A critical review of the false dichotomy surrounding the Iowa Gambling Task

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Abstract

The debate surrounding how emotion and cognition are organized in the brain often leads to Damasio's Somatic Marker Hypothesis. This theory endorses a highly interactive process between emotion and cognition, but has been criticized for being too broad to capture the specific links between the two. It also implies that emotion operates from a neural architecture that is dissociable from cognition. Although empirical findings from the Iowa Gambling Task lend support for the theory, this can promote a false dichotomy between emotion and cognition. Issues will be raised regarding the view that the theory and the task are ill-formulated to account for the phases of decision making. Further theoretical work may be required to align the task with Damasio's view of emotion as integrated with cognition.

Keywords: Iowa Gambling Task; decision making; emotion; cognition; somatic marker hypothesis

Introduction

Emotion plays a fundamental role in our everyday life, taking part in our learning, decision making, goal management, and ability to communicate and maintain relationships. Emotion has a number of characteristics that can be differentiated from cognitive processes, such as intelligence or memory. However, whether emotion can be dissociable from cognition, particularly at the neural level, is a question of debate.

Much of this debate surrounds Damasio's (1994) Somatic Marker Hypothesis (SMH). Damasio theorizes how emotion facilitates decision making under conditions of uncertainty. The theory is founded on the dissociable processes of patients who suffer from lesions to the ventromedial prefrontal cortex (VMPC). These patients have intact cognitive processes (i.e., intelligence), but are unable to function in their daily lives. They display poor interpersonal skills, are impulsive, are short sighted in their decision making (i.e., only concerned with immediate outcomes), and engage in risk taking behaviours.

Damasio (1994) argued that damage to the VMPC leads to problems in undergoing tasks that require longer term planning and integrating emotional information with cognitive processes (i.e., as memory). VMPC lesion patients are short sighted in their decision making as they are unable to access the automatic somatic marker system that is regulated in the VMPC. Access to this system provides information about predicted future outcomes. The reason for this is that in ambiguous situations where future outcomes are unknown, bodily feedback arising from the peripheral nervous system unconsciously biases response options. This is done with a somatic marker, which tags a mental representation with changes in bodily states associated with emotion. Response options are constrained and only options labelled as pleasant are evaluated as a possible course of action.

Somatic markers can either be formed through 1) the Body loop, as part of a reaction to somatovisceral stimulation from within the body, or 2) the As-if loop, where a previously created somatic marker (including changes in bodily states) is reactivated from emotional memories stored in the amygdala (Dunn, Dalgleish, & Lawrence, 2006).

The current paper will examine the issue, that while the SMH endorses a highly interactive process that emotion has with cognition, it has also been criticized for: 1) being too broad to capture the specific processes that emotion offers cognition, and 2) implicitly promoting an emotion/cognition dichotomy stemming from the notion that somatic markers operate from a separate neural architecture that is functionally dissociable from cognition.

The argument will draw evidence from the main source of support for the SMH: -- the Iowa Gambling Task (IGT). The behavioural findings using the IGT are misconstrued from Damasio's initial view, which highlights emotion as a distributed and integrated across the brain. Interpretation of IGT findings appears to promote a false emotion/cognition dichotomy. There is an over reliance of using performance deficits from lesion patients to provide the anatomical location of emotion. The lesion may be affecting a sub process as opposed to impairing an entire module that functions as the emotional response system.

There are also large inconsistencies across healthy and clinical populations in IGT research. This highlights a problem with viewing the task as able to selectively tap into emotion as separable from cognition. Issues will be raised regarding the validity of the IGT to assess the role somatic markers have in decision making, particularly about whether the task is a reliable index of emotion. Concluding remarks will address theoretical work that may aid in aligning IGT findings more appropriately with Damasio's views.

Iowa Gambling Task (IGT)

The IGT was designed to mimic real life decision making (Damasio, 1994). Participants are required to gain points by making selections from four decks of cards. They are unaware that there are two risky decks, which yield large rewards but also large punishments (in the form of points gained or lost), and two non-risky decks that provide small but consistent gains over time.

