition (see Vul et al. [2009]). Reimann et al. ([2011], p. 609) state:

> (1) *f*MRI permits interpretation of psychological processes in the brain as they are taking place; (2) *f*MRI enables the measurement of nonconscious conditions and processes; (3) *f*MRI allows localization and differentiation of constructs that subjectively may seem similar but which are actually processed differently; and (4) *f*MRI makes feasible measurements of the simultaneous activation of two antithetical conditions and processes.

A protocol was established and a certificate of ethics obtained from the Université du Québec en Outaouais (UQO) and from the University of Ottawa (Canada). A poster was put on some of the University of Ottawa campus boards in order to find potential participants in the neurobiological experiment. In this experiment, participants would face various maze challenges punctuated by threatening images of snakes that were retrieved from the established International Affective Picture System database (Lang, Bradley, and Cuthbert [1997]).

A standard procedure in *f*MRI studies is to put participants flat on their back in the MRI machine. They can see the maze through a set of mirrors and can activate a response pad with one hand. In our design, the participants go through the maze trying to capture a yellow circle that earns them money or else flee a red triangle that, if it catches them, will make them lose money. Our design included sporadic and random flashes of threatening images of snakes in order to see if fear is a factor in cognitive decision making with respect to earning (catching the yellow circle) or losing money (being caught by the red triangle). Snakes have been used in past experiments with strong results (Nili et al. [2010]). In fact, our initial results are in line with this past experiment, with the same brain regions being activated. Also in line with past experiments (Nili et al. [2010]), we complemented the *f*MRI study with self-assessment questionnaires. The use of a maze in fear assessment and decision-making has also been promoted in past research (e.g. Mobbs et al. [2009]).

An initial number of 47 candidates filled out the well-established fear-of-snakes questionnaire—the SNAQ questionnaire (see Klorman et al. [1974]). We chose only those candidates who showed significant snake fear but who did not display excessive phobia of either snakes or a closed environment. In all, 20 participants were chosen—10 female and 10 male, all aged between 18 and 25 years. The use of 20 participants is relatively common in this kind of *f*MRI study (e.g., see Herwig et al. [2011]).

The participants were brought to the *f*MRI centre (St-Joseph in Gatineau, Québec, Canada) from nearby regions, including Ottawa. They were presented with the task at hand and then invited to go into the MRI scanner. Once in the scanner, they had to go through an intensive 30 minutes of maze challenges. Their path choices, speed of reaction, and brain activity were recorded. Before and right after the experiment, a sample of their saliva was taken to measure their cortisol levels, a strong indicator of stress that is also associated with negative feelings (see McCullough et al. [2007]). The participants were then debriefed and received the full C$50 promised in the poster recruitment ad regardless of whether they had been preys to the red triangle more often than predators of the yellow circle.

Participants were invited to enter into a somewhat uncomfortable scanner (lying down in a dark room, surrounded by a noisy machine scanning their head at close proximity; they were instructed not to move their head and stay as still as possible, except for their right hand which was handling the response pad) and as such were put in a situation of vulnerability, or, put otherwise, of dependence toward the scanning technician, who could control the machine and the ability to exit the machine. In the CMFP, dependence serves as a moderating variable[18], as pointed out in sales and marketing literature (Vlachos et al. [2010]). Vulnerability is key as trust can be defined as the willingness to be in a position of vulnerability in the belief that the other person has good intentions (Mayer, Davis, and Schoorman [1995], Lewicki, McAllister, and Bies

[1998], Rousseau et al. [1998], Bell, Oppenheimer, and Bastien [2002], Riedl and Javor [2012]).

We decided not to disclose to the participants how much money they would earn if they were to catch the yellow circle and how much money they would lose if they were to be caught by the red triangle. We relied heavily on the fact that the study was conducted by two local universities, in a highly scientific setting and we were meticulous in conveying a sense of high professionalism, so that the participants would be as trusting towards us as possible. What we were doing, among other elements of the research, was to test blind trust (a form of halo effect). Literature shows that when people believe that they have control of the situation (as is the case in our study: the students could elect to withdraw at any point in time), they tend to let their guard down (Bechara and Gupta [1999]).

