An Economic Approach to the Self : the Dual Agent

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Abstract

This paper extends the notion of the rational agent in economics by acknowledging the role of the unconscious in the agent's decision-making process. It argues that the unconscious can be modelled by a rational agent with his own objective function and set of information. The combination of both the conscious and unconscious agents is called the "dual agent".

This dual agent presents rationally biased behaviors that may not disappear through aggregation, and could be potentially measured.

It also provides a theoretical approach to the emotionally-driven actions.

On the social sciences side, the paper pleads for a wider use of substantive rationality in the understanding of human behavior.

JEL Classification: B41,D01, D81, D82.

1 Introduction

The rational agent hypothesis is at the heart of economic theory. Developed among the neo-classical school during the middle of the nineteenth century, this hypothesis states that economic agents are rational; meaning that they choose their actions in order to maximize their utility. By systematically disregarding all non-rational behaviors, the theory has allowed economics to abstract itself from the vagaries of human nature and, as such, has been a powerful tool in the reshaping of the discipline as a natural science.

While other social scientists were adamant in their quest to model human nature, economists created a world in which agents are perfectly rational; always optimize to the best of their knowledge and make no systematic errors.

Critics of this "perfect rational man" have been lurking in the economic literature for more than 50 years. They rightly point out that models based on such assumptions have blatantly and repeatedly failed to foresee any market

crash or other economic disruption from the theoretical equilibrium. They stress the fact that economics should acknowledge the findings of other social sciences and build on them, rather than going on assuming improbable hypothesis.

This stream of criticisms has materialized in the behavioral branches of both economics and finance, which seek to suggest mathematical alternatives with firm psychological foundations to rational assumptions.

However, it ignores the fact that psychology suffers from its own evils. The empirical approach adopted by the discipline condemns its theories to be regularly rejected or amended according to new empirical findings. Moreover, by focusing on procedural rationality rather than substantive rationality[1], it ignores a convenient way and potentially useful tool to think about the unconscious.

Finally, however realistic behavioral assumptions might be, models based on fully rational microeconomic behavior usually yield results that are much richer, deeper and more interesting than those achieved by standard models assuming full rationality. This is probably why despite its grossly caricatural assumptions; the rational agent is still so much in favor in economics.

My point here is by no means to take part in any kind of controversy, but rather to acknowledge the fact that if there is some kind of unconscious process undergoing in the psychic activity, then its influence should be assessed by economics. If the unconscious can be seen as a separate agent that has his own set of information, his own reward and the ability to act in a way distinct from the conscious, then this agent should be encompassed alongside the conscious agent, and his influence should be analysed within the scope of economic theory.

To put things differently, economics may have been wrong in assuming one monolithic (conscious) agent. It has gone one step too far in its quest of simplification, and by assuming that one body should be the siege of one rational mind. It does not follow, however, that its global approach is wrong.

In this paper, I will relieve one assumption of the neo-classical literature, and consider the economic agent composed of two rational agents, the conscious agent and the unconscious agent.

The paper is organized as follows. The next section presents the premises of the model. As will become apparent, introducing the unconscious within an economical model, however useful, is not absolutely straightforward. Alongside the necessity to define clearly the notion we are dealing with, are the necessary assumptions about his operating process. An extensive presentation of the unconscious agent is therefore in order, and is presented here. Section 3 developps the model : it presents the context, both the conscious and unconscious agents, their objectives, and the resulting action of the combined agent. Section 4, presents the results of the paper at the microeconomic level. Section 5 assesses the potential impact of the model for other social sciences. Section 6 concludes.

[1] For an assessment of the two rationalities, see Simon [17]

2 Premises

As mentioned earlier, the task I shall undertake here is to describe economically two agents; the conscious and the unconscious, and their possible interactions within a single economic agent. The conscious agent that I will consider is the neo-classical rational agent. It apprehends the parameters of the reality through noisy signals. He is rational in the sense that he chooses his actions to optimize his welfare given all the information at his disposal. Since this agent will turn out to be quite familiar, I would rather present what I mean by the unconscious agent.

In its very general meaning, the "unconscious" can refer to two kinds of psychic activities: first, the part that is not part of the conscious mind, but could emerge to the conscious; and second, what is decidedly beyond the grasp of the conscious mind. However true this definition may be, it is not pertinent to an economic approach.