To do well in the task, participants are required to engage in a longer term deck selection strategy by learning which decks are the most advantageous. Damasio (1994) argued that this requires the use of somatic markers instead of reasoning skills. Somatic markers are formed during the IGT from repeated exposure to rewards and punishments, which leads to developing pleasant or unpleasant feelings toward each deck. Damasio claims somatic markers are evident in skin conductance reactions (SCR). These reactions indicate a marker of emotion, even if participants do not consciously feel emotion when playing the IGT (Bechara, Damsio, Tranel, Damasio, 1997).

Both healthy participants and VMPC lesion patients show SCR after sampling the decks in the beginning of the task. Around the midway point of the task (40-60/100 trials), healthy participants implicitly learn that the advantageous strategy is to pick from the non-risky decks. At this point, healthy participants (before consciously aware of this strategy) also show anticipatory SCR prior to risky deck selections (Bechara, Tranel, Damasio, & Damasio, 1997). Through the As-if loop, healthy participants can anticipate the possibility of unpleasant feelings associated with large punishment cards and, as a result, learn to avoid these decks. VMPC lesion patients do not show anticipatory SCR. They continually select from risky decks, possibly because they are unable to access somatic marker information through the As-if loop. On the other hand, patients with lesions to the amygdala are unable to form somatic markers through the Body loop and As-if loop. This is evident from these patients' absent SCR, both during evaluations of deck outcomes and during the anticipatory phase (Bechara, Tranel, & Hindes, 1999).

The above observations do not fully support that the IGT directly measures the assumed emotional processes. There are alternative explanations worthy of exploration. The following section will highlight research critical of this theoretical pairing of emotional response to risky deck selections.

Interpretation of IGT Research

Criticisms have been made that anticipatory SCR is the result of conscious knowledge rather than the formation of somatic markers guiding decision making (Guillaume, et al., 2009). Maia and McClelland (2004) found that participants were able to verbally report knowledge about the earning schedule that guided their advantageous decision making. These findings suggest that the IGT measures explicit learning.

Although anticipatory SCR is thought to be a warning signal to guide decision making away from risky decks, Tomb and colleagues (2002) found that healthy controls displayed anticipatory SCR prior to anticipated wins of a substantial amount (i.e., a positive somatic marker). If VMPC lesion patients are short sighted and only concerned with immediate gains, then this would be contradicted by the lack of anticipatory SCR to high wins. There would be no mechanism for basing a decision off of that gain. Thus, VMPC lesion patients' deficits may be more about difficulties in reversal learning: switching from one strategy to another following a change in reinforcement (Stapleton, 2011). Lesion patients, like controls, tend to sample from all decks. However, healthy controls are able to switch strategies when selecting from risky decks for the high rewards cards is no longer advantageous, due to the high punishment cards in those decks. This may be because VMPC damage is related to normal acquisition of learning, but a failure to adapt behavior to changes in contingencies (Fellows & Farrah, 2003; Rolls, 2004).

It appears IGT performance does not hinge solely on intact emotional processing. Emotional intelligence has been inconsistently linked to an intact somatic marker system and optimal IGT performance (Bar-on, Tranel, Denburg, & Bechara, 2003; Pilarik & Schuller, 2009; Demaree, Burns & DeDonno, 2010). Yet, in studies that unpack the emotional intelligence construct, greater emotion regulation (Werner, Duschek, & Schandry, 2009) and awareness (Inman, 2007), has been associated with poor performance.