The participants should normally have asked ahead of time how much catching a yellow circle would earn, and how much money would be lost if they were caught by the red triangle. The basic idea behind any investment strategy is to maximize revenues and minimize costs (wealth maximization). It would thus have been expected that the participants would want to have the above-mentioned information in order to fully benefit from the experiment (maximize reward by catching the necessary number of yellow circles and minimize punishment by escaping the necessary amount of red triangles; see Seymour, Singer, and Dolan [2007]). Relying on economic theories such as expected utility theory (Newman and Morgenstern [1944]) or the rational expectations theory (see Muth [1961]), we took for granted that participants would be risk adverse, that they would want as much useful financial information as possible ahead of time and that they would somehow put the odds of earning money (give or take errors they would make in going through the maze) in their favor. Relying on bounded rationality (Simon [1957]) and game theory (Gintis [2009]), we were prepared to see some participants not act in their best interests at all times.

It seems, however, that the information we provided, despite being short on key components, was enough to instill trust (see Deutsch [1958]). Multiple studies tend to show indeed that trust operates in relation to the possibility of reward (Johnson and Mislin [2011]) but not necessarily to actual reward: people continue to trust even if the reward is below expectations (Dunning, Fetchenhaeur, and Schlösser [2012]). This, of course, goes against neoclassical economics, which posits that trust should not be a factor in investment decisions (Fetchenhauer and Dunning [2009]).

If, for example, catching one yellow circle was to earn a participant $50, but being caught was to cost her/him 1 cent, we would expect her/him to try to catch as many yellow circles as possible and somehow not care so much about being caught by a red triangle (we did not initially tell the participants this red triangle was controlled by a computer so that they readily assumed it was controlled by one of the researchers). However, none of the 20 participants who were chosen in the end asked the question ahead of the game, that is, "How much value is associated with the catch and be caught scenarios?"

The red triangle used in the *f*MRI experiment served as a threat; so did the random images of snakes for those participants who were found to be scared of snakes based on their screening test results. The participants were told up front that they would be challenged in escaping a threat and would be seeing images of snakes. On the other hand, we provided a trustworthy environment that conveyed a highly objective, scientific methodology.

Participants had every reason to believe that the experiment was not a fraud and was conducted with scientific rigor, and to trust the researchers and technologist who were there to guide and monitor them. Put in this situation, the participants seem to have devoted a large amount of trust into the experiment and experimenters, forgetting in the process to focus on their possible financial gains and losses. Yet the initial motivation of these participants (all university students[19,20]) was to earn money. If the students had been there only to eventually get an image of their brain, it is doubtful they would have been so eager to escape the predator (red triangle). Furthermore, examination of the intensity of their efforts and debriefing comments both point towards a strong inherent motivation to flee capture rather than receive financial gain. In fact, quite a few participants forgot or did not know they would get an image of their brain free of charge after the experiment.

The fact that participants ignored their initial drive to earn money and by a large majority did not bother before or after the experiment to seek how much they would earn by catching a yellow circle (financial gain) and how much they would lose by getting caught by a red triangle (financial loss) can be explained by the CMFP. Indeed, economic motives are not always at the heart of behaviors (see Douhou and Magnus [2012]).

One can assume that having established (possibly blind) trust towards the researchers, the participants then became quite willing to cooperate, engaging in a rather long series of maze challenges, giving their saliva before and after the scans[21], and attending a debriefing session. The researcher who spent the most time with them was a student in his first doctoral year, about the same age as the participants. Hence, it can be assumed that the participants felt even more at ease being consistently in touch with people similar to them with whom they sensed they could talk equal to equal.

Two important phenomena were discovered as a result of the experiment. First, when comparing two conditions presented to the participants (condition "a" being the difference between being chased and actually chasing; and condition "b" being the difference between being chased and actually chasing with images of snakes appearing), we noted that there was significantly more activity for being chased compared to doing the chasing[22]. In other words, the participants' basic motivation can be assumed to escape danger rather than earn money. One can speculate that a basic motivation in investing blindly is to escape the possibility of *not* earning money rather than to actually earn money. In this case, the financial predator will invite the client to invest blindly by outlying the risk of *not* earning money given a real or hypothetical uptrend in the market. The client is afraid of missing out on an opportunity rather than being truly keen on making smart financial choices; the financial predator will promptly identify this weakness in her/his client's mindset.