Indeed, if the unconscious were reduced to the second part of the former definition, i.e. if it were the part of psychic activity beyond the reach of the conscious mind, the parameters of the reality the unconscious agent could react to through his action would be radically beyond the knowledge of the conscious agent, and both the conscious and the unconscious agents could and would indeed coexist in radically independent worlds. Our purpose would be trivial; the action of the resulting economic (combined) agent would be the sum of two distinct and independent actions performed by two distinct agents, endowed with radically different knowledge and clearly defined fields of competence. Besides, in such a context, the action of the unconscious would be of slight interest to the economist. Alternatively, if we were to focus on the first part of the former definition of the unconscious, and exclusively consider the part of the mind that is not conscious, but could become conscious at some point, we could reduce the economic agent to the traditional rational agent, only impaired by his imperfect information of reality, as he would be unaware of some of the parameters of the reality.

A more economical definition of the unconscious should start with recognizing that the actions of the unconscious agent are not distinct from those of the conscious agent. Whichever action is chosen by these two agents separately, there is only one - physical - agent that can act. Therefore we cannot treat these two agents separately.

Moreover, some human behavior, while being systematically biased and suboptimal, are nonetheless coherent to some extent. As such, they could be modeled as the result of an (alternate) optimization, and in this respect, should be regarded as fully rational. The best economical approach to the combined agent should be, therefore, to describe the unconscious as a second rational agent, distinct from the conscious in its reward, his perception of reality, and necessarily constrained in his actions.

Therefore, the unconscious I will consider in this paper is an agent that, when facing an actual situation, confront his own lecture grid and reacts according to his own goals, i.e. maximizing his own reward.

More precisely, how can we apprehend the reward and perception of reality of the unconscious? I assume that the unconscious is innate and not acquired such that a priori everyone is endowed with an unconscious. However, I will allow it to be modified and evolve through time. This refinement, however, will not be modeled here. I will assume that the reward of the unconscious is to guarantee the well-being of the agent, based on a body of past knowledge, acquired through time by the individual. It is, therefore, backward. More precisely, this reward must be optimal when two conditions are met: First, when the individual immediate well-being is assured, and second when the structural, i.e. past conditions of the individual well-being, are met. This means that the unconscious reward is both extremely weighted towards the immediate present, and towards conditions that have been set in place in a very distant past, although they might have been episodically and marginally modified through time.

If the unconscious can be considered as a defense mechanism of the individual, then, for the most part , it must be able to operate at an early stage of life. If this is the case, then it is reasonable to think that the set of information upon which the unconscious operates must be extremely flexible: it will never be retrieved, per se, in its entirety in the actual world, nor should it be used in this way. Rather, the information set of the unconscious should be used as a structural grid or scale through which the characteristics of the present situation are scanned and analyzed. As such, whenever a set of characteristics are recognized and correspond to a potentially harmful data structure, the unconscious will be set into motion. This implies two comments: first, that the unconscious agent is always operating, and that it is not considering definite complex situations, but that it shall, instead, decompose a complex set of information in relatively smaller pieces of information that are of interest to it, and in which it can recognize pre-established elements considered as "problematic". Secondly, that it will not take into account the conditions of the reality per se, but will decompose and project a definite grid on these conditions, and look for similarities.

To conclude, the unconscious is clearly a rational agent, but the structural nature of his actions and his set of information does not lead him to react to the same triggers. Now that these premises are set, let me turn to the model.

3 The Model

In the above section, I have showed that the unconscious has his own set of information, his own reward, and his own action. He can therefore be considered as economically rational. Besides, recall that the conscious agent will be the neo-classical rational agent. For the sake of simplicity, I will call respectively "conscious" and "unconscious" these two rational economic agents. This model will combine these two agents in one agent -hereafter the dual agent.

I will first present the external reality that conscious and unconscious face. I will then turn to present these two agents as well as their goals. I will then present the full model of the dual agent and his optimization. To simplify the

matter, this model will exclude any dynamics. This refinement is left for further research.

3.1 The external reality

Dealing with conscious and unconscious suppose a context, an external situation in which actions can take place. Because we are considering the modeling of a rational agent, reality must be described quantitatively by mean of parameters. These parameters can take various forms: they can be a set of behaviors, agents, costs, external conditions, interactions that constitute the environment that the dual agent faces, and to which it is confronted. The only necessary condition here is that these parameters should be able to be measured quantitatively, so as to be included in the reward function of the agent.