Populations who do *not* have damage to their VMPC and/ or who are *not* viewed to have explicit emotion deficits have been found to perform poorly on the IGT. These include obesity, chronic pain, Alzheimer's disease, epilepsy, chronic migraines, Huntington's disease, and multiple sclerosis (for review: Dunn, Dalgleish, & Lawrence, 2006). Variables in healthy populations, such as intelligence, age, gender, personality traits, and education level have also been related to poor performance (for review: Buelow & Suhr, 2009). Research inconsistencies in these populations makes the profile of an *unimpaired* baseline control group that can be used to evaluate the performance of emotion deficit experimental groups (i.e., lesion, clinical) unclear (Cella, Dymond, Cooper, & Turnball, 2007).

Instead of manipulating emotion in the task, research in support of the SMH uses various clinical populations that have their own set of biases that could influence performance, suggesting a possible broader information processing deficit. This is especially evident in the inconsistent findings across clinical populations (i.e., psychopaths, depression) who have been widely theorized to have frontal lobe impairments and emotion deficits.

Incarcerated and community psychopaths are one case of a clinical population with variable IGT performance. Psychopathic offenders' attention and number of convictions were more predictive of performance than psychopathy (Schmitt, Brinkely, & Newman, 1999; Losel & Schmucker, 2004). However, the samples from prisons may be biased. Factors found to impede IGT performance and are frequent in offenders include: substance abuse, impulsiveness, low education level, low inhibition and behavioural activation. (for review: Buelow & Suhr, 2009). In the community, alcohol dependency, impulsiveness, and antisocial traits were more predictive of poor IGT performance than psychopathy (Miranda et al., 2009). Psychopaths' deficits could be explained by cognitive impairments related to reversal learning. Newman and Lorenz's (2093) response modulation hypothesis states that psychopaths are unable to automatically shift attentional resources to monitor contextual cues. As a result, they are unable to adjust goal directed behaviours to incorporate information from these cues.

In turning to Turnball and colleagues (2005), these authors theorize that because IGT performance is dependent on access to somatic marker information it is not vulnerable to disruptions that load cognitive resources (i.e., memory). Yet, the authors state loading emotional resources will disrupt performance as these resources would selectively utilize the somatic marker system.

Research testing this claim has been mixed. Disrupting working memory has been found to inconsistently impede performance (Peccindara, Dretsch, & Chapman, 2006; Turnball et al., 2005). The findings have been mixed when emotional resources were loaded during the task. Cella and colleagues (2007) found participants with a time constraint of 2 s every trial had fewer advantageous deck selections than those participants with 4 s time constraint or no time constraints. Bowman and colleagues (2005) found that instilling a 6 s time constraint did not alter performance. Similarly, Hardy (2009) found loading the IGT with emotional images for 7 s every 10 trials did not disrupt performance. However, this study may have methodological issues. Participants were asked to record which decks they thought were advantageous every 10 trials before attending to a separate monitor to view the images. The IGT was modified to include 200 trials and a 7 s disruption every trial. Fatigue and frustration could have been an issue for participants.

It is possible that many tasks, regardless of whether performance is thought to be hinged on cognitive or emotion resources, could be affected by disruptions, such as negative emotions elicited from images or frustration. These induced feelings could influence the participants to be less engaged/ focused, become bored, fatigued, and stop caring to follow the task instructions, compared to if there were no disruptions.

Heilman and colleagues (2010) manipulated healthy participants' emotional resources prior to performing the IGT via unpleasant film clips. These negative emotional experiences impeded performance. It is not clear that disrupted performance from emotional priming supports the assumption that the IGT is an *emotion based* task that *selectively assesses* the recruitment of emotional resources. Fredrickson and Branigan (2012) found that positive emotions broadened the scope of attention, lead to more thought-action urges, and aided in such tasks as problem solving, whereas negative emotions were found to narrow attention. Negative emotions act on attention resources and thus, could disrupt performance on *cognitive based tasks.* This was evident in Robinson and colleagues (2007) study, who found negative emotional priming impeded performance on the Wisconsin Card Sorting Task (WSCT).