Second, there is a significant difference between two other conditions, with condition "c" being the difference between actually being chased with the image of the unknown predator—the red triangle, and the baseline measurement[23] and condition "d" being the difference between actually being chased with images of snakes randomly appearing and the image of predator – the red triangle, known by association and the baseline measurement[24]. In other words, participants are more activated in unknown condition (when the predator cannot be readily identified: a snake is a known figure *vs.* a red triangle which can be anything). This is to say that participants show more brain activity when they cannot put a face (an image) on the threat (the red triangle) than when they can (the snake). Perceived predation seems to be indeed an important variable. This suggests that financial decisions are first and foremost affected by perceived predation, which in turn affects trust, rather than being solely affected by trust. Instilling blind trust in a customer's mind may be a way for a financial predator to blur the rational behind wealth maximimization.

DISCUSSION

Out of the 20 participants, only 2 mentioned in the debriefing period that it would have been nice to know what the value of each yellow circle and red triangle catches were. Yet this information was crucial *ahead of the game* in order for them to make sound financial decisions. The question is why did the participants not obey classical economic principles of wealth maximization? The answer may be in the phenomenon of blind trust, which is intimately related to perceived predation. Financial predators excel at instilling blind trust in order to reduce perceived predation. Blind trust, in turn, reduces the level of perceived predation.

Initial reviews of all of the participants' brain activity during the scan confirmed that the brain areas expected to be active in such settings were indeed active[25]. Hence, it can be assumed that all of the participants displayed normal brain activity; yet, they did not attempt to maximize their gains and minimize their losses, contrary to what sound financial theory would predict. One possible explanation is that participants became more interested in displaying their level of trust and cooperation (see Fetchenhauer and Dunning [2009]) than in displaying an image of greed but then, they would probably not have been so eager to catch yellow circles that meant earning money.

In other words, the participants entered into the *f*MRI scan with considerable asymmetry of information. A possible explanation for this counter-intuitive behavior would be the precedence of blind trust in financial decision making, the kind of which has led countless investors to become preys to remorseless financiers. In this particular experiment, since participants showed not to be concerned with financial loss but rather to be more concerned with escaping a predator, it can be assumed that loss aversion is not the key motivation. A remarkable pattern is shared though between our results and the risk or loss aversion viewpoint: there seems to be more value attributed to not being caught (or to losing) than in catching (or to earn money). Thus, our results are in line with past findings (Kahneman [2003]). The difference between Kahneman's viewpoint and the CMFP is that the latter put the emphasis on perceived predation. Also, the CMFP does not subject financial decisions to either purely cognitive efforts or emotions that then affect decision-making; rather, the CMFP identifies perceived predation as the key factor generating emotions such as fear or loss/risk aversion, which then impacts cognition. It can be assumed that the reference point for the participants was the $50 initially promised; yet, as discussed, participants displayed near "myopia" toward it. Furthermore, participants became intensely engaged in running away from the red triangle, even when they suspected it was in fact controlled by an unbeatable computer. They were in the maze for the moment, not for the financial gain or even for the potential loss. This reactivity is very much in line with predatory defense as explained in end note 7.

Faced with the prospect of being challenged by a snake and that of losing money, participants seem to have narrowed down their focus on escaping the red triangle while not even bothering to find out if this was worth their efforts. This is also in line with past observations in the area of decision making (Thaler [1985], Kahneman and Lovallo [1993], Read et al. [1999]). In other words, the participants put their entire trust into the researchers and the experiment to the point that their objective of earning money ranked second. By inflating their sense of trust in the team of researchers and assistants, the participants also boosted their construct of cooperation leading to a sense of reward (having completed the task) even though the initial reward was actually to earn money, and not succeeding in running away from a red triangle. Of note, some participants disclosed during the debriefing session that they realized the red triangle was actually controlled by a computer rather than by a human so that they knew they could never win, but kept playing and lived up to the challenge of trying not to be caught by this red triangle.