I will call θ this set of parameters describing the reality. Namely the reality θ is a vector:

$$\boldsymbol{\theta} = (\theta_1, ...\theta_n) \tag{1}$$

Each parameter θ_i could actually be seen as a vector of characteristics that fully describes θ_i. This refinement is not necessary to the exposition, and will therefore be ignored.

3.2 The conscious

The conscious is the familiar rational agent : he chooses his actions so as to maximize his well-being to the best of his knowledge. If alone, he would take an action a optimizing a social reward

$$R\left(a, \theta_1, ...\theta_n\right) \tag{2}$$

Note that this reward is depending only on the action of the agent and the parameters of reality. If the conscious were fully informed, the optimization of this reward would lead to an optimal action a^{opt}. For the sake of simplicity, I will further assume that this action is a linear combination of the parameters of the reality, so that a^{opt} will be a linear function of the parameters :

$$a^{opt} = \sum \alpha_i \theta_i$$

The optimal action is the weighed sum of the parameters of the reality. The α_i can be seen as transformers : they translate the quantitative parameters of the reality into an action.

Insofar as the conscious is not fully informed, it can at best grasp a mixed signal of the θ. This set $\tilde{\boldsymbol{\theta}}$ is defined as:

$$\tilde{\boldsymbol{\theta}} = (\theta_1 + \varepsilon_1, ...\theta_n + \varepsilon_n) \tag{3}$$

where the ε_i are independently and identically distributed. To establish a benchmark case, I will present the optimization of the conscious if he were the only agent within the dual agent.

If alone, the "conscious" agent would optimize its expectations such that

$$E^c R\left(a, \theta_1, ...\theta_n\right)$$

he will therefore set his action such that

$$\begin{aligned} a &= E^c a^{opt} = \sum \alpha_i E^c \theta_i \\ &= \sum \alpha_i \left(\theta_i + \varepsilon_1\right) \\ &= a^{opt} + \varepsilon \end{aligned} \tag{4}$$

where ε is the overall mistake induced by the incomplete information of the conscious:.

$$\varepsilon = \sum \alpha_i \varepsilon_1$$

As mentioned above, this is the standard optimization of the rational agent, where imperfect information leads the agent to take erroneous decisions.

3.3 The unconscious

Even if he is considered as rational, the unconscious must be modelled differently from the conscious. Indeed, we have argued in the premises that his objective function is radically different from the one of the conscious. We have also stated that it should be strongly backward-looking.

Because his objective is timeless, he cannot consider the real situations as they occur. He will rather try to decompose whatever complex situation may arise into a set of caracteristics and known elements. We infer from this assumption that he can be modelled as recreating a situation distinct from the present situation, and characterized by his own subset of parameters θ^u. We define θ^u as:

$$\boldsymbol{\theta}^u = (\theta_1^u, ...\theta_n^u) \tag{5}$$

These parameters represent the grid through which the unconscious analyses the reality. They are seldom of importance to the conscious. The activity of the unconscious is to systematically analyze the present context and evaluate to what extent it coïncides with these parameters. Namely, the unconscious will seek to recognize these parameters within the present context. The recognition of part or all of these parameters triggers the unconscious reaction. However, because we are considering an activity of pure interpretation, the reactions brought about by the unconscious can take an acception that can be at times radically different from a conscious interpretation.

The conscious and unconscious are therefore disymmetric: the conscious perceives reality through the fog induced by his incomplete information, while the unconscious keeps on projecting a mainly backward-looking set of parameters.

Once the θ^u are recognized, the unconscious will seek to maximize a reward R^u

$$R^u\left(a, \theta_1^u, ...\theta_n^u\right)$$

that depends on the situation spotted. Recall that the unconscious agent works "backward" and only reacts to past situations. R^u is therefore a backward reward, and induces actions that react to real past situations. As such his actions are bound to be suboptimal in the present situation.

3.4 The dual agent

We now consider the situation where both the conscious and the unconscious are combined to form the dual agent.

Consequently, the dual agent now not merely reacts to the parameters of a reality it can grasp, but also to the ones the unconscious is projecting on reality.

