

# Does the “Iowa Gambling Task” Really Verify the Somatic Marker Hypothesis?

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## 1. What is the Somatic Marker Hypothesis (SMH)?

Damasio investigated people with damage to the ventromedial prefrontal cortex (VMPFC). They perform well at intellectual and psychological tests, but show severe deficits in their ability to make rational decisions or engage in prudential behavior in actual situations. The VMPFC is critically involved in the induction of emotion; damage to VMPFC causes the deficit of emotion.

The emotion deficit induces VMPFC patients’ decision-making disorders and abnormal behaviors although their intelligence is intact.

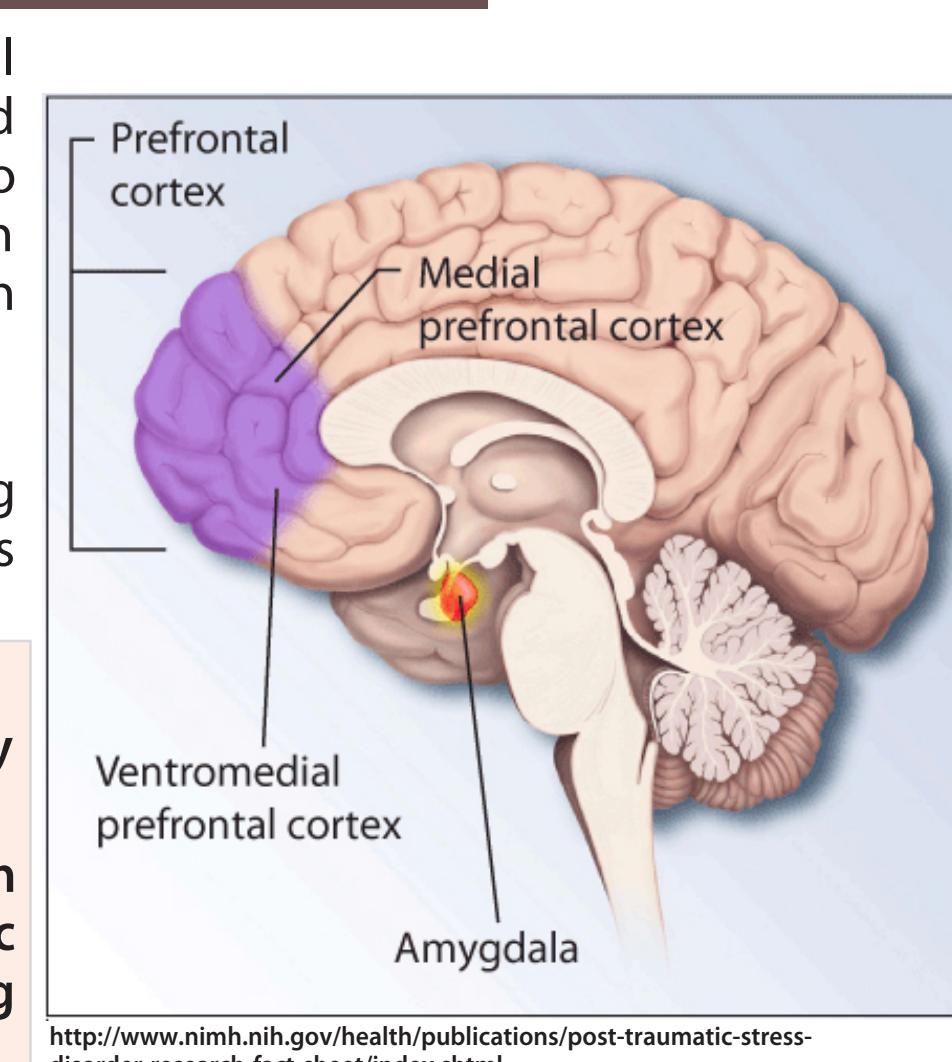
### EMOTION

- Emotion contains bodily states which are automatically caused by objects in the environment.
- The information of somatic states is conveyed to some areas in the brain. Brain states which carry information about somatic states work as a marker of values of objects in decision-making processes in the brain.

Damasio claims that emotion biases implicitly increase the accuracy and efficiency of the decision-making processes (Damasio 1994, pp.173-175).