A willingness to engage in blind trust superseding a simple financial calculation of profits and losses is one plausible explanation for the results we obtained. Put in the financial sector, it seems to make sense. Time and again, naïve investors have put their life savings into the hands of savvy financial experts, whom they trusted to the point of not verifying their credentials, their activity, and not double-checking their monthly statements, losing focus on their goal of earning money in a rational fashion.

Put differently, blind trust has interfered with the cognitive capacity of participants to target profit maximization and cost minimization. The impact of emotions on decision-making is indeed a well-known fact in neuroscience and seems to be proven once again in the above-described experiment (see Van't Wout and Sanfey [2008]). The simple cognitive financial effort of profit maximization and cost minimization seems to hold true only under certain emotional conditions, in particular in the absence of threats and if investors are unable to engage in blind trust. *Homo economicus* appears to be in fact subjected to social and emotional constraints (see Wishniewski et al. [2009], Mesly, Lévy-Mangin, and Racicot [2013a]) as well as to learned routines (Lee [2006]).

We emit the hypothesis that people are indeed motivated by gain maximization and loss minimization, but *only under* the constraints of perceived predation (which affects trust negatively).[26] Under this constraint, an actor cannot withdraw from an interaction without jeopardizing the other party (a situation similar to Pareto efficiency) and she/he cannot increase her/his gains without taking the risk that the other party retaliates (a situation similar to Cournot-Nash equilibrium; see Mesly [2012a]). We assume that when a dyadic partner feels that there is equilibrium (a sense of fairness), she/he is more prone to blind trust as the risk level is minimized at that point. There is no doubt that such effort at maintaining social equilibrium involves a large neural network, including the prefrontal cortex, the anterior cingulate cortex and the insula (Wischniewski et al. [2009]), three areas that have shown activation in our experiment.

CONCLUSION

We have raised the question of how to gain customers' trust in this day and age where savvy and naïve customers alike have developed a negative perception of financial and banking institutions. We have used the consolidated model of financial predation (CMFP) and a neurobiological study to hint to the fact that perceived predation inevitably leads to a diminution in trust and we have focused on the role of blind trust in its relation to perceived predation.

In all, three key findings of the neurobiological research discussed in this paper are that participants who have normal brains and display normal brain activity given their tasks at hand (1) clearly do not obey classical wealth maximization processes whereby maximum profits would be sought while cost minimization would be favored, independent of trust sentiments; (2) display a significant stronger motivation to escape danger than to earn money; and (3) display more brain activity when the predator is not known (red triangle) than when it is known (snake). Perception is indeed a fundamental aspect of decision-making. This tends to support further the CMFP. The construct of perceived predation is indeed an integral part of the theory of financial predation as put forth since the early 2000s. View from another angle, perceived predation may well nurture a negativity bias (Kahneman and Tversky [1973]) toward financial experts or financial institutions.

One important consequence of the findings of our experiment, should they prove to hold true in future studies, is that financial and banking institutions should not foster blind trust and not enroll financial experts that target naïve customers, because in the end, the risk of wrong financial decisions being taken seems to increase. History shows that financial predators hurt *both* their clients and their organizations (e.g., Barings' case–see Körnert [2003]). Thus, financial and banking institutions have a keen interest in ensuring that all aspects of their relationships to their clients, including proper levels of trust, are in marching order as failure in one area of customer service carries over to other areas (Darke, Ashworth, and Main [2010]).

Our study suffers from many limitations, including the fact that we did not investigate participants' personalities, which could be a key factor in explaining some levels of decision-making (Johnson, Rustichini, and MacDonald [2009], MacLaren, Best, and Bigney [2010]). In particular, research shows different personalities react differently to trust building and trust violation: secure individuals will tend to favor intimacy in the first case and talk with a significant other in the second case. Avoidant and anxious people will long for security in the first case and resort to denial (avoidant) or rumination (anxious) in case of trust betrayal (Mikulincer [1998]). Thus, on two important constructs that are part of the CMFP—trust and cooperation (revealed by decision-making), personalities appear to play a crucial role. We should also remark that the sample chosen in the present study may be biased from the point of view that only university students were tested.

