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Mood and insight: the moderating role of task enjoyment

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ABSTRACT

Insight (Eureka!) processes are likely to be an important part of the development of an organization. Additionally, mood controls vital cognitive functions involved in the manager's daily work, for instance judgment, perception, attention, and cognitive processing style. While divergent thinking tasks have no definite solution, insight tasks are designed to have only one correct solution. This makes the concept of insight highly relevant for organizations, especially for enabling dynamic capability and absorptive capacity, and also an important contribution to the creativity stream in management that traditionally has favored divergent thinking tasks in their studies. We used a between-subjects experiment (N = 76) in Cambridge (UK) to test whether positive, neutral, and negative moods differ in enhancing insight measured by six algebraic tasks with four levels of difficulty. Higher level of positive mood decreased the number of insight solutions, but reduced the time reaching correct responses given relatively high task enjoyment.

Keywords: Insight; mood; emotion; task enjoyment; mediator regression modeling.

1. Introduction

Creativity, defined as the ability to generate ideas, insights, and solutions that are new and potentially useful (Amabile et al., 1996; Runco, 2004), is influenced by the mood of individuals but the nature of this relationship is far from clear (Baer, 2012). On some accounts mood influences creativity mainly because positive affect leads to the sort of cognitive variation that stimulates creativity (Clore et al., 1994). Other accounts suggest negative mood acts as a signal that something is amiss and as a result people will continue to be motivated on tasks (Martin et al., 1993). While other research shows the simultaneous experience of positive and negative mood activates a greater number of memory nodes, thereby increasing both cognitive variability and creativity (Fong, 2006). This lack of clarity is particularly marked for an important aspect of creativity: insight. The most prominent focus of creativity research is originality (Amabile et al., 1996) but creative insights, defined as "problems where the problem solver struggles to find a solution until [Aha!] the solution suddenly appears" (Öllinger et al., 2006) are also important outcomes of the creativity process.

Insight involves a conceptual reorganization that results in a new, nonobvious interpretation, and so is a form of creativity which can result in important innovations (Davidson, 1995; Friedman and Förster, 2005; Metcalfe, 1986a, 1986b; Metcalfe and Wiebe, 1987). Yet creative insights have received relatively little attention particularly in terms of their relationship to moods (Davidson, 1995; Metcalfe, 1986a, 1986b; Metcalfe and Wiebe, 1987). This is surprising because insights, given their clear connection to focused attention and problem solving, promise to help bridge the aspects of idea generation and ideas implementation underpinning the creativity process (Baer, 2012). Further, insights have strong links to two important aspects of organizational effectiveness. First, the combinatorial aspects of creative insights have clear resonance in the dynamic capabilities tradition (Teece et al., 1997). Dynamic capabilities involve creating, integrating, and rebuilding resources in order to take advantage of turbulent markets. Insight is important for enabling dynamic capabilities since it contributes to discovering new opportunities (Zahra and George, 2002), which do not appear by themselves, but as a result of underlying learning processes (Eisenhardt and Martin, 2000; Jansen et al., 2005; Kiechel, 2010; Zollo and Winter, 2002), which for insight is generated by subverting implicit assumptions making resources fit in new ways. Second, absorptive capacity, which (Cohen and Levinthal, 1990, 1989) defined as the ability to identify, assimilate, and exploit external knowledge, is important to achieve the necessary resource amendments underlying dynamic capabilities. Since absorptive capacity is about problem-solving skills (Kim, 1998), insight processes are subsumed by this concept, again by subverting assumptions that previously inhibited valuable but seemingly unrelated areas of knowledge.

In this paper we examine the relationship between insight and mood by focusing on the following question: *Do positive and negative moods influence insight differently?* To develop our understanding of this relationship we test whether positive, neutral, and negative moods differ in enhancing insight measured by six algebraic tasks with four levels of difficulty.

We contribute to the creativity literature by identifying a core outcome of creativity – insight - and highlighting how mood influences this construct. Although insight is an important aspect of the creativity process, researchers have not yet fully examined its relationship with mood. Thus our work answers calls to look at creativity not just in terms of originality and divergent thinking but to emphasise the nature of problem solving and combinatorial thinking present in the concept of insight (Seifert et al., 1994).

We also contribute to the literature on mood by assessing, in addition to the effects of induced moods, the effects of state positive and negative moods, which are largely neglected within the mood-creativity literature. This is important since it is reasonable to believe that not only changes in moods, but also their levels, affect ones creative output. We also assess the moderating and mediating roles of task enjoyment since the more general concept of (intrinsic) motivation has been found to be an important factor in explaining creative success (Amabile, 1993; Amabile et al., 2005; Bradley et al., 2007). A further contribution is the use of insight tasks rather than traditional divergent thinking tasks, which adds to the mood-creativity literature by focusing on solving specific problems rather than to assess more subjective ideas that may only loosely be related to any end solution.

2. Theoretical background and hypotheses

2.1 Insight

(Bowden and Jung-Beeman, 2003) described insight as an Aha! experience irrespective of whether this sudden understanding that reaches awareness is concerned with shallow or deep problem solutions. They argued that insight-problem solvers often (1) reach an impasse (Ohlsson, 1992); (2) cannot remember the processing that made them overcome the impasse; and (3) experience their solution as both surprising and sudden (Davidson, 1995; Metcalfe, 1986a, 1986b; Metcalfe and Wiebe, 1987). Point (3) may be seen as the main defining element of insight, even though this may endanger the concept to become more similar to *intuition*, the latter in which (Kahneman, 2003) defined as: “thoughts and preferences that come to mind quickly and without much reflection”. Even though insight processing may be automatic and beneath awareness, this does not mean that its results (Eureka moments) come to mind easily, and *insight* must therefore be distinguished from *intuition*.

(Gilhooly and Murphy, 2005) found evidence supporting that insight not only consists of System 1 thinking (automatic and implicit processing) as is the case for divergent creativity, but also System 2 thinking (sequential, executive, and working-memory processing; cf. (Stanovich and West, 2000)) during representational restructuring. However, for most parts though, it seems that creativity by insight is a more automatic and pre-attentive process (Gilhooly and Fioratou, 2009; Kounios et al., 2008). However, insight can also occur through more intentional thinking strategies as when using *heuristics* (rule of thumbs) rather than *representational change* (Bowden et al., 2005; Newell et al., 1972; Öllinger et al., 2006). For instance, in means-ends analysis (heuristic) one reduces the problem into sub-problems and sub-goals until means are found that satisfactorily obtain these sub-goals and therefore approach a solution to the initial problem (Chronicle et al., 2004; Newell et al., 1972).