### The Somatic Marker Hypothesis (SMH)

1. Emotion includes somatic states which reflect values of objects in the environment.
2. It biases decision-making processes toward the most profitable choice.



<http://www.nimh.nih.gov/health/publications/post-traumatic-stress-disorder-research-fact-sheet/index.shtml>

## 2. Iowa Gambling Task (Bechara et al. 1997)

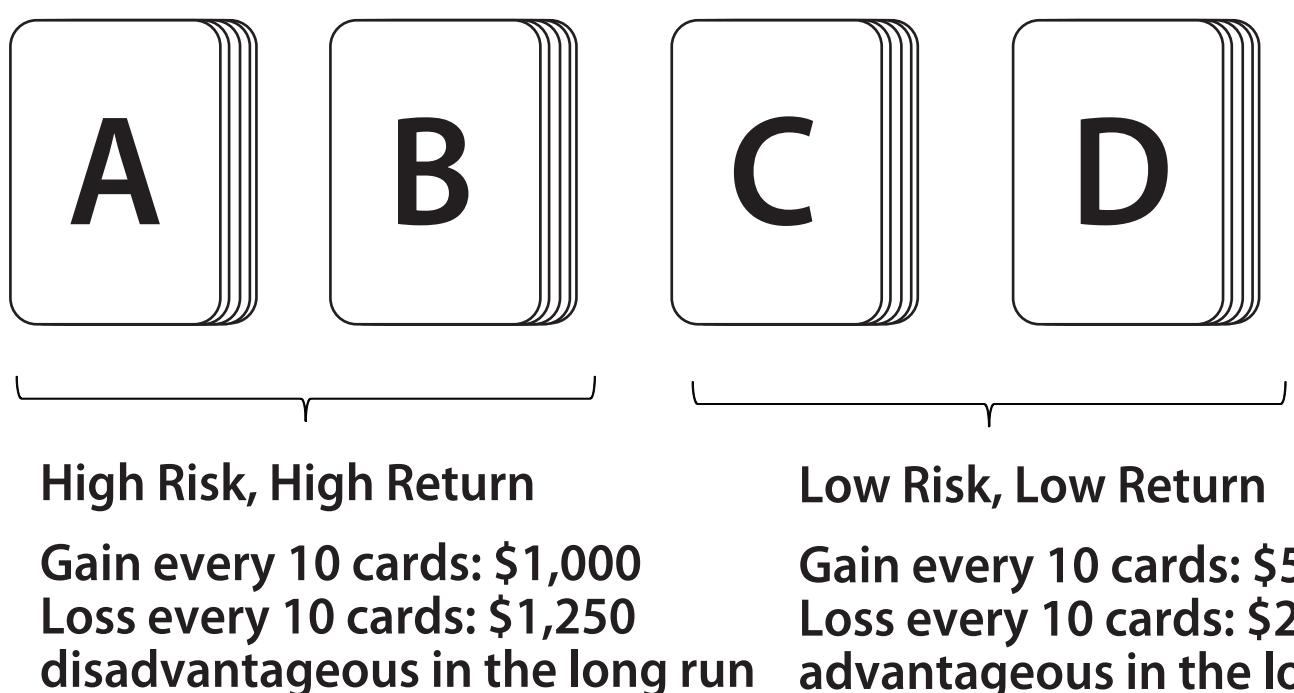
### 2.1 Experimental Purpose and Design

#### Purpose:

To investigate whether subjects choose correctly only after or before conceptualizing the nature of the game and reasoning over the pertinent knowledge.

#### Design:

Subjects are presented with four decks of cards. Two decks (A and B) are “high risk and high return”, containing high profit cards and high penalty cards. They are disadvantageous in the long run: drawing more often from these decks leads to the overall loss. The remaining two decks (C and D) are “low risk and low return”, containing only low profit cards and low penalty cards. They are advantageous in the long run: drawing more often from these decks leads to the overall gain. The subjects are given a loan of \$2,000 facsimile U.S. Bills, and asked to pick a card from each deck until they are stopped. They do not know when the game is over.