However, this study has taken several steps to ensure the validity of its results. Rather than arbitrarily guessing that individuals at large do not follow the classical model of financial investment, we went one step further. We ensured the participants had normal brains and checked that their brains behaved as predicted, which was the case. We were able to show through a neurobiological experiment using a minor financial exercise that perceived predation plays an important role in financial decision, as explained by the consolidated model of financial predation (CMFP). This offers a considerable insight into *homo economicus*' behavior and points to the relationship between predatory behavior[27] and the establishment of blind trust. Again, blind trust in the financial sector should not be fostered, quite the opposite: the best a financial institution can do is to entice its customers to remain vigilant. This will ultimately serve the interests of both the clients and of the financial institution.

Finally, it can be noted that this understanding of wealth optimization (wealth maximization *given* perceived predation) could well shed a new light on the phenomenon of market bubbles the likes of the 2008 American real-estate crisis (see Yahanpath [2011]). In the latter case, money lenders closed their eyes on potential risks and laypeople chose to believe in easy access to cash in a way that encouraged predatory behaviors (e.g.. predatory mortgages). Put simply, the blind zebra cannot see the tiger approaching.

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NOTES

1. The origin of the financial impact of predatory behavior goes back to the works of Thorsten Veblen (early 20th century). Predation was initially recognized in the Unites States through the Sherman Anti-Trust Act of July 2, 1890 (followed by the 1914 Clayton Antitrust Act and the 2002 Sarbanes-Oxley Act). The state of Maine has attempted to pass "The Act to prevent predatory marketing practices against minors" in 2009. The word "predation" is used in marketing and the sales literature very occasionnaly (Morgan and Hunt [1994], Zaltman [2004]). The CMFP was put forth by the author since 2007.
2. Three levels of responses to predation prevail in the human behavioral structure: an immediate response when facing urgency, involving behaviors such as fleeing. These behaviors are programmed most particularly in the hypothalamus (e.g., medial hypothalamus); a second level which has less requirements for prompt reaction thus allowing for some level of inhibition of fear (Mobbs et al. [2009]); finally, a third level, over the long-term, involving heavy use of prefrontal cortex, calculative capacity typical of financial predators. The *f*MRI study that we performed corresponds to a short/medium term level. The immediate/urgent level was not tested.
3. In statistical (not in neurobiological) terms, it acts as a moderating variable.
4. Defensive and offensive aggressions are to be differentiated (Weinshenker and Siegel [2002], Siegel and Victoroff [2009]): affective (defensive) aggressors are impulsive, overt and do not plan in advance; predatory aggressors plan carefully, are goal-oriented and highly focused (Meloy [1997]), show little or no emotions and display little autonomic arousal, such as increase in heart rate (Gregg and Siegel [2001]). Impulsivity is assumed to be linked to rewards: it is suggested that people "who have high sensitivity to reward but who are relatively insentitive to punishment might tend toward impulsive behavior" (MacLaren et al. [2010], p. 143). From a hormonal point of view, both behaviors depend on the testosterone-to-cortisol T/R ratio (Terburg *et al*., 2009), but in the case of offensive/ instrumental aggression (predation) the accompanying level of serotonin (5-HT) is high (Montoya et al. [2012]). Reidy et al. ([2011], p. 520) explain: "Testosterone inhibits the function of the [hypothalamic-pituitary adrenal] HPA axis and associated autonomic systems, reducing sensitivity to punishment. In contrast, cortisol is thought to increase sensitivity to fear" (see also Stenstrom and Saad [2011]). Along these lines, Riedl and Javor ([2012], p. 73) note that the steroids testosterone (T) and cortisol (CRT) are linked to avoidance behavior and distrust. Serotonin (5-HT) (and oxytocin OXT along with estrogen and dopamine) is linked to approach behavior and trust. Oxytocin seems to increase trust "by reducing anxiety about potential non-reciprocation" (Rilling, King-Casas, and Sanfey [2008], p. 161). On the other hand, Ueda et al. [1999] found that levels of serotonin are strongly correlated to impulsivity in both animals and humans: high levels of serotonin (low impulsivity) are found to entice prosocial behavior (Verbeke et al. [2011]), a key characteristic of successful financial predators. Overall, the following ratios seem to be key in explaining the difference between defensive and instrumental aggression: T/CRT given 5-HT/ OXT (see also Viau [2002]). Examining impulsivity among clients appears important in understanding blind trust (see Barratt [1993]).
5. Mediating variable from a statistical point of view, not in the sense mediation is used in neuroscience.
6. The ventral striatum and the anterior insula, respectively; see Rilling, King-Casas, and Sanfey [2008].
7. This has been referred to as the law of perceived predation; see Mesly [2010]. It seems to be in line with other research; see Todorov and Engell [2008].