2.2 Mood, creativity, and insight

Even though the mood-creativity literature in general and indirectly supports the view that positive compared to negative moods enhance insight and other forms of creativity, this relation is far from clear-cut due to the many conflicting findings. Thus, presenting these perspectives in a democratic fashion is not an easy task, which is why Figure 1 is designed to clarify the discussion that follows. Note that the "+" sign in the Figure indicates that the perspective may positively influence or even lead to more insight, while the "-" sign represents the opposite effect. The arrows leading from the edges of the Figure represent the mechanisms and the boxes in the middle the theoretical perspectives and effects. The positive and negative moods can either mean a change in, or state (level) of, these mood conditions. The citations are important examples of the corresponding perspective, and should not be the treated as exhaustive lists.

Insert FIGURE 1 about here

2.3 Mood as information

A mainstream view is that positive moods improve creativity since these moods have been found to enhance cognitive flexibility and associative thinking (Isen, 2000). The most prominent of these perspectives is the affect-as-information theory (Bless et al., 1990; Bohner et al., 1988; Frijda, 1988; Schwarz, 2012, 2001, 1990; Schwarz and Clore, 2007, 2003, 1996, 1983; Wyer and Carlston, 1979), or feeling-as-information as it is often termed. Proponents of this view see moods and other forms of affects as information. Positive mood indicates that the situation or environment is safe, while negative mood signals threat or a situation that needs to be attended to. Being in a benign situation may further lead to more cognitive playfulness and the relaxation needed to experiment with novel ideas and solutions. Conversely, when in a threatening situation one has the feeling of emergency, which is not really the time for developing novel approaches.

Moods may have different informational effects on insight depending on how information is interpreted (Schwarz, 2012; Zanna and Cooper, 1974). A perceived threat towards fulfilling ones goals is likely to generate negative moods, while progress towards goals is associated with positive moods. (Pham, 2004, 1998) found that this goal-relevant effect was stronger for experiential goals compared to instrumental goals. This argument can also be turned around; being in a positive mood may signal approaching goal fulfillment (Headey and Veenhoven, 1989), while negative mood may inform about a non-sufficient progress towards obtaining the goal (Frijda, 1988).

2.4 Mood and processing style

This perspective has also influenced the idea that moods have potential effects on processing style (Schwarz, 2012). Positive moods have been shown to facilitate heuristic and top-down processing, while negative moods have been associated with analytic and bottom-up processing (Bless et al., 1990; Bless and Schwarz, 1999a; Fiedler, 1988). Top-down thinking may prevent insight since one follows the most common associations among elements, and therefore does not dare to move outside the box. Alternatively, one does not have the ability to be creative when heavily bounded by scripts. However, it may be that if you are a person that more often than not yields creative ideas, then a top-down process may enhance this skill compared to the overly critical bottom-up process.

(Gasper and Zawadzki, 2013) found that perception of weak performance led to more information seeking behavior, while the perception of strong performance reversed this effect. Thus, the feedback that managers give employees should have an effect on their creative performance given the possible mechanisms explained above. For depressed mood states that often lead to reduced processing motivation, one might not experience enhanced analytic processing (Peterson and Seligman, 1984). Further and more generally, strong or chronic negative moods are not only associated with a certain degree of analytic thinking, but also intruding thoughts that can be difficult to suppress (Martin and Tesser, 1989), and therefore may interfere with information processing, for instance due to attention limits (Ellis and Ashbrook, 1988).

2.5 Hedonic contingency view

The above processing perspective implicitly assumes an automatic heuristic or analytical cognitive strategy depending on mood states. The mood maintenance perspective by (Wegener and Petty, 1994) – the hedonic contingency view – argued that positive moods do not necessarily lead to automatic processing deficits, which is in line with the mood management literature (Clark and Isen, 1982; Sinclair and Mark, 1992). In situations when one wants to avoid thinking about certain topics and issues in order to maintain a current positive mood state, then one incurs a chosen and voluntary process deficit. Further, (Wegener et al., 1995) argued that positive mood leads to enhanced thinking and message scrutiny if it is believed that this better will maintain ones current mood state. When in negative moods, the mood management perspective argues that one attempts to repair ones mood through the deliberate choice of cognitive content (Clark and Isen, 1982; Erber and Erber, 2001).

2.6 Mood and cognitive capacity

The cognitive-capacity argument is another perspective commonly thought to affect processing style (Isen, 1987; Isen et al., 1987a; Mackie and Worth, 1989), with a fundament in the mood-congruent recall hypothesis (Blaney, 1986; Bower, 1981; Bower et al., 1978; Isen et al., 1987b). This hypothesis states that positive moods activate positive memory units, while fewer negative memory units. Thus, the argument goes that positive moods activate more of ones total memory than what is otherwise the case, which further increases the likelihood of connecting seemingly unrelated elements and ideas. The result may be an Eureka moment. Negative moods have still been found to activate negative memory in the same way, although attached to fewer positive memories (Natale and Hantas, 1982; Singer and Salovey, 1988). One possible explanation for this asymmetry is that positive memories may be more interconnected than negative memories (Matlin and Stang, 1978). The cognitive-capacity view relies on this fundament in order to claim that positive moods reduce systematic processing, possibly due to defocused attention (Isen et al., 1987b) or just because of cognitive overload. However, (Bless et al., 1990) argued that the association between positive moods and heuristic processing is unlikely to be due to cognitive overload, based on their findings that participants in positive moods engaged in systematic message elaboration as for negative moods when instructed to do so.

2.7 Mood and cognitive flexibility

The mood-as-information, processing-style, and cognitive-capacity perspectives presented above, are the most commonly used when linking mood and creative performance. Figure 1 also includes three other perspectives (cognitive flexibility, attention mode, and control flexibility), which are associated with the former ones. It has consistently been found that positive moods enhance cognitive flexibility (Ashby and Isen, 1999; Isen, 2008; Isen et al., 1992, 1987b; Isen and Daubman, 1984), and that negative moods lead to more narrow mental categorization (Sinclair, 1988). Thus, positive moods should provide alleviation for the issue of impasse that often accompanies insight problem solving. However, positive moods have been found to yield narrower categorization during high approach motivation, though with a broader categorization when having a low approach motivation (Gable and Harmon-Jones, 2010). Also, the negative affective state of distrust has been found to enhance cognitive flexibility (Mayer and Mussweiler, 2011), which indicates that more discrete forms of moods may act differently on mental categorization than according to the mainstream views. In addition, (Göritz and Moser, 2003) did not find any difference among positive, neutral, or negative moods on cognitive flexibility using the Velten technique. Overall all, then, it may seem that whether positive moods lead to more insight or not would depend on the mechanisms one believes in.