We therefore consider that the dual agent, as a single agent, optimizes a combination of the social reward and an unconscious reward R^u:

$$(1-\beta)\, E^c R\left(a, \theta_1, ...\theta_n\right) + \beta R^u\left(a, \theta_1^u, ...\theta_n^u\right) \tag{6}$$

where β is the weight of the unconscious in the process of choice. We also assume that R^u is quadratic in the $(\theta_1^u, ...\theta_n^u)$.

At this point, it can seem awkward to state a single reward for the two agents. Indeed, using game theory, we could model two agents playing one against the other, each having its own action. This remark calls for some additional comments :

First, only one agent, the dual agent, is playing in this model, and this single action must nonetheless be the result of a combination of two rewards and two possible actions.

Second, it seems difficult to establish in what respect both unconscious and conscious are aware of one another. This point will be discussed further in section 5, but for now, and to simplify the matter, I will suppose that they are both unaware one of the other. It follows that the action of the dual agent is the result of the combined actions of the conscious and the unconscious, but that this cannot - at least in the context of this paper- be assessed through game theory.

The timing of the action could also be refined : each agent could act separately, or even sequentially, and then observe the result of these two actions. We could also consider that the unconscious is blurring the parameters of the conscious with his own parameters, which is equivalent to modifying the reward of the conscious. These situations turn up to be equivalent and can alternatively and more conveniently be modeled through the single (dual agent) reward combining both (conscious and unconscious) agents' rewards.

The parameter β describes the power of intrusion of the unconscious in the reality. The higher the parameter β, the more the dual agent reacts to the unconscious grid of information, and the more reality fits this grid (see the above paragraph) . β is therefore dependent on the parameters θ and θ^u, and

in tunr depends on the personal history of the dual agent. As a consequence, it can evolve over time.

Formally, the action taken is thus a combination

$$\begin{aligned} a &= (1-\beta)\, E^c a^{opt} + \beta + \sum \gamma_i \theta_i^u \\ &= (1-\beta)\left(a^{opt} + \varepsilon\right) + \beta \sum \gamma_i \theta_i^u \\ &= (1-\beta)\left(a^{opt} + \varepsilon\right) + \beta \left(\sum \gamma_i \theta_i^u - a^{opt}\right) \\ &= a^{opt} + (1-\beta)\,\varepsilon + \beta \sum \left(\gamma_i \theta_i^u - \alpha_i \theta_i\right) \end{aligned} \tag{7}$$

Let us now assess the results of the model.

4 Results

The above equation shows that the action is composed of three terms : the first term is the optimal action the conscious would have chosen, had he been both the sole agent involved and fully informed. The last two terms, taken together, produce an overall bias to the optimal social choice.

The first term $(1-\beta)\,\varepsilon$ is unavoidable and results from the lack of information of the conscious about the parameters of the reality. It represents the overall noise that blurs the conscious choice. Its result is to produce a sub-optimal and totally random choice.

The second term $\beta \sum \left(\gamma_i \theta_i^u - \alpha_i \theta_i\right)$, that represents the action of the unconscious, is on the contrary not random, and represents a systematic bias with respect to a^{opt}. We could argue that it cannot be sub-optimal, since it optimizes a reward. Let us however recall that R^u, the reward of the unconscious, does not merely optimize the actual and real situation faced by the agent, but rather a set of past situations reactivated by the present situation. However the weigh given to R^u within the dual agent optimization, it only seldom represents an optimal action vis-à-vis the present - conscious - situation, but should rather be seen as an effective loss for the conscious. To the dual agent, the bias is part of his optimization, and cannot be seen as a loss. On a social point of view, it is nonetheless inefficient as being biased toward past personal events.

What is the exact nature of this bias?

The first intuition is that it represents combinations of differences between parameters seen by the conscious as real and observable, and parameters that are a priori totally unobservableto the conscious, soince by definition the θ_i^u are the projections of the unconscious onto the θ_i. θ_i^u is therefore the result of an interpretation processed by the unconscious and as such uncomprehensible to the.conscious. Besides, the γ_i are the translators of this intepretation in actions.

It results from the above that this bias is an action in the real world (even-though it might only be intellectual), that is directly observable to the conscious, that he cannot control, induced by an unconscious activity, and resulting from the overinvestment of a situation by the unconscious. If we name this bias in few words, we could call it "the emotive part of the agent action".

The coexistence of two perfectly rational but asymmetrically informed agents induces actions that are usually considered as mostly irrational, and that are yet perfectly grounded in the context of this model.