8. This was found following numerous factorial analyses perfomed on over 30 groups amounting to more than 1000 participants. Factorial analyses are a key tool in psychology (Nunnally [1970]).
9. Affinities, benevolence, ability, and integrity.
10. Four subvariables to measure a latent variable such as trust seems to be a proper number (see Anderson and Gerbing [1988]). For formative and reflexive variables, otherwise known as structural and functional variables in neurobiology, see Jarvis, MacKenzie, and Podsakoff [2003]).
11. Most particularly, the amygdala known to mediate fear-related physiological arousal (LeDoux [1996]).
12. In particular, the prefrontal cortex; the subgenual anterior cingulate cortex, known to increase parasympathetic tone in order to regulate the autonomic nervous system in situation of negative emotions (Matthews et al. [2004]).
13. The caudate nucleus; see King-Casas et al. [2005], Rilling et al. [2008].
14. For example, the fusiform gyrus for face recognition (Haynes and Rees [2006]).
15. Marketing literature identifies the emotional, cognitive and behavioral components as attitude.
16. Respectively referred to as R, Rn, T, and Th.
17. Measured on a 7-point Likert scale (see Mesly [2010]).
18. In a statistical sense.
19. The use of students for financial research is accepted amongst scholars (e.g., Reynolds, Schultz, and Hekman [2006]).
20. Many experimental studies use undergraduate or graduate business (MBA) students for convenience purposes (Friedman and Sunder [1994]).
21. To measure their cortisol level, a marker for stress, the latter being known to be linked to emotions (see Pelletier [1993]).
22. This is very significant at a p value that is family wise error corrected (FWE) with only clusters shown with more than 100 significantly activated voxels.
23. *Family Wise Error (FEW) = 0.001, voxels at 100.*
24. *FWE = 0.001, voxels at 100.*
25. Including the thalamus (sensory information), medial prefrontal cortex (action-outcome prediction), parahippocampal gyrus (context, spatial navigation), anterior and posterior cingulate (error detection and conflict monitoring–Herwig et al. [2011]), M1 (motor area for handling the response pad) and the visual cortex (see Annex A).
26. Hence, we believe a better term to express this particular dynamic is *wealth optimization*.
27. Predatory behaviors also are suggested among traders themselves (see Brunnermeier and Pedersen [2005]).
28. Sources and full details are as follows: 1) Mesly [2010]; 2) Mesly and Maziade [2013]; 3) Mesly [2013]; 4) Mesly [2010]; 5) Mesly, Lévy-Mangin, and Racicot [2012], Mesly, Lévy-Mangin, and Racicot [2013]; 6) Mesly [2012], Mesly [2013]; Mesly, Lévy-Mangin, and Racicot [2012], Mesly [2013]; 7) Mesly [2013b]; 8) Mesly [2013a]; 9) Mesly [2010]; 10) Mesly [2013a]; 11) Mesly [2013a].
29. A moderating influence (in the statistical sense) exhibiting a triangular distribution.
30. See footnote 10. For predation to occur, one must mobilize some elements of R, Rn, T, and Th.
31. *K* has been found to be a constant in over 34 groups that were studied over the years, signifying the functional predator/prey ratio to which clients or financial advisors abide in order to maintain a sound interactional atmosphere (see the works of Mesly 2010–2013).