#### Data with the experiment:

1. The number of cards selected from each deck
2. Skin conductance responses (SCRs), which are a reliable measure of emotion arousal, generated before the selection of each card
3. The subjects’ account of how they conceptualized the game and of the strategies they were using

### 2.2 Result

#### Normal Subjects:

Normal subjects came to generate anticipatory SCRs after encountering a few losses from the disadvantageous decks A or B. They soon began to select more often from the advantageous decks (C and D) even before they explicitly described which decks were advantageous and which were not, and came to generate anticipatory SCRs before drawing a card from the disadvantageous decks.

#### Patients with VMPFC damage:

VMPFC patients kept selecting more often from the disadvantageous decks even after they explicitly learned which decks were advantageous and which not, and failed to generate anticipatory SCRs before drawing a card from the disadvantageous decks.

#### 2.3 Damasio’s Consideration

Emotion is indispensable for rational decision-making because emotion enables normal subjects to make advantageous decisions while the deficit of emotion leads VMPFC patients to disadvantageous ones. Damasio realizes that the results of the Iowa Gambling Task provide evidence for the SMH.

## Introduction

The Somatic Marker Hypothesis (SMH) proposed by A. R. Damasio brings forward a new framework for understanding our decision-making, based on latest findings in neuroscience, and holds that emotion is an essential factor in any decision-making. But the “Iowa Gambling Task” (IGT), which is evidence for the hypothesis, has unclear points about how to interpret its results. This poster makes clear the interpretative problem of the IGT results, suggests some additional tasks to solve the problem, and then, clarifies the contents of the SMH.

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### EMOTION

- Emotion contains bodily states which are automatically caused by objects in the environment.
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### The Somatic Marker Hypothesis (SMH)

1. Emotion includes somatic states which reflect values of objects in the environment.
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## 3. Problems

### 3.1 Can We Explain a Behavior by Emotion?

According to Damasio, patients with VMPFC damage choose the disadvantageous decks because of the deficit of emotion. The patients fail to generate anticipatory SCRs before drawing a card not only from the disadvantageous decks A or B but also from the advantageous decks C or D. If so, based on the SMH, they do not prefer any deck. Thus they must draw a card randomly. Nevertheless, they prefer to select a card from the disadvantageous decks. Damasio’s interpretation does not sufficiently explain this.

#### 3.1.1 Positive Emotion

According to the SMH, emotion is indispensable for rational decision-making and for preferring a choice. If someone prefers a choice, just as VMPFC patients prefer the disadvantageous decks, he or she must show anticipatory emotion. So patients with VMPFC damage might have anticipatory emotion which is not detectable by SCRs. I call it “positive emotion”.

→ Suppose that VMPFC patients lose sensitivity for punishment, but keep sensitivity for reward. If so, the patients with VMPFC damage are more sensitive to reward than punishment because they lose sensitivity for punishment. In this view, they draw many cards from the disadvantageous decks.

To establish this interpretation, there must be two kinds of emotion: one is negative emotion which is detected by SCRs and sensitive to punishment, and the other is positive emotion which is undetected by SCRs and sensitive to reward.

Tomb et al. (2002)

They provide an alternative gambling task to normal subjects. In this task, two decks, containing high profit cards and high penalty cards, are advantageous in the long run. The remaining two decks, containing only low profit cards and low penalty cards, are disadvantageous in the long run. If emotion plays a role of biasing to avoid the overall loss, and SCRs are a reliable measure of emotion arousal, the magnitude of anticipatory SCRs should be higher for the disadvantageous decks in this task. But the magnitude of anticipatory SCRs is higher for the advantageous decks.

They detect positive emotion by SCRs. To explain VMPFC patients’ continuous card selection from the disadvantageous decks, we need another explanation which is not based on emotion.

#### 3.1.2 Tendency to Immediate Reward

→ Suppose that human beings are apt to require immediate reward and this tendency drives patients to frequently draw a card from the disadvantageous decks.

To demonstrate this tendency, we would need to find out neural networks to support it. But there is no evidence. We need to wait for the development of brain science.

#### 3.2 Anticipatory SCRs and Posterior SCRs

According to Damasio, VMPFC is critically involved in the induction of emotion which biases decision-making processes toward the most profitable choice. “immediately after making a penalty card, the patients avoided the deck from which the disadvantage card had come, just as normal subjects did, but then, unlike normals, they returned to the disadvantage deck” (Damasio 1994, p. 217).