2.8 Mood and attention

Positive affect is usually presumed to broaden attention (Bolte et al., 2003; Carver, 2003; Gasper and Clore, 2002), which may improve insight since more elements are potentially connected to form new ideas and solutions. However, positive affect combined with high approach-motivation has been found to narrow attention span (Gable and Harmon-Jones, 2011, 2008; Harmon-Jones and Gable, 2009). Further, (Hunsinger et al., 2012) found support for the *malleable mood effects hypothesis*; whether positive mood yielded a global focus was dependent on the information processing style active at the moment. Positive moods tended to maintain the current processing style, while sad moods did not. (Gasper, 2004) also found support for moderators, in this case mood-attribution-relevance to the task at hand, and task ambiguity.

2.9 Mood and attention shift

The last main issue in Figure 1 is concerned with how moods affect attention shift. Since this literature is rather scarce with regard to moods, the affect and emotion literatures also needed to be consulted to infer implications for the mood concept. As for the attention-breadth literature, conflicting findings can also be found within the attention-shift literature. On one hand, positive affect (including moods and emotions) have been found to enhance attention shift and cognitive control. For instance, (Baumann and Kuhl, 2005) presented evidence that shifting attention to a non-dominant alternative was easier under positive affect, in line with (Dreisbach and Goschke, 2004) finding that positive affect enhanced cognitive flexibility, though with the cost of more distractibility towards novel stimuli. (Isen, 2008) argued that positive affect improves attention responsiveness to the context, and (Johnson et al., 2010) found evidence for both cognitive flexibility and broaden attention when in positive emotion based on video clips as emotion-induction, and facial electromyographic measures.

It is tempting to claim that positive mood is likely to enhance problem solving by insight since improved attention shift more easily can overcome moments of impasse. However, the relation is likely to be more complicated. For instance, (Fenske and Raymond, 2006) argued that allocation of attention feeds back on affective states and emotional salient stimuli, creating a non-recursive system. (Sedikides, 1992) conducted three experiments indicating that self-evaluation and self-worth acted as mediators between mood and attention. Further, (Demanet et al., 2011) did not find that positive emotion affected attention shift at all, but instead that arousal increased the switching cost.

(Rowe et al., 2007) went even further and yielded results from a remote associate test and flanker task that positive mood inhibits selective focus on a target.

2.10 Aligning the perspectives

Figure 2 below presents a more detailed overview of the main mechanisms that underlie the connections between positive mood and insight. It functions as a summary of the elaboration of theoretical perspectives above, in addition to align the perspectives. For negative mood, the mechanisms and effects on insight can be turned around compared to positive mood, except for the mood-maintenance view – negative mood is likely to improve the likelihood of insight through the attempt to convert negative mood into positive mood. The plus and minus signs mean enhancing and diminishing insight, respectively. The various theoretical perspectives in Figure 2 all have one aspect in common; their effects on insight are dependent on the ease of which constraining assumptions underlying a problem can be subverted. Constraining assumptions are one of the main hallmarks of insight processes as explained earlier, and by alleviating this obstacle insight should be easier to achieve.

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Insert FIGURE 2 about here

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Positive mood signals that everything is as it should be, and this information might allow oneself to become more experimental when solving a problem since one is less constrained by implicit assumptions about how the world functions. Since this positive and playful state is desirable, one wants to maintain a positive mood. Together, the mood-as-information perspective and the hedonic contingency perspective (mood maintenance) create a willingness and readiness to go through a process by insight. However, this is not enough. One also needs the ability to achieve such an end. The dominant general-knowledge perspective states that positive mood leads to stronger reliance on top-down cognitive processing, meaning that it becomes harder to realize the need to subvert taken for granted assumptions. In comparison, negative mood creates a more bottom-up cognitive processing. Further, the cognitive-capacity perspective argues that positive-laden stimuli activates other positively charged memory nodes, which may lead to an overloaded cognitive environment since people in general have more positive memories than negative ones, and by that scrutinize the underlying assumptions to lesser extent. Positive mood is also found to broaden attention span, which means that more cognitive content is taken into consideration during problem solving, an effect that could be used by capacity theorists to argue that people indeed become overloaded. However, one could also argue that broaden attention makes it easier to discover ideas and connections not previously thought about due to the tendency of people to misattribute, i.e. the tendency to connect what is on one's mind at the moment. Based on these five perspectives, it seems that positive mood increases the willingness and readiness to be create solutions by insight, but that positive mood could reduce the cognitive capacity to do so.

However, it is unlikely that positive mood consequently reduces insight as the general-knowledge perspective and the cognitive-capacity perspective state. For instance, the mood-congruent memory perspective uses the same mechanism as the cognitive-capacity perspective, namely the activation of memory nodes that share a threshold of positive mood attached, but still believes in the ability to handle the increased information from more associative thinking. This means that one is more able to discover believable weak associations. By the latter we mean that seemingly unrelated ideas or content appear more plausible as helpful for shedding light on the problem at hand, which enhances the likelihood of generating a solution by an insight.

Positive mood also enhances insight by making cognitive categories broader according to the cognitive-flexibility and attention-shift perspectives. Cognitive flexibility is about seeing alternative approaches to a problem (i.e., alternative categories), which makes current implicit assumptions weaker. Further, attention shift is especially sensitive to novel stimuli, which increases the likelihood of discovering new categories (i.e. solutions) that are so incompatible with the underlying assumptions, that it is the assumptions themselves that are changed rather than discarding the potentially new solutions.

Hypothesis 1: People experiencing a higher positive than negative mood solve more insight tasks.

2.11 Solution time

This section is concerned with how the mood perspectives elaborated on above will affect the time spent on reaching a solution, whether this is an insight solution or not. We argue that mood as information (Bohner et al., 1988; Schwarz, 2012, 1990; Schwarz and Clore, 2007, 1983) and mood maintenance (Wegener et al., 1995; Wegener and Petty, 1994) are likely to also shorten the time to solution in addition to their positive effects on insight. When the situation is considered safe, as is the general case when one is happy, this yields more confidence in whatever solution one comes up with. Thus in this case, one is likely to stop earlier when searching for the solution, although this depends on what question one implicitly asks oneself ([the mood-as-input view] (Martin et al., 1997, 1993). If one implicitly asks oneself whether the process is enjoyable, then one is likely to continue searching for a solution longer than when in negative mood. If one instead implicitly asks oneself whether the suggested solution is good enough, then positive mood is likely to make one stop earlier than when in a negative mood. This confidence in one's solution is also likely to be generated by top-down processing since one relies on heuristics and scripts that are assumed to be correct and a reflection of how the world functions (the processing-style perspective –

e.g. (Bless and Schwarz, 1999b; Fiedler, 1988). On the other hand, in negative mood one is more attuned to seek additional information and to scrutinize the potential solution.

