

Introduction

For a long time, emotion was proposed to be irrelevant to decision making. That is, it was assumed that individuals dispassionately make choices that maximize the utility of final consequences. However, as much evidence emerged since 1970s (e.g., Tversky & Kahneman, 1974), the notion that decision making is absolutely rational was gradually undermined, and, especially in the recent decade, the role of emotion in decision making was accordingly highlighted (Loewenstein & Lerner, 2003).

Among those that explore how emotion is involved in decision making, the Somatic Marker Hypothesis (SMH), proposed by Damasio and his colleagues, is the one that gives considerable impacts on this issue (Damasio, 1994). According to SMH, an individual's decision making is positively influenced by his/her emotion, specifically by the emotional experience related somatic responses. Furthermore, Damasio and his colleagues suggested that the operation of somatic markers (SMs) could be fully under consciousness and be independent to knowledge about the situation or the process of working memory (Bechara, Damasio, Tranel, & Anderson, 1998; Bechara, Damasio, Tranel, & Damasio, 1997).

It is undoubtedly that the SMH does make significant contribution on the field of emotion and decision making research, not only because it provides a framework of how emotion gets involved in decision making, but also it explains the relationship among emotion, cognition, and human behavior. However, it is important to note that, the core task of SMH, namely the Iowa Gambling Task (IGT), is likely to be confounded by participant's conscious knowledge about the task design. Utilizing a modified IGT, Maia and McClelland (2004) showed that normal participants consciously penetrated the IGT design in very early phase of the task, thus their advantageous selections in the task might be accounted by the knowledge to the task, instead of the unconscious SM Operation. As

the result, Maia and McClelland (2004) argued that the confounding of conscious knowledge in IGT might underline the SMH.

The findings of Maia and McClelland (2004) indeed weaken the SMH (Dunn, Dalgleish, & Lawrence, 2006; Rolls, 2005). However, it is noteworthy that, in the Maia and McClelland's study, there are still some problems (e.g., using too many questions may cause their task to be away from the original IGT design) which would make their critiques being limited, and make the issue whether consciousness is involved in IGT remain open.

For the above regards, the questions (a) Whether participant's advantageous selection in IGT is guided by SM operation or by their conscious knowledge; and (b) whether SMs can operate without coming to consciousness, as Damasio and his colleagues claimed, were re-examined in the present study. In order to preclude confounding from conscious operation, a revised IGT was created in this study in that the expected values of all the decks are equal, and the emotion associated with each deck is activated by subliminally-presented emotional pictures. It is assumed that, since the expected values across all decks are equal, participant would have no preference to any of the decks. However, given that there are emotional pictures subliminally presented during the task (in particular, after each card selection), the subliminally-activated emotions would make participant select more cards from decks associated with positive pictures, whereas select fewer cards from decks associated with negative pictures.

The revised IGT does make it possible to assess the subliminally-activated emotion (as SMs) without being confounded by conscious operation. Furthermore, the design can also let us examine other two issues that are important to the SMH: (a) Whether SM operation is involved in decision making only when the task or situation is with conflict? And (b) whether task-irrelevant emotions (i.e., emotions activated by pictures) can be

taken as SMs which will in turn guide decision making?

For the first question, although it has been suggested that emotional information, such SMs, would be used for decision making only when the situation is complicated and is with conflicts (Damasio, Bechara, & Damasio, 2002; Peters & Slovic, 2000), empirical supporting evidence to the notion, to the author's knowledge, is still few. The answer to this question is fundamentally important to SMH because it will help us to clarify the conditions upon which the SM operation can or can not occur.

For the second question, it is worthwhile to note that, in an informal meeting in 2006 American Psychological Association (APA) annual meeting, Dr. Bechara suggested that only emotions derived from task (i.e., from task outcome) would be taken as SMs to guide decision making (personal communication, August 12, 2006). Notice that Bechara's suggestion indeed implies an appraisal process involved in SM operation, that is, any emotions during the task have to be contributed to a specific source. However, given the fact that appraisal process is commonly regarded as a cognitive and conscious process, Bechara's suggestion here would be inconsistent with the notion of unconscious processing of SMs. Fortunately, this issue could be examined in this study by the revised IGT design with subliminally-presented pictures. Since the emotions activated by pictures are task-irrelevant, if Bechara's suggestion is correct, it was expected to find no effect of the subliminal-presented pictures. In contrast, if Bechara's suggestion is incorrect, the opposite results would be expected.

As will be discussed more detailed later, three experiments were conducted in this study. The Experiment One was a complete replication of the original IGT study. In Experiment Two, as what mentioned above, the issue of consciousness and SMH, as well as the issue of conflict and of task-irrelevant emotion, were examined. In addition in Experiment Two, the issue of task-irrelevant emotion was further examined in Experiment

Three with a different experimental design being used.

In the followed sections, literature related to this study will be reviewed firstly. Secondly, the rationale and hypotheses of this study will be addressed. Thirdly, the design as well as the findings of the three experiments will be presented. Finally, general discussion will be given in the end of this study.