Emotion and cognition: A false dichotomy

Damasio's (1994) intention with the SMH was to argue that Descartes "error" was the dualist separation of mind/reason and body/emotion. Damasio wished to shed light on the integral part emotion has in cognition, such as in the areas of learning, decision making, and reasoning. However, Stapleton (2011) acknowledges that the SMH implicitly endorses a neural architecture that views emotion and cognition as "separate but interacting modules" (p. 1).

The paper will now turn to three examples that exemplify the approach taken by researchers to discuss empirical support for the SMH as promoting a false dichotomy between emotion and cognition.

First, the false dichotomy is evident in studies that use the IGT as an *emotion based* task that can selectively recruit emotion, in contrast to *cognitive* tasks, such as the WSCT, which does not recruit emotion and is thought to rely on cognition (i.e., working memory, Lezak, 2000).

Second, Evans and colleagues (2004) study provides an example of the false separation of emotion and cognition. The authors state that the IGT is designed to "tap only one of these sources [emotional or cognitive] of information" (pp. 243). Yet, Damasio (1994) would advocate that the IGT *taps* into both sources of information, due to the highly interactive process emotion offers cognition during decision making. Evans et al. (2004) found higher levels of education related to poorer IGT performance. The authors interpreted their findings as "those with tertiary education rely on *both* cognitive and emotion sources of evidence, while those without a university education rely unduly on emotion-based resources" (p.243). In contrary to Damasio's views, the authors' interpretation implies that relying solely on emotion based resources accounts for optimal performance.

Third, studies have specifically investigated the debate on whether IGT performance relies on "purely emotion based processes" that are independent of cognitive processes (Pecchinenda, Dretsch, & Chapman, 2006, p. 192). In this line, poor decision making skills are thought to stem from an inability to use the emotion learning system (Turnball et al., 2005). Turnball and colleagues (2005) and Bechara and colleagues (1998) found that IGT performance is not vulnerable to disruptions during the task that load cognitive resources. Turnball and colleagues (2005) interpreted this finding to mean that "emotion based learning and cognitive resources are doubly dissociable" because cognitive resources "do not overlap, in the cognitive architecture, with emotion based learning skills that are required for IGT performance" (p. 246-7). It is unclear why research emphasizes that optimal IGT performance is dependent on access to a discrete *emotion system* over the cognitive system, and not the *interaction* between emotion and cognition for optimal performance.

Lesion patients: A deficit sub process or module?

Researchers may be tempted to draw on a separation between emotion and cognition to interpret IGT results, likely because the SMH is founded on the dissociable features of lesion patients. It is vague to conclude that performance deficits on the IGT in patients provide an anatomical location of emotion. Performance deficits do not identify what produces the deficit, whether it is a malfunctioning module, or a more integrated sub process. The mixed findings between lesions to additional brain regions (i.e., dorsolateral prefrontal cortex) and IGT performance suggests that impairments may be to an integrated sub process, as opposed to a module that can be anatomically localized and functionally dissociable from other brain areas (Lin, Chiu, Cheng, Hisch, 2008).

The above issues make it difficult to generalize findings from lesion studies to larger samples. Clinical populations (i.e., schizophrenia, psychopathy), who, like lesion patients, have poor IGT performance when compared to healthy controls, have been viewed to have abnormalities with brain areas associated with the somatic marker system. Yet, these clinical disorders have distinct behavioural outcomes. Damasio has conceptualized the SMH too generally to shed light on what specific sub process in a very complex emotional response system is necessary for optimal decision is making (Bergeron & Matthen, 2006). A more detailed account of the somatic marker process may help identify the underlying processes affecting the decision making and everyday impairments associated with each disorder.

Phases of decision making

It appears that researchers are tempted to draw on the simplistic and broad emotion cognition dichotomy because the SMH does not offer anything more specific. If the SMH is not clearly defined about what it is supposed to predict, it follows that the IGT cannot adequately test the theory, or provide support to the theory. Dunn and colleagues (2006) claim that the IGT cannot discriminate among a range of somatic marker mechanisms that could underlie performance. For example, lesions to different brain areas may impair different phases of decision making (Lin, Chiu, Cheng & Hsieh, 2008). These phases includes the ability to: 1) recognize the point in time that a decision needs to be made, 2) generate response options, 3) deliberate these options, 4) assign values to rank these options, and 5) execute the decision (Linquist & Bartol, 2012). The paper will now turn to defining phases of decision making and the adequacy of the IGT in testing these phases.