While it seems that the mood-as-information, mood-maintenance, and processing-style perspectives reduce the time spent on reaching a solution that one interprets as sufficiently realistic to solve a problem (whether this suggested solution is by insight or not), we are not convinced that attention shift necessarily has the same property. One could argue that since positive mood has the ability to shift attention to not only relevant issues during problem solving, but also irrelevant ones, then this could increase confusion about the best way forward. If the cognitive-capacity perspective holds (which many do not believe is the case), then too many shifts in attention could lead to cognitive overload relative to the task at hand. However, attention shift is believed to be especially sensitive to novel stimuli and enhance cognitive control (Baumann and Kuhl, 2005; Dreisbach and Goschke, 2004), which means that one is still able to discriminate among mood-laden cognitive content even in positive mood.

We argue that the mechanisms of the cognitive-capacity perspective (Isen et al., 1987a; Mackie and Worth, 1989), the cognitive-flexibility perspective (Ashby and Isen, 1999; Isen, 2008), and attention-span perspective (Bolte et al., 2003; Carver, 2003; Gasper and Clore, 2002) may lengthen the time spent on reaching a solution. If one gets overwhelmed by cognitive content during problem solving when in positive mood, this could lead to confusion and reduction in the confidence to stop the search earlier, the latter stemming from the mechanisms underlying the mood-as-information, mood-maintenance, and processing-style perspectives. If one does not believe in the cognitive-capacity perspective, one can still get negative effects on the time spent on reaching solutions through more flexible categories and a broader attention span induced or enabled by positive mood. The reason is that when flexibility and attention span are enhanced, then more information needs to be interpreted and assessed for its usefulness relative to the respective problem, and consequently one uses more time before believing in a potential solution. However, we argue that the signalling effects from mood (mood as information) and the top-down processing ensuing from positive mood, should create more confidence in what one believes in beyond any confusion generated by having to consider more cognitive content. The reason is that your processing style is an ability (your mental hardware), rather than momentary effects of capacity constraints, flexible categories, or broader categories. Additionally, the top-down processing style interacts with the mood-as-information effect by reinforcing and generating positive mood by giving the impression that it is safe to believe in ones scripts and heuristics. After all, in top-down processing it is more difficult to question underlying assumptions that may inhibit any Eureka! moment.

Hypothesis 2: People experiencing a higher positive than negative mood solve insight tasks faster.

3. Methodology and methods

3.1 Experimental design and participants

A between-participants design with three mood conditions were used (positive, neutral, and negative) together with six matchstick-insight tasks and one 9-dot task. The 76 participants were employees and professionals from several organizations (36%), as well as undergraduate and postgraduate students at University of Cambridge, randomly assigned to the mood conditions. The age ranged from 18 to 52 years old (mean = 27.05; s.d. = 7.24), with 48 female respondents (63.16%). Tweny-five participants had English as first language (32.9%). The participants received £10 for the 30 minutes that the experiment lasted.

To make it more convenient for the reader, we present variable names in brackets in this section and when presenting results, in addition to the full variable names. Hopefully this will make it easier to get an overview of results, and to interpret the various figures and tables.

3.2 Procedures

The employees and professionals were recruited by convenience sampling, while the university students were attached to a database intended to match respondents and researchers. Participants received instructions that they would be part of a study on creativity, and that their responses would be anonymously handled. They were further asked to use an online timer for several of the exercises[1] or an alternative timer of choice with equal precision.

The first exercise was the PANAS test (Watson and Clark, 1994) followed by a 4-minute autobiographical recall task where the participants were asked to recall a happy (N = 25), neutral (N = 26), or sad (N = 25) situation in their life. In the neutral condition the instructions were to remember and write down as many details as possible of a typical day. All the participants were told to write in their first language, and that their stories should not be handed in. After this task, three questions followed concerned with whether they had written complete sentences rather than bullet points, and a question assessing to what extent they felt the mood induction. The PANAS test was not administered again immediately after the autobiographical recall task since this most likely would have eliminated the misattribution mechanism (Schwarz and Clore, 1983). As a manipulation check, we used instead the method by (Johnson et al., 2010) asking participants how well they felt the remembered happiness, sadness, or typical day.

Next, participants conducted six counterbalanced 2-minute matchstick tasks measuring insight at four levels of difficulty (Knoblich et al., 1999). Two of these tasks were at the easiest level, and the following two at the next level of difficulty. The remaining two insight tasks were considered to be at the two most difficult levels. After these, a 2-minute 9-dot problem was presented (Kershaw and Ohlsson, 2004), with the purpose of assessing the correspondence between

[1] http://stopwatch.onlineclock.net/alarm/

the untraditional and traditional ways of measuring insight, respectively. PANAS was rearranged and administered a second time after the insight tasks to check whether the mood induction lasted for the duration of the experiment. As a very last item, participants were asked whether they were familiar with any of the insight tasks.

3.3 Measures

3.3.1 Insight

The following six algebraic matchstick tasks were presented based on (Knoblich et al., 1999), using two counterbalance sequences of opposite order: (1, type A task) **IV = V – III**; (2, type A task) **IV = III + III**; (3, type B task) **I = II + II**; (4, type B task) **IV = III – I**; (5, type C task) **III = III + III**; (6, type D task) **XI = III + III**. Participants had 2 minutes to solve each of the tasks. The letters A to D represent the degree of difficulty, where task D was considered the most difficult based on reported solution frequencies in (Knoblich et al., 1999). These four levels are based on the number and type of constraints to finding a solution leading to one or several periods of an impasse. The two type A tasks had a value constraint combined with loose chunks (explained below); the two type B tasks had value and operator constraints together with loose and intermediate chunks; the type C task had operator and tautology constraints with intermediate chunks; and the type D task had a value constraint combined with tight chunks (Ericsson and Lehmann, 1996; Knoblich et al., 1999; Ohlsson, 1990). Recurrent and recalled constellations of features of objects, events, or any other part of knowledge, are called *chunks* (Ericsson and Lehmann, 1996). If a chunk consists of other component chunks, it is called *loose*, while otherwise it is labeled *tight*.