This simple model therefore bridges the gap between economics and emotion theorists, since, according to [6]

> Whereas economists mainly try to explain behavior, emotion theorists try to explain emotions. By and large, psychological studies of the emotions have not focused on how emotions generate behavior. Instead they have tried to identify the proximate or ultimate causes of the emotions.

Here, we have presented a economic and theoretical approach to the emotions.

This emotional bias within the action can be seen as a phenomenon of "overreaction" or "overinvestment". It shows a contrario that economical phenomena can convey an unconscious aspect that does not disappear through aggregation, since part or most of these phenomena can be induced by unconscious collective schemes. More generally, the economic activity or decision process being necessarily a part of psychic activity, one cannot distinguish one from the other.

Last but not least, this bias could be observable and quantitatively estimated. Let me first recall that the hypothesis of of an imperfectly informed conscious does not a priori allow him to suspect the presence of a bias in his optimization. Without prior knowledge of the unconscious, the conscious would deduce ex post - after revelation of the true parameters - that a suboptimal action resulted from his misestimation of the situation measured by $(1-\beta)\,\varepsilon$ and repeated mistakes could lead him to the conclusion of a lack of estimation power.

However, the presence of the systematic bias $\beta \sum (\gamma_i \theta_i^u - \alpha_i \theta_i)$ could be measured by the correlation of the mistakes in a series of similar situations.

Indeed, measuring the average of his actions through an extended period of time and over a large sample of similar actions could lead him to eliminate random errors and measure an average action

$$\bar{a} = a^{opt} + \beta \sum (\gamma_i \theta_i^u - \alpha_i \theta_i)$$

Ex-post, when a^{opt} is revealed, the systematic bias could be measured.

We can even venture the idea that the θ_i^u could be partly retrieved. By examining the biases over a sufficiently large sample of events, one could retrieve a minima some structural similarities among various situations, and postulate a structural form for a set of θ_i^u. This would help determine the form of the triggers inducing the unconscious reaction. This would however require, given our description of the parameters and the relevance of their structural interactions, to abstract oneself from the contingencies of the present situation, and to rather seek the similarities within a set of situations.

Last but not least, the bias in the action of the dual agent will not always disappear when aggregating over agents. It will depend on the nature of the bias. Actually, if its trigger is a common scheme among individual, and not a personnal feature, it will sum up over a population. This can explain rationaly some common seemingly irrational behaviors.

4.1 Comments and extensions

We just argued that the bias produced by the optimization of the unconscious were indeed observable by the conscious.

This observation leads to some comments:

First, if the conscious is, with time, able to understand the bias it faces, it can try to overweigh his actions in order to compensate for the unconscious bias. This approach does not imply any knowledge of the θ_n^u, but requires a constant effort to compensate for the bias, that will constantly be recreated by the unconscious. This ever-going correction is reminiscent of time inconsistency in monetary economics.

A second approach would be to try to reduce the weigh of the unconscious within the optimization.

How can this be achieved? A system of trial and error could lead to guess the θ_i^u that lie behind the unconscious optimization. This is the purpose of an analysis (whether it should be a psychoanalysis or other). The purpose of this analysis, reinterpreted in the context of this model, should be to inform the unconscious that his grid is not adapted to the actual context.

A last and independent but not unrelated comment : to make things simpler, we have totally distinguished the conscious and unconscious perceptions of reality. It would actually be more accurate to consider that the unconscious has also the power to blur the conscious perception. This corresponds to replacing the conscious perception of the parameters

$$\tilde{\boldsymbol{\theta}} = (\theta_1 + \varepsilon_1, ...\theta_n + \varepsilon_n) \tag{8}$$

by a blurred combination

$$\tilde{\boldsymbol{\theta}}' = (\theta_1 + \lambda_1\theta_1^u + \varepsilon_1, ...\theta_n + \lambda_n\theta_n^u + \varepsilon_n) \tag{9}$$

In this context, analysis would consist of a net gain of information for the conscious by re-establishing the true signals $\tilde{\boldsymbol{\theta}}$.

5 Discussion

This section discusses our results and assesses their impact for other social sciences. In doing so it draws on and discusses some of the conclusions of Simon [17].