Decision point recognition VMPC lesion patients may have problems recognizing the point when a decision needs to be made (Linquist & Bartol, 2012). The somatic marker system could be overwhelmed with input (i.e., from sensory information), which results in overstimulation. It is not possible to detect decision points in the IGT as it is too artificially structured-- participants do not generate or recall these points (Linquist & Bartol, 2012).

Option generation and deliberation The heightened input from decision point recognition may contribute to the production of a much wider range of response options (Linquist & Bartol, 2012). Colombetti (2008) highlights that Damasio conflates two possible routes this phase could take: "At times he states somatic markers are needed to choose among options, yet are also needed to consider the long term outcomes of available options" (p.53).

In the first route, Damasio (1994) hypothesized that lesion patients are bad decision makers because they are indecisive and unable to sort through this endless loop of response options. The formation of somatic markers would aid in limiting the time and energy put into decision making by preventing the deliberation of response options from going on indefinitely (i.e., narrowing down attention to focus on future consequences and goal planning).

Bechera et al. (1994) highlight the second route and state that damage to the VMPC results in short sightedness and impulsive decision making. Lesion patients are unable to generate adequate response options as they rely on the consequence of immediate events and plan for only their short term goals. They are unable to scan their memories and imagination to generate options that include information about the anticipation of future consequences, which are relevant to long term planning (Linquist & Bartol, 2012).

Option generation and deliberation cannot be adequately assessed with the IGT. There are only four clearly defined options in the form of decks and participants are not expected to deliberate during the IGT. Lindquist and Bartol (2012) argue that deliberating would involve generating response options relevant to a goal, along with a rule for determining when option generation should terminate. Participants either select a card or they do not. There are "minimal opportunities for the participants to deliberate and go off track" (pp. 29). If a participant does not select a card their data is incomplete and would usually be discarded. There "does not seem to be a way to gain information from IGT performance about the amount or nature of deliberation associated with each card selection" (pp. 29).

The IGT does not seem methodologically suitable to assess either indecisiveness or impulsiveness in relation to option generation or deliberation. Colombetti (2008) states it may be empirically impossible to disprove indecisiveness as it is too broadly categorized. Colombetti argues that it does appear that VMPC lesion patients do have preferences, but they are not very good ones.

In terms of impulsiveness, Colombetti (2008) argues that maximizing points does not require consideration of future consequences beyond the next card selection. There is "no reason to think that a subject concerned with maximizing the long term gain and a subject concerned with maximizing expected gain on the next card only would behave differently" (p. 60). Further, there is no point during the task where a participant is required to consider the long term outcome and take steps to contradict a short term goal. Chiu and colleagues (2008) corroborate Colombetti's (2008) conclusion: decisions are likely driven by: 1) the most recent outcomes as indicated by the frequency of encountering reward cards, and 2) immediate gains that reinforce the probability that a deck will be selected.

Value assignment The decision making deficit in VMPC lesion patients may rest not on the ability to generate response options, but to: 1) assign preferences to them, and 2) rank them accordingly in relevance to a goal. An impaired somatic marker system may prevent the emotional tagging of response options and prevention of ordering those relevant for goal attainment.

In assessing value assignment in the IGT, the earning schedule of the decks does not appear cognitively opaque (Linquist & Bartol, 2012). Previously outlined research supports that participants are able to decipher the earning schedule of the deck (Maia & McClelland, 2004; Guillaume et al., 2009).