A value constraint refers to when a numerical value only is changed through a compensating change in another value, or when both changes concern the same number item. For instance, the solutions to the two type A tasks included only this type of constraint (**IV = VI – II** and **VI = III +**

III, respectively). The two type B tasks included additionally a so-called operator constraint, which among other changes involved subtraction (**I = III – II**, and **IV – III = I**, respectively). A tautology constraint, which together with an operator constraint defined task C, involved equalizing three numerical values (**III = III = III**). Task D had a value constraint combined with a tight chunk (**VI = III + III**), where the problem of dissolving **X** into **VI** was considered more difficult than the other chunks.

Four candidate-dependent variables were defined and assessed to which degree they together were applicable for MANCOVA analysis. Two of these were solution-frequency variables, and two were solution-time variables (See Table 1 and 2). The non-frequency-mimicking variable (*sfreqe)* means that the overall solution frequency for the six matchstick tasks was calculated disregarding that these tasks had different levels of difficulty (i.e., averaged by equal weighting). The frequency-mimicking variable (*sfreqa2*, henceforth labeled as the internal-frequency variable*)* attempted to represent the various levels of difficulty by using cumulative frequency solutions reported by (Knoblich et al., 1999) as weights in the calculation of the average solution frequency.

The two type A matchstick tasks, which had the easiest level of difficulty among the six insight tasks, had a solution frequency of 62.50% within 2 minutes solution-time in (Knoblich et al., 1999). Type B, C, and D tasks had 53.33%, 18.33%, and 16.25% solution frequencies, respectively, within 2 minutes solution-time. To create a variable reflecting these levels of difficulty (*sfreqa2)*, type A tasks were given the score 100 as an arbitrary starting point, with the remaining tasks given a score based on how many times higher the frequency were for these more difficult levels.

In addition to solution frequency, two dependent solution-time variables were generated as candidates for the MANCOVA analysis: Cumulative time across the correctly solved matchstick tasks (*stimec*, henceforth labeled as the correct-time variable); and cumulative time across the six tasks assigning 120 seconds to incorrect solutions (*stimef*, henceforth labeled as the total-time variable). They were strongly uncorrelated in the sample (-.07, $p > .05$), but with largely opposite correlations to the internal-frequency-mimicking scores (*sfreqa2*, .60, $p < .001$; -.51, $p < .001$, respectively). Since the total-time variable (*stimec*) had a positive correlation (.60) – the only approximate level in the interval between $\pm .60$ where MANOVA models most likely have higher statistical power than multiple ANOVA models with alpha-correction (Tabachnick and Fidell, 2012) – the variable was included for further analysis. The same was the total-time variable (*stimef*), which had the beneficial property of being negatively correlated with the internal-frequency variable (*sfreqa2*).

To summarize, the dependent variables chosen for the MANCOVA test were the internal-frequency-variable (*sfreqa2*), the correct-time variable (*stimec*), and the total-time variable (*stimef*). The non-frequency-mimicking variable (*sfreqe*) was only assessed further for its descriptive characteristics.

3.3.2 Mood induction and manipulation check

To induce the three mood conditions (positive, neutral, negative), a 4-minute autobiographical recall task was used. In order to enhance the mood effects from this induction, an essential part of the instructions was: “Try to remember such a day as clearly and vividly as possible, and in as much detail as you can”.

The mood states were measured by the PANAS test (Watson et al., 1988; Watson and Clark, 1994). The Norwegian participants were presented a validated and translated PANAS test (Matthiesen and Einarsen, 2008). The manipulation check was assessed by having the participants answer the following question right after the mood induction based on a method by (Johnson et al., 2010): *In question 2, how strongly did you feel the happiness [sadness; typical day] that you* *remembered?* A 5-point scale was used ([1] very slightly or not at all; [2] a little; [3] moderately; [4] quite a bit; [5] very much).

3.3.3 Covariates

For the MANCOVA analysis, two task enjoyment variables (*mot123* [positive task enjoyment] and *mot45* [negative task enjoyment]) were used as covariates based on their lack of significant correlations with the mood conditions measured by the Johnson, Waugh, and Fredrickson test (-.04, $p > .05$ [*mot123*]; -.03, , $p > .05$ [*mot45*]), in addition to their potential motivating effects on the dependent variables (Amabile, 1993; Amabile et al., 2005, 1996; Deci et al., 1999; Gagné and Deci, 2005; Nakamura and Csikszentmihalyi, 2002). The positive task enjoyment variable (*mot123*), was based on parts from the Intrinsic Motivation Inventor (Ryan, 1982; Ryan et al., 1983)[2], and consisted of the average of the following three statements measured on a 7-point scale ("1" – Totally disagree; "7" – Totally agree): *I enjoyed solving the exercises*; *I think I was pretty good at solving the exercises*; and, *I would describe the exercises as interesting*. The negative task enjoyment variable (*mot45*), which was used for the MANCOVA analysis, was the average of the following two statements: *I didn't try very hard to do well in solving the exercises*; and, *The exercises were boring*.

3.3.4 Control variables

For the regression models, which were conducted post-hoc the MANCOVA models for reasons explained below (see the section "Mediator and moderator regression analyses"), eight variables acted as controls: State positive and negative mood; gender (dummy variable with female respondents as reference category [63% of the sample consisted of female respondents]); age;

[2] http://www.selfdeterminationtheory.org/questionnaires/10-questionnaires/50

positive task enjoyment (*mot123*); gender and task enjoyment interaction; state positive mood and task enjoyment interaction; and state negative mood and task enjoyment interaction.

4. Results

4.1 Mood manipulation check

As explained above, the participants were presented with a question immediately after the mood induction concerning how strongly they experienced the same feeling as they once felt. The response scale was *Very slightly or not at all* (1); *A little* (2); *Moderately* (3); *Quite a bit* (4); and *Very much* (5). Options (3) and above would indicate a mood induction effect. The PANAS test was not administered again immediately after the mood induction since this most likely would have eliminated any mood induction effects due to a cancellation of the mood misattribution mechanism. All the three mood conditions indicated a significant effect of the mood induction using the single-check question based on the method by Johnson, Waugh, and Fredrickson (2010; t[24] = 8.06, p < .0001, $\eta^2 = .01$ [Positive]; t[25] = 8.06, p < .0001, $\eta^2 = .00$ [Neutral]; t[24] = 6.59, p < .0001, $\eta^2 = .02$ [Negative]). Also with the Bonferroni adjustment ($\alpha = .05/3 = .017$; e.g. (Maxwell and Delaney, 2004), the mood induction was successful among the mood conditions.