5.1 Substantive and procedural rationalities

This paper has adopted an economic approach to the unconscious. The conclusions that I draw here are pleading for a wider use of substantive rationality in the understanding of human behavior. In dealing with humans, and psychological processes, one has to ask oneself, not only how the mind actually processes information, but also how the mind can perceive other things within its environment, be it objects, persons, situations.

This has two major implications for the functioning of the human mind.

First, we have seen that each agent, conscious and unconscious, are both rational. However, we do not know if they have any consciousness one of the other. In fact, we could suspect that they do not have any consciousness of the other**.** This was the assumption made in this paper.

To understand how this would be possible, consider the two following considerations:

The conscious is by nature the least informed of the two agents. As such, it might as well ignore that a more informed agent exists behind him.

The unconscious on his side is the most informed of the two agents, since he perfectly scans the information of the conscious, and that he has his own information set. However, this does not mean that he should be totally informed, in the sense that he has no reason to suspect that a conscious agent exists. In particular, because his knowledge encompasses everything the conscious agent knows, and that his actions are mixed with the conscious actions, he could as well consider that this second agent is not another agent, but a simple part of itself. Alternatively, he could consider the conscious as an agent with such limited cognitive abilities that it could be dismissed.

Second, if we admit that conscious and unconscious at least at first approximation, are blind to each other, we can wonder about the perception of the other's action the unconscious agent can have. Here, two cases can arise:

In the first case, if the unconscious believes that there is only one unconscious in the mind that ultimately decides of everything, controls everything within the mind, then he must consider the behavior of others around him as perfectly rational. That is, he will never see the actions of others as pure accident, he will never see the bias in behavior as irrational, but rather, it will treat it has being part of a wider optimization, that has a purpose, and even more so, that is of critical importance.

In the second case, the dual agent, observing the biases of other peoples' actions, could rightly put the biases to the action of others' unconscious, and would act consequently.

In both cases, the dual agent will act as a rational agent facing rational competitors. As such, social sciences which have actively promoted a procedural rationality to study human behavior should not dismiss lightly the economic - substantive - approach to rationality.

5.2 A theory of choice

H. Simon argued that economic rationality, i.e. the assumption that actors maximize subjective expected utility, supplies only a small and often not essential part of the premises in economic reasoning. He claimed that the remainder of theses premises, auxiliary empirical assumptions about actors' utilities, beliefs, expectations, to be made correctly, required an empirically founded theory of choice. This theory of choice in turn needed to specify what information decision makers use and how they actually process it.

This paper shows that the economic approach, by establishing a minimal framework for the description of the unconscious as a rational agent, provides a convenient way to establish and validate empirical psychological assumptions. This is the standard scheme in which a quantitative theory can make predictions that can be tested later on.

5.3 A digression on psychoanalysis

The model tends to show that most unconscious activity takes place during broad daylight. If the rudimentary hypotheses of this model are indeed correct, "the royal road to a knowledge of the unconscious activities of the mind" is what I have called "the emotive part of human activity", (i.e. the bias revealed by the optimization of the dual agent), rather than dreams, as suggested by Freud[2].

This is a circular process: emotions (or, more generally, "the emotive part of the mind") are a sign of the unconscious and its first means of expression. Alternatively, the active reduction of the bias between the conscious and the unconscious is striking proof of the existence of the unconscious.

Anecdotally, these results also tend to show that the ability to "be moved" or "touched" is not a sign of greater consciousness, as is often assumed, but rather a sign of a greater "unconsciousness", so to speak.

6 Conclusion

We have showed that modeling the unconscious as a second agent alongside the neo-classical rational agent induces a bias in the optimization of the agents. These biases, although rational and optimal when viewed from the perspective of the dual agent, are actually generating economical losses for the agents. Besides, these biases do not necessarily disappear when agents are aggregated, insofar as they are generated by predetermined collective schemes.

The dual agent, therefore, represents an alternative to think the economic agent under a psychological angle, or vice-versa. We have shown its utility in providing a theoretical framework to the emotionnaly-driven actions. In addition, the notion pleads in favor of the introduction of substantive rationality in social sciences.

[2] Freud, S. The Interpretation of Dreams (Die Traumdeutung), 1899/1900

The concepts that have been discussed here allow for a certain amount of extensions, both on the theoretical and empirical grounds. On the theoretical side, the introduction of dynamics and the introduction of interaction between the conscious and the unconscious agents are the most obvious and immediate extensions. On the empirical side, the conception of tools to measure the bias are called for.

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