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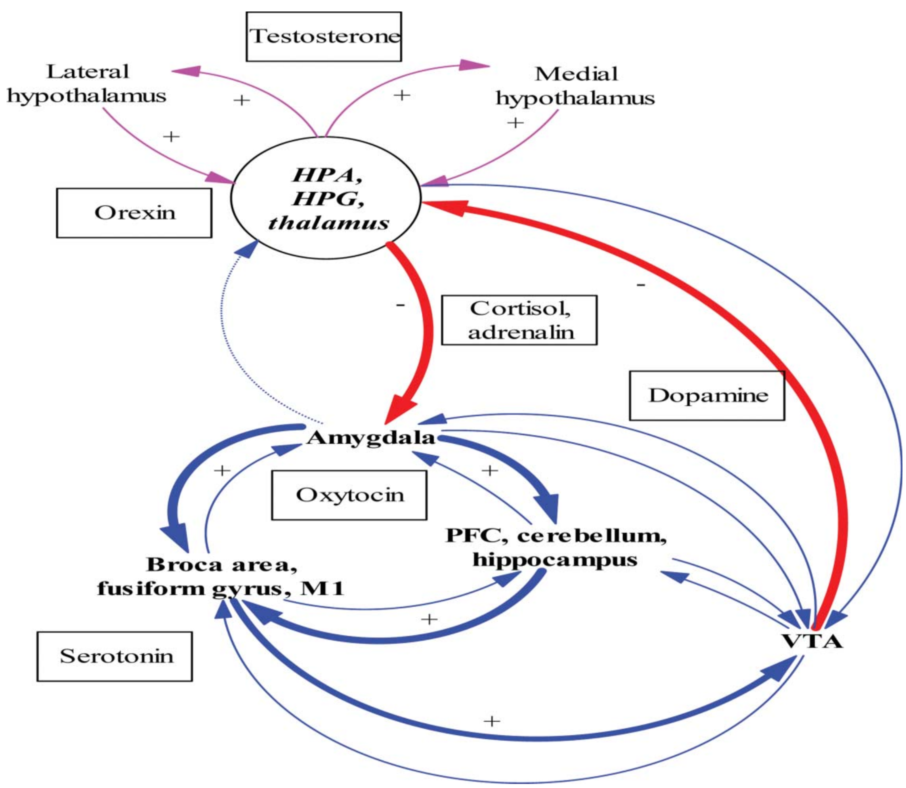
APPENDIX A
The CMFP in neuroscience terms



In the above model and to paraphrase Alvarez et al. ([2008], p. 6214), brain "region selection was kept parsimonious to minimize model complexity" to align it with the marketing model. In other words, we only highlighted some of the brain structures and some of the hormones involved in regulating behaviors. The arrows represent the neural and hormonal flow; however, the dotted arrow represents only the neural flow as hormones do not go back to the hypothalamus once they entered into the pituitary gland. To get a feedback response, the hypothalamus needs hormones going through the entire body, hence through the full circle displayed above.

APPENDIX B
Tables of interpretation

Tables of interpretation (7-point Likert scale)

Construct	Value In %	Type	Emotional involvement	Type of commitment
For Trust and cooperation	60 to 70	Transactional	Little	Almost indifferent (contract-driven)
	71 to 85	Relational	Moderate	Trust-driven
	86–100	Interpersonal	High	**Blind trust**

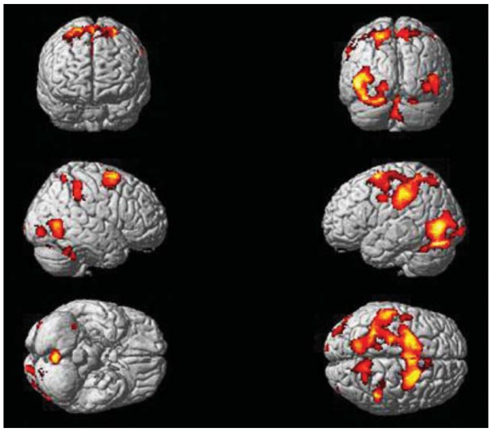
Construct	*K* Value	Zone	Likely Emotion	Outcome
For predator or prey	4 and above	Conflict	Hostility	Strenuous
	2 to 4	Normal	Amicable	Lasting
For the Predator/Prey ratio	Above 1.8	Conflict	Hostility	Strenuous
	1.2 to 1.8	Normal	Amicable	Lasting
	Below 1.2	Conflict	Hostility	Strenuous

See Mesly [2010].