The PANAS test administered the second time after the matchstick tasks was mainly intended to measure whether the mood induction lasted as long as 20 minutes. The comparison of the two PANAS tests using an one-way ANOVA did not show any significant difference among the mood conditions (F[2, 73] = 1.18, p > .05, $\eta^2 = .02$ [Positive mood condition]; and (F[2, 66] = 0.13, p > .05, $\eta^2 = .03$ [Negative mood condition]). To assess borderline size-of-the-test cases, the Tukey's HSD test for planned contrasts was performed though the ANOVA did not indicate significance, which as expected yielded no statistically significant pairwise differences among the conditions (${}_{Pos|Neg}T_{.05} = .34$, $p > .05$; ${}_{Pos|Neu}T_{.05} = 2.02$, $p > .05$; ${}_{Neg|Neu}T_{.05} = 1.67$, $p > .05$).

The reason for this might be that the mood effect disappeared during the 20 minutes between the mood induction and the second PANAS test at the end of the experiment. As argued above, if the second PANAS test instead had been applied immediately after the mood induction, then it is likely that the inducement would have been largely cancelled due to lack of misattribution during the matchstick tasks. This is so because the participants would have been aware of the purpose of the PANAS tests (Fong, 2006; Schwarz and Clore, 1983). Since the single manipulation check indicated mood changes in all the three conditions, and that this check was not similar to the PANAS test and therefore did not block the misattribution mechanism, it is presumed that the autobiographical recall task worked as intended.

4.2 Descriptive statistics

Table 1 summarizes the cell means and standard deviations for the insight (matchstick) tasks as well as for the task enjoyment variables. The average frequency of correct solutions (*sfreqe#*) for each matchstick task for the positive and neutral mood conditions was above that of the negative mood condition except for the neutral condition for tasks 1 and 5. Based on (Knoblich et al., 1999), it was expected that the solution frequencies would be: task A1 = task A2 > task B1 = task B2 > task C > task D. However, as showed above, the actual frequencies for task A1 (68.4%) and task A2 (80.26%) were significantly different ($\chi^2(1) = 16.11$, $p < .001$), and task D significantly higher than task C (39.47% and 13.16%, respectively; $\chi^2(1) = 13.50$, $p < .001$).

Only 8 out of 68 participants (11.76%) solved the 9-dot problem, concurring with the notion that this insight task in general has a low solution rate. This was one of the reasons why the matchstick tasks were used as an alternative in order to achieve higher solution frequencies applicable to statistical inference testing.

Insert TABLE 1 about here
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4.3 Testing hypotheses

4.3.1 MANCOVA analysis

The hypotheses were tested using MANCOVA models since the correlations among the three dependent variables were likely to generate more statistical power compared to multiple ANCOVA's with alpha-adjustment (Tabachnick and Fidell, 2012). The MANCOVA model initially included the covariates positive task enjoyment (*mot123*) and negative task enjoyment (*mot45*). In addition, two restricted models were compared including either of these covariates in order to assess which of the two negatively correlated variables (-.46, p < .001) had the best ability to reduce unexplained variance. As Table 2 shows, the positive task enjoyment variable (*mot123*) significantly explained the group of dependent variables, while the negative task enjoyment variable (*mot45*) did not have any explanatory meaning for this sample.

Insert TABLE 2 about here

With correlated dependent variables, the usual post-hoc ANOVA analyses are partly inappropriate due to their dependent F-tests. Thus, the Roy-Bargmann stepdown procedure was used to assess each of the dependent variables with respect to the covariates. For the first and second model in the stepdown procedure, the positive task enjoyment variable (*mot123*) was significant (F[1, 72] = 9.80 , p < .01, $\eta^2 = .12$ [for the internal frequency-mimicking variable, *sfreqa2*]; and

F[1, 71] = 16.60, p < .01, $\eta^2 = .14$ [for the total-time variable, *stimef*], respectively). However, for the last model in this stepdown procedure, the positive task enjoyment covariate (*mot123*) was not significant (F[1, 70] = 1.39 , p > .05, $\eta^2 = .01$[correct-time variable, *stimec*]). Thus, since the internal frequency-mimicking (*sfreqa2*) and total-time (*stimef*) dependent variables were significantly influenced by the positive task enjoyment covariate (*mot123*), together with insignificant differences among the mood conditions, regressions were also used as additional post-hoc analyses. To summarize, based on the MANCOVA models alone, none of the hypotheses were supported.

4.3.2 Mediator and moderator regression analyses

The scores on the second PANAS at the end of the experiment indicate that the mood induction did not last for the duration of the experiment. There is also the possibility that the mood induction where too weak initially, even though the check by (Johnson et al., 2010) suggest otherwise. To take this possibility into account, we conducted mediator and moderator regression analyses (MacKinnon, 2008) on the relation between levels (states) of moods and insight, with task enjoyment as a potential mediator. If we had been completely certain that the mood induction worked as intended, then it would of course have been infeasible to run these regression models in addition to the experiment; in experiments we control by excluding factors (e.g. randomizing), while the opposite logic applies to regression models where we include factors to control.

Three regression models were used to test the explanatory abilities of six additional variables compared to the MANCOVA models. The regressors were state positive mood (measured as the average of the first and second PANAS tests), state negative mood (average of the first and second PANAS tests), a gender dummy variable (with female respondents as reference category since this was the largest gender group), a centered age variable (*c.age*), centered positive task enjoyment (*c.mot123*), an interaction variable between state positive moods and positive task enjoyment, and an interaction between negative state moods and positive task enjoyment. All the regressors were mean-centered except for the gender dummy variable. Table 3 contains means, standard deviations, and correlations among the variables except for the interaction variables before centering.