If patients fail to generate anticipatory SCRs to avoid the overall loss because of VMPFC damage, they might draw a card from the disadvantageous decks just after the disadvantageous card had come. But they do not. Damasio gives no explanation for this.

Bechara et al. (2005)

When a person draws a card, he or she generates anticipatory SCRs. The SCRs are affected by “posterior SCRs”. Posterior SCRs are generated when he or she received reward or punishment.

Anterior SCRs: detected just before drawing a card  
= Anticipatory SCRs + Posterior SCRs

#### Normal subjects: Anterior SCRs = (Anticipatory SCRs + Posterior SCRs)

When they draw a card from the disadvantageous decks, they generate anticipatory SCRs. Also, they generate posterior SCRs when they received reward or punishment.

#### VMPFC patients: Anterior SCRs = (Anticipatory SCRs + Posterior SCRs)

They generate posterior SCRs, but fail to generate anticipatory SCRs.

Despite anticipatory SCRs, VMPFC patients avoided the deck from which the disadvantageous card had come. It seems that VMPFC patients generate only posterior SCRs after receiving punishment, and it may be enough to avoid the deck for a while. But then, they returned to the disadvantageous deck because the shock of punishment declines over time.

### 3.3 Ambiguity of “Consideration of Long-term Consequences”

Damasio’s interpretation is as follows. In the gambling task, anticipatory SCRs mark emotions which bias decision-making processes toward a choice which is expected to bring the most benefits in the future. Normal subjects generate anticipatory SCRs. Hence they choose an option based on consideration of long-term consequences. But VMPFC patients fail to generate anticipatory SCRs. Thus they choose an option not based on such consideration.

In this task, VMPFC patients became to understand which decks were advantageous and which were not. Nevertheless, they draw a card from risky decks. Why does it happen?

There are two possibilities which Damasio does not point out.

1. VMPFC patients consider long-term consequences for their decision-making, but they lack emotion. Thus, the consideration is not influential in their practical decision-making but in their theoretical one.
2. VMPFC patients practically consider long-term consequences for their decision-making, but they lack emotion. Thus, they can make a decision but not execute it.

Damasio argues that emotion is influential in decision-making. Thus, he might maintain the first possibility. But he does not consider the second one.

To show the adequacy of the SMH, it seems that we need to make clear which of the two possibilities is right. It is necessary to investigate the case empirically; namely, psychologically and neuroscientifically, not speculatively.

## 4. Conclusion

### A Problem within the SMH

1. There are two kinds of emotions: one is negative emotion which is sensitive to punishment, and the other is positive emotion which is sensitive to reward. The SMH needs to show how each of these emotions influences decision-making.
2. There is a possibility that human beings may be apt to require immediate reward.
3. To explain VMPFC patients’ behavior from the viewpoint of the SMH, a distinction should be made between anticipatory SCRs and posterior SCRs.

### A Fundamental Problem with the Framework of the SMH

There is a possibility that emotion influences not decision-making processes but the execution process of behavior.

To solve these problems, it is necessary to investigate the case empirically; namely, psychologically and neuroscientifically, not speculatively.

## References

- Bechara, A., Damasio, H., Tranel, D., and Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science* 275: 1293-1295.  
Bechara, A., and Damasio, A. R. (2005). The somatic marker hypothesis: A neural theory of economic decision. *Games and Economic Behavior* 52 (2): 336-372.  
Burne, K., and Bechara, A. (2007). Decision making and free will: A neuroscience perspective. *Behavioral Sciences and the Law* 25: 263-280.  
Colombe, G. (2008). The somatic marker hypothesis, and what the Iowa gambling task does and does not show. *British Journal for the Philosophy of Science* 59: 51-71.  
Damasio, A. R. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: Putnam Publishing.  
Strack, F., and Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review* 8 (3): 220-247.  
Tomb, I., Hauser, M., Deldin, P., and Caramazza, A. (2002). Do somatic markers mediate decisions on the gambling task? *Nature Neuroscience* 5 (11): 1103-1104 (author reply 1104).  
von Neumann, J., and Morgenstern, O. (1944). *Theory of Games and Economic Behavior*. Princeton, NJ: Princeton University Press.