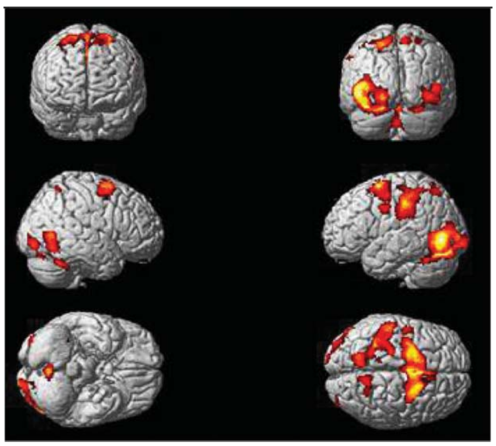
Note: Gottman ([1993], p.13) also notes a particular dysfunctional ratio as follows: “Negativity appears to be dysfunctional only when it is not balanced with about five times the positivity (. . .)”. On the other hand, it should not come as a surprise that human behaviors and systems are subject to some organized mathematical functions (see, e.g., Mackey and Glass [1977]).

APPENDIX C
Some preliminary results from the *f*MRI study on the CMFP

1 There are two fundamental positions: that of predator, and that of prey:



In context as follows: Difference between [Being chased] and [Actually chasing]

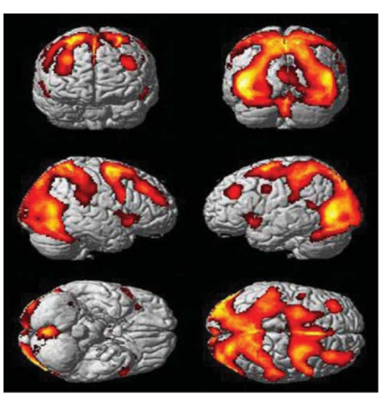


In context as follows: Difference between [Being chased] and [Actually chasing with images of snakes appearing]

Conclusion

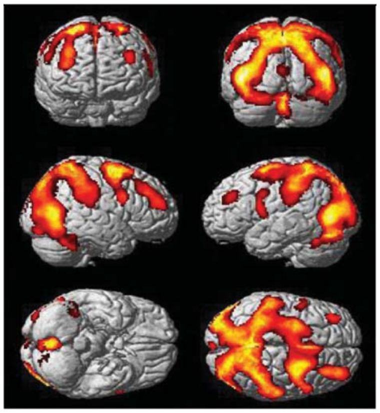
In both contexts, there is significantly more activity for being chased compared to doing the chasing. This is very significant at a *p* value that is family wise error corrected (FWE) with only clusters shown with more than 100 significantly activated voxels. In other words, the participants' basic motivation is to escape danger rather than earn money.

2 Perception seems to be more important than reality



In context as follows:
[Actually being chased]; image of predator unknown
Less [Baseline measurement *(FWE = 0.001, voxels at 100)*]

(Continued on next page)

	In condition as follows: [Actually being chased with images of snakes randomly appearing]; image of predator known by association Less [Baseline measurement *(FWE = 0.001, voxels at 100)*]
Conclusion	There is a significant difference between the first and the second context: participants are more activated in unknown condition. This is to say that participants show more brain activity when they cannot put a face (an image) on the threat (the red triangle) than when they can (the snake). Perceived predation seems to be indeed an important variable. (*p=0.001 (not FWE) (NS for reverse)*)

Note: Brain areas that have been found to be involved in the above mechanism match closely those found in other similar studies (and are reminiscent of the Papez circuitry): Alvarez et al. ([2008], p. 6214)–parahippocampal cortex, hippocampus, orbitofrontal cortex, anterior cingulated and interior insula among others; Nili et al. ([2010], p. 952)—in particular, visual processing areas, motor areas, cingulate cortex, insula, and cerebellum (see also Timmann and Daum [2007]); Mobbs et al. ([2009], p. 12236): amygdala, subgenual anterior cingulate cortex and hippocampus; Herwig et al. [2011], on risk evaluation): amygdala, ventromedial prefrontal cortex and insula.