Insert TABLE 3 about here

Equation system (1) contains the regression-mediator models based on (MacKinnon, 2008).

$$\eta = \Phi\eta + \Gamma\upsilon + \zeta \qquad (1)$$

where the (4×1) vector, η, contains the dependent variables (*sfreqa2, stimef, stimec,* and *c.mot123*) The (4×4) parameter matrix, Φ, includes parameters between dependent variables and the potential mediator, positive task enjoyment (*c.mot123*). The (4×8) matrix, Γ, contains the parameters between the dependent and independent variables, while the (4×1) vector, υ, includes the independent variables. Lastly, the (4×1) vector, ζ, comprises the error terms. In order to see this system of non-recursive models more clearly, (1) is presented in full in equation (2).

$$\begin{bmatrix} c.mot123 \\ sfreqa2 \\ stimef \\ stimec \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ \phi_{21} & 0 & 0 & 0 \\ \phi_{31} & 0 & 0 & 0 \\ \phi_{41} & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} c.mot123 \\ sfreqa2 \\ stimef \\ stimec \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & 0 & 0 & 0 & 0 \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \gamma_{25} & \gamma_{26} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} & \gamma_{35} & \gamma_{36} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} & \gamma_{45} & \gamma_{46} \end{bmatrix} \begin{bmatrix} c.spos \\ c.sneg \\ dgen \\ c.age \\ c.ipm \\ c.inm \end{bmatrix} + \begin{bmatrix} \ell_1 \\ \ell_2 \\ \ell_3 \\ \ell_4 \end{bmatrix} \qquad (2)$$

where the labels, *c.spos and c.sneg*, represent state positive and negative moods, respectively. The intercept-dummy-gender variable is labeled as, *dgen*, with female respondents as reference category. The labels, *c.ipm* and *c.inm*, are the centered slope-interaction variables between state positive mood and task enjoyment, and between state negative mood and task enjoyment, respectively. The error term is represented as, ℓ, while the remaining symbols are slope parameters.

Table 4 contains results from the mediator regressions. For each of the dependent variables (*sfreqa2, stimef, and stimec*) two regression models were estimated initially. The first one with all the independent variables included using a standard rather than sequential regression method (cf. Tabachnik & Fidell, 2012), while the second model had the positive task enjoyment mediator (*c.mot123*) as the dependent variable and the two state moods as independent variables. For model (i), one outlier was deleted that had a standardized residual (3.99; post transformation of variables) greater than the critical significance level appropriate for outlier detection (.01; cf. Tabachnik & Fidell, 2012).

The Breusch-Pagan test indicated heteroscedasticity in line with visual inspections of residuals ($\chi^2 = 16.88$, $p < .05$), which was mainly due to the fact that state negative mood, age, and the interaction between state negative mood and positive task enjoyment (*inm*), were skewed above ± 0.5 together with high kurtosis. Thus, these three variables were transformed using natural logarithm after comparing with two alternative transformations (square root and inverse). Since the interaction variable (*inm*) partly had negative scores, a reflected-transformation was conducted. Table 4 contains significance testing for the non-transformed variables since the transformations did not yield significantly different estimates than otherwise, and since transformations can lead to more difficulty in assessing results, especially with reflected variables.

Insert TABLE 4 about here

Table 4 shows that state positive mood (*c.spos*) and age (*c.age*) both affected the internal frequency-mimicking variable (*sfreqa2*) negatively (b = −0.30, t[67] = −3.04; $p < .001$, $\eta^2 = .09$

[*c.spos*]; b = −0.33, t[67] = −3.32, $p < .001$, $\eta^2 = .10$ [age]). Even though a higher state positive mood yielded fewer correct solutions, the ones solved satisfactorily were done in a shorter time compared to a higher state negative mood (b = −0.30, t[67] = −2.83, $p < .001$, $\eta^2 = .09$).[3] Thus, hypothesis 2 has some support, although conditionally on relatively high levels of task enjoyment. The dummy-gender variable was statistically significant for the internal frequency-mimicking variable (*sfreqa2*, b = −0.23, t[67] = −2.28, $\eta^2 = .05$), meaning that the female participants on average generated around two more correct solutions than the male participants.

Age had a negative effect on the total-time variable (*stimef*, b = 0.25, t[67] = 2.62, $p < .05$, $\eta^2 = .06$), but not so for the correct-time variable (*stimec*). Positive task enjoyment (*c.mot123*) had a positive effect on solution frequency (b = 0.33; t[67] = 3.05, $p < .01$, $\eta^2 = .09$), although higher enjoyment led to more time spent on generating the correct solutions (b = 0.29, t[67] = 2.41, $p < .05$, $\eta^2 = .07$). Positive task enjoyment affected the total-time variable (*stimef*) negatively as expected since it had a positive effect on solution frequency (b = −0.45, t[67] = −4.39, $p < .001$, $\eta^2 = .17$). The state moods did not affect positive task enjoyment (*mot123*) significantly (see model four in Table 4), and therefore there was no mediator effect by *mot123* (MacKinnon, 2008).

In addition to standard regression modeling as presented above, we ran sequential regressions in order to assess whether the independent variables had overlap of explained variances among themselves to the extent of making a standard regression mask real effects. Using this method, none of the variables were masked to the degree of concluding differently whether they were statistically significant or not.

[3] Higher positive state mood was positively related to the total-time variable (*stimef*, beta = 0.23, t[67] = 2.46, $p < .05$), which was expected since it led to lower solution frequency.

Figure 3 shows two simple-slope regressions for total-time (*stimec*) on state positive mood (*c.spos*), with positive task enjoyment (*c.mot123*) as a moderator with one standard deviation above and below the mean. With low task enjoyment, state positive mood had no significant effect on solution-time for correct responses (coeff. = −0.46, t[72] = −.05, $p > .05$), but it had a negative effect in case of high task enjoyment (coeff. = −79.07, t[72] = −3.70, $p < .01$). Another way of interpreting this interaction is that motivating benefits on solution-time from high task enjoyment were partly or fully cancelled when in high state positive mood.

Insert FIGURE 3 about here
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5. Discussion

The main purpose of this experiment was to assess whether positive and negative mood differ in their influence on the ability to generate insight and time spent on reaching an insight solution. Higher state positive mood decreased the number of insight solutions (no support for hypothesis 1), but reduced the time reaching correct responses given relatively high task enjoyment (conditional support for hypothesis 2). No effects were found directly from the induced mood changes.

What can be the reasons for why hypothesis 1 was rejected? The only two perspectives we earlier suggested could yield a negative effect from positive mood on insight were the top-down processing style and cognitive capacity restrictions. The reason for this is that top-down processing strongly relies on taken-for-granted assumptions, and that when overwhelmed by positively charged cognitive content, one gets confused and less likely to scrutinize these underlying implicit assumptions. As explained earlier, it is the impasse from blindly adhering to assumptions that blocks insight. An interesting question is which of the two perspectives that most likely yielded our results. Working memory and higher-order cognitive functions are strongly interconnected (Engle et al., 1999), and since positive mood enhances working memory performance (Brose et al., 2012; Storbeck and Maswood, 2015), it is less likely that it was the cognitive capacity-constraint perspective that led to the failure to support hypothesis 1. Note that there are disagreements whether positive mood enhances working memory capacity (see for instance (Martin and Kerns, 2011). Further, semantic processing has also been found to improve positive affect (Storbeck and Watson, 2014), which means positive affect and momentary semantic processing ability could reinforce each other, making the cognitive-capacity explanation even less likely. Additionally, (Yang et al., 2013) found that positive affect enhanced the functioning of the controlled working memory processes rather than only improving the short-term storage processing. Thus, even in a situation of cognitive overload due to positive mood and mood-congruent associative thinking, positive mood might enhance the ability to focus on the seemingly most relevant subset of this information. Altogether, this means that reliance on top-down processing could have reduced the number of solutions by insight in our experiment.