In taking an alternative approach, Bergeron and Matthen (2006) view VMPC lesion patients to have an impaired sub process of the emotion response system that affects the value assignment phase of decision making. The authors conceptualize somatic markers as containing a cognitive aspect, which is responsible for entertaining a response option with values, and an emotion aspect termed the "state of moral deixis", where the agent can situate themselves in a landscape of these values (pp. 208). An intact somatic marker system allows individuals to make a sub-personal commitment to values assigned to response options; the agent places themselves in the context of these values, commits to act on these values (Bergeron & Matthen 2006).

Bergeron and Matthen (2006) describe their views with one of Damasio's (1994) case studies of a lesion patient named Elliot. The authors describe how "*he* assigns values to response options, but *he* lacks the feeling that these valuations are *his* and that they give *him* reason to act in a certain way. He cannot really *feel* the difference in values because this sub process of the emotion response system is impaired. It does not allow him to place himself in the context of these values to make them *his*" (p. 206). VMPC lesion patients can generate and deliberate response options and attach values (i.e., pleasant or unpleasant) to them but there is no associated *feel*. The agent cannot personally interact with the mental representation of response options as it is not contextualized with their own values. The agent cannot manipulate the representation, nor have a feeling of presence to make the response option motivationally relevant (Bergeron & Matthen, 2006).

Execution It could be that VMPC lesion patient have the ability to make a choice, but they are impaired in executing a decision. Patients may be unmotivated to decide on a response option, or do not care enough about the negative outcomes of their decisions to avoid them (Dunn, Dalgleish & Lawrence, 2006).

Laboratory tasks, such as the IGT have trouble capturing the ongoing, open ended, uncertain change/development, and self-motivation needed in real life situations (Bergeron & Matthen, 2006; Linquist & Bartol, 2012). The IGT externally imposes the execution of a decision. Participants are forced to select a deck because they have been instructed to do so and are not internally motivated to do so.

There are different mechanisms underlying the phases of decision making and the IGT does not appear to be a reliable measure to discriminate among them. As a result, it is difficult to know what it means to do well on the task. Conflating the stages of decision making, both in the SMH and in interpreting the IGT, makes it unclear about how to categorize the deficit in lesion patients, and how this may generalize healthy populations, in regards to how emotion contributes to decision making. Researchers currently interpret VMPC lesion patients' IGT results to mean that there is a problem with the emotion system, and if it were intact emotion would properly interact with cognition to optimize performance. Linquist and Bartol (2012) suggest further theoretical work be put into defining the features of decision making that are being probed by somatic markers. Once these are clearly formulated they can be used to modify the IGT to assess these features.

Conclusion

Currently the SMH is incomplete, but it is not inaccurate. It is unhelpful to view the relation between emotion and cognition as artificially distinct. Damasio's (1994) intention was to highlight the integral and interconnected role that emotion has in cognition. It is a mistake to view emotion and reason, as depicted by Descartes, as separate.

The anatomical module responsible for the somatic marker system could be localized in the VMPC and does not exist widely across the brain. However, this does not mean that all processes involved with this module are confined to this brain region. The module may interact with other modules sensitive to emotion, such working memory, gaze direction, or executive attention.

An anatomical module specialized for the somatic marker system should not imply it is localized to the VMPC, but rather that the functioning of this system is dependent on the input and output of other brain areas. For example, the fusiform gyrus has been referred to as a module specified for facial perception. However, it is active during the recognition of objects other than faces, while still having sub process specialized for face perception (Bergeron & Matthen, 2006).

There may be many sub processes (i.e., working memory, cost-benefit analysis, value content, reversal learning) recruited from the outputs of several cooperating modules when a participant undergoes the IGT. The sub processes involved with the somatic marker system that are associated with emotion and cognition could be recruited from several cooperative processes (Bergeron & Matthen, 2006).

Further theoretical work is required to realign the SMH in with Damasio's views. A first step would be to clearly formulate what phases of decision making are influenced by somatic markers. This may help categorize the deficit in lesion patients, and how these may inform decision making deficits in other populations.

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