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Journal of Economic Theory 157 (2015) 384–396

JOURNAL OF
**Economic
Theory**

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The value of information under unawareness[☆]

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Received 4 March 2013; final version received 19 December 2014; accepted 23 January 2015

Available online 28 January 2015

Abstract

The value of information is examined in a single-agent environment with unawareness. Although the agent has a correct prior about events he is aware of and has a clear understanding of his available actions and payoffs, his unawareness may lead him to commit information processing errors and to behave suboptimally. As a result, the value of information can be negative, contrasting what is true in the standard model with partitional information and no unawareness. We show that the source of the agent's suboptimal behavior is that he misunderstands the information revealed by his varying awareness, treating it asymmetrically. © 2015 Elsevier Inc. All rights reserved.

JEL classification: C70; D01; D80; D82

Keywords: Unawareness; Value of information; Uncertainty; Knowledge; Bounded perception; Awareness

1. Introduction

Consider an agent who contemplates investing in the stock market today. His payoff is determined by the prices of shares tomorrow and his particular buy and sell orders. The agent is aware of all possible actions (investments) and prices of the shares.

[☆] Some of the results in this paper also appear in an earlier form in Galanis [4]. I am grateful to two anonymous referees and the editor, Paulo Borelli, Piero Gottardi, Larry G. Epstein, Martin Meier, Herakles Polemarchakis, Marzena Rostek, David Rahman, Fernando Vega-Redondo, Marek Weretka, Xiaojian Zhao, seminar participants at the University of Bath, the European University Institute, the University of Southampton, the Summer in Birmingham workshop and the International Workshop on Unawareness, University of Queensland.

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Suppose now that there are other contingencies, expressed by questions, which indirectly influence the prices of shares tomorrow, and therefore the agent's payoff. Examples of such questions are whether there will be a merger, what are the characteristics of a new CEO or whether a specific innovation will be announced. The agent may be aware of some of these questions and unaware of others. Being unaware of a question means that he does not know its answer and he does not know that he does not know. In other words, he misses some information and at the same time fails to recognize it.

Although the agent has an *incomplete* understanding of the world and there are questions that he has never thought about, he receives correct information about events he *is aware of* and, within the bounds of his reasoning, he is perfectly rational and updates using Bayes' rule. Moreover, he is aware of all of his possible actions and he does not err when contemplating their deterministic payoff.

Is information valuable in such a setting? We study this question in an environment where an agent chooses an action, after receiving his awareness and information. We compare what is the effect of more informative signals on his *ex ante* expected utility.

As we show with an example in Section 2, the value of information can be negative. This is opposite to what is true when the agent is always fully aware and has a partitional information structure. In particular, Blackwell [1] and Laffont [11] show that more information is equivalent to having a higher *ex ante* expected utility from choosing an optimal action in the interim period, after receiving some information.

Since unawareness is a mistake of reasoning, this is not entirely surprising. Even within the standard framework, these phenomena can occur if agents have a non-partitional information structure, as in Geanakoplos [7], or misinterpret their signals and have wrong posterior beliefs, as in Morris [13] and Morris and Shin [15].¹ We cannot use the model of Geanakoplos [7] to analyze the value of information under unawareness, because Dekel et al. [2] have shown that a single state space can only express trivial unawareness. In order to overcome this criticism, we use the multiple state space model of unawareness developed in Galanis [5], which is based on Heifetz et al. [10].

The model in Morris [13] and Morris and Shin [15] is a reduced-form representation of beliefs. It allows all possible conditional beliefs, even wrong ones, without providing a theory of how they are formed. Because we need to derive conditional beliefs specifically generated by unawareness, we use a multiple state spaces model. We clarify this difference between our model and theirs at the end of Section 3, showing that (unlike them) unawareness does not generate all possible conditional beliefs, thus restricting behavior.

Moreover, Geanakoplos [7] and Morris and Shin [15] only compare an agent who makes some information processing errors with another who is less informed but is otherwise perfectly rational. In this paper we formulate results that allow for any agent, not just the more informed, to be unaware and to make information processing errors. Finally, Quiggin [16] shows, in a model with unawareness where the value of information is always positive, that the sum of the gains in expected utility, going from no information to some information and from minimal awareness to full awareness, is always constant.

¹ In the standard framework that we refer to and in this paper, information is valuable if it allows the agent to choose better actions. However, there is also the possibility of having an intrinsic (i.e. for its own sake) value of information, that does not depend on one's actions. Grant et al. [9] examine this case and provide several examples, some with negative value of information. For instance, expectant parents may be willing to pay *not* to learn the sex of their future child, even if their actions will not change whether they have this information or not.

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