What can explain that respondents generally solved insight tasks slower for relatively high task enjoyment for a given level of positive mood? In other words, what can explain the cross-sectional part of Figure 3? It is possible that task enjoyment is a proxy for motivational direction, which again acts as a moderator for the mechanisms underlying mood as information and processing style. Motivational direction is “whether the affect is associated with a motivation to approach or avoid a stimulus” (Gable and Harmon-Jones, 2010). Since the matchstick tasks are goal oriented – there is only one solution, and not just about generating as many solutions as you can – it is reason to believe that some respondents became immersed in finding the solutions. Additionally, the tasks can be interpreted as about intelligence by some respondents, and by that creates a stronger motivational approach since more is felt to be on stake. Further, as different from low-approach positive mood, high-approach positive mood narrows attention and cognitive breadth (Gable and Harmon-Jones, 2008; Harmon-Jones and Gable, 2009). This creates a stronger filtering-out effect of what is seen as irrelevant perceptions and cognitions concerning solving the problem, which means that it is less likely that taken-for-granted assumptions will be questioned, and it will take longer time solving the problems in those cases where these assumptions are considered as part of the solution. Since such assumptions per definition are what prevent one to solve insight problems, high task enjoyment corresponding with high approach motivation would lead to more time spent on finding the correct insight solutions.

Why did respondents solve the tasks faster the higher the positive mood only for relatively high task enjoyment? We expected that respondents would reduce the time spent on solving the insight tasks primarily due to the mechanisms of the processing-style and mood-as-information perspectives, although not only for those with relatively high task enjoyment. One possible explanation is that higher positive mood reduced the motivational-approach effect explained above. In other words, the higher the positive mood, the less did relatively high task enjoyment lead to narrowing of attention and cognitive breadth. Another potential explanation is that relatively high task enjoyment led respondents to focus more on the enjoyment of conducting the task rather than the enjoyment of finding the correct solution. According to the mood-as-input view (Hirt et al., 1997; Martin et al., 1993), this would lead the respondents to spend more time on solving the matchstick tasks compared to those with relatively low task enjoyment. The reason is that people tend to continue longer if they implicitly answer positively to the question whether they enjoy the process. If one rather asks oneself whether the solution is satisfactory, then one is likely to shorten the time spent on solving the problem when in positive mood.

5.1 Theoretical implications

Though moods have been intensively studied with respect to creativity, the focus has not mainly been on insight. Our study attempts to address this gap together with a more general focus on the value of Eureka moments within a creative process. These processes are important for organizations since the affective context can easily be modified by giving supportive and positive feedback in the creative process (Baas et al., 2011; De Stobbeleir et al., 2011; Madjar et al., 2002), to mention one example, in order to change creative output. Additionally, it is only the workable solutions that matter in the end, which makes insight a too important concept to ignore. In fact, insight is what problem solving is about in the first place if we see a problem as something that "exists when someone has a goal for which they are unable to generate a suitable sequence of actions either from memory or by applying a routine method" (Gilhooly and Murphy, 2005). Insight is all about restructuring the problem space in order to overcome the impasse (Bowden and Jung-Beeman, 2003). Our finding that higher state positive mood decreased the number of insight solutions indicates how top-down processing might inhibit the generation of insights. Second, the study shows the importance of high task enjoyment in reducing the time in reaching correct responses and to insight overall.

5.2 Managerial implications

For those organizations that choose to compete in a turbulent industry or market, continuously being novel is necessary in order to obtain and sustain competitive advantages. However, novelty is not a sufficient condition – novel ideas also need to be applicable in real life in order to reach actual solutions that are valued by your customers. These two criteria – novel and useful – are exactly what the concept of creativity consists of (Mayer, 2007), where insight is about such a process breaking down implicit assumptions that otherwise prevent ideas to transform into innovative products and services. Managers should facilitate working environments to enable the possibility of individuals rethinking resource combinations. A possibility could be to stage problem-solving workshops in a way that emphasize the serious and urgent matter of the task at hand, and by that prevent employees to be satisfied with potentially useful solutions too fast (the mood-as-information and mood-as-input perspectives).

5.3 Limitations

Even though the scoring method for the insight tasks attempted to take into account their levels of difficulty based on solution frequencies reported in (Knoblich et al., 1999), this is just one way of assigning scores, and other methods may have produced different findings. An alternative approach would have been to use the solution frequencies from the participants in the current experiment, despite the risk of sample-specific findings leading to overfitting results. Another possibility would have been to directly ask the participants how difficult they felt each task was.

A second limitation is that these algebraic matchstick tasks only can do so much in mimicking day-to-day problems that the manager faces. The wide variety of obstacles that organizations meet, and which are allocated to their managers, cannot be fully subsumed into laboratory insight tasks. However, the matchstick tasks were designed to represent the underlying problem solving process typical for managers and others (impasse and Eureka moments).

5.4 Future research

Moods are often seen as being global and diffuse by definition. However, moods can also be discrete (Mayer et al., 1995; Meeten and Davey, 2012; Raghunathan and Pham, 1999; Scott et al., 2003; Scott and Steidtmann, 2006). For instance, (Raghunathan and Pham, 1999) argued that sad people prefer high-risk (high-reward) options, while anxious people seek low-risk (low-reward) outcomes in order to reduce uncertainty. (Siemer, 2005a) argued in line with the Disposition Theory of Moods (DTM), that some moods have multiple objects attached compared to the traditional view of moods as objectless affective states. In other words, moods may both be characterized as being discretely diffuse (multiple objects) and globally diffuse (objectless). In addition, since moods and related cognitions are strongly connected (Siemer, 2005b), and the fact that misattribution easily occurs, it is tempting to argue that moods in many cases will involve appraisal tendencies as we find them in emotions, though with lower intensity. Thus, there is a need for mood-insight researchers to focus more systematically on how to identify and test discrete forms of mood.

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