

Solving Insight Problems: How watching Funny Video-clips Can Improve Creative Thinking.

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Abstract

The goal of the research was to establish if there is a difference in people's performance on insight problems solving test if they have been exposed to a funny video-clip and a neutral video-clip prior to the testing. The study also looked at the correlation between positive mood and insight problems solving as well as on the domain specificity of the insight problems. Forty-five adult subjects participated in the study. An experiment revealed that participants who have watched a funny video-clip scored slightly but not significantly better than participants who have watched a neutral video-clip. However, medium positive correlation was found between participants' good mood and the amount of insight problem solved. No evidence for domain specificity of insight problems has been found. The limitations and implications of the study are discussed.

Introduction

People have to face multiple problems in their every-day life and while some of the problems can be quite similar to one another, others may be completely different, challenging the person who has to solve them. Given the variety of problems that can be encountered, researchers attempted to categorize them along a number of dimensions. Firstly, they divided problems according to their complexity and the amount of knowledge which is needed to solve them (Eysenck & Keane, 2010). Problems may be knowledge-lean or knowledge-rich, requiring just little knowledge or a deep understanding of the problem area, accordingly. An example of a simple, knowledge-lean problem could be jigsaw puzzles, while looking for a cure for cancer would be an example of a complex, knowledge-rich problem. Secondly, problems can differ based on the specificity of knowledge needed to solve them - they can be domain general or domain specific (Robertson, 2001). Domain specific type of a problem is a problem an individual is able to solve only if they have sufficient knowledge of a particular domain such as java programming. Only a person

familiar with the Java programming language would be able to solve a problem stated in this language. Therefore a sample of people able to solve a domain specific problem can be very limited. Domain general types of problems, on the other hand, can be solved by a wider group of people, as those types of problems do not require the expertise in one particular area, but rather a general ability to work through a problem using basic skills. An example of a domain general problem would be opening a box of chocolates. Since infancy human children are surrounded by variety of box-like objects they can play with, move around, and open or close. Therefore they are familiar with these types of objects which make it easier to deal with them. Finally, there are different ways through which problems can be constructed. Researchers described well-defined and ill-defined problems, where the first ones have clear-cut solutions, like algebra problems, when the latter ones can be solved in a number of ways, e.g. reducing emission of greenhouse gases to the atmosphere (Schraw, Dunkle & Bendixen, 1995).

As stated by Robertson (2001) problem solving starts in an initial state – a situation a problem solver is in, and ends in a goal state – a situation the problem solver wished to be in. In order to arrive at the goal state, to find a solution to a problem, an individual has to engage in goal-directed cognitive processes (Anderson, 1980). An information processing model of problem solving proposed by Newell and Simon (1972) states that in order to solve a problem one has to understand it, construct an initial problem representation, establish what actions have to be taken in order to solve the problem and establish what constraints cannot be violated in order to achieve the solution.

The extent to which the initial problem representation is complete, coherent and qualitative determines the effectiveness of further steps taken by the person to solve the problem (Glaser, 1984). Such an importance of the problem representation results from the fact that it is the very foundation of the problem solving process. It shows the extent to which an individual understands the problem. Without a proper understanding of the problem structure, a person is unable to achieve the goal state (Newell & Simon, 1972). Forming an initial problem representation is determined by the person's knowledge and past experiences (Glaser, 1984) and therefore is a product of reproductive thinking. Reproductive thinking relies solely on the previously learned and applied (to the particular type of problem) methods of dealing with a problem (Eysenck & Keane, 2010). Relying on this type of information processing

seems to be beneficial in number of cases as it saves both time and mental resources. However, reproductive thinking reduces cognitive flexibility and creativity and promotes choosing typical and dominant solutions (Birch & Rabinowitz, 1951).

Reproductive thinking underlines the problem known as ‘set effect’ or ‘Einstellung’, which describes a way in which people apply previously learned strategies to solve problems which could otherwise have been approached differently and solved more efficiently (Luchins & Luchins, 1950). A popular example of mental set is a phenomenon known as ‘functional fixedness’ or fixity (Maier, 1931, Dunker, 1945 cited in Robertson, 2001; Luchins & Luchins, 1950). Functional fixedness describes a way in which people associate objects with their main functions and are unable to see that these objects may as well serve a different purpose. Parents are often amazed watching their children putting sand buckets on their heads pretending they are hats, or building tents in a middle of the room from a range of old clothes, chairs and towels. These children still haven’t developed functional fixity of these objects and can use them for any purpose they want, and therefore their thinking is more creative and innovative in a way that, as Mednick (1962) describes it, it enables them to form associative components into new combinations in order to achieve a goal.

Individuals’ prior knowledge is therefore limited and biases them in a way that they will firstly search for the most popular and successful solutions they have used in the past and only when these solutions fail, will they look for novel strategies and try to rearrange existing associations into new combinations. At this point people may engage in productive thinking instead and experience insight. Productive thinking, as described by Wertheimer (1959), is characterized by a true understanding of the problem structure, which can only be achieved once a person gives up previously learned methods of approaching the problem and is able to see the problem from a different perspective. Wertheimer (1959) believed that productive thinking is a type of reasoning closely related to insight.

Insight, as defined by Mayer (1995), is a sudden transition from an initial problem state to a goal or solution state, accompanied by so-called ‘Aha!’ or ‘Eureka!’ experience. In order to experience insight a problem solver has to overcome a cognitive impasse, a state of being ‘stuck’ in a problem (Bowden

& Jung-Beeman, 2007). Originally insight was studied by Gestalt psychologists who have used specifically designed insight problems, mainly ill-defined, to elude individuals and make them produce wrong initial problem representations which had to be re-arranged in order to achieve the solution (Mayer, 1995; Groome et al, 2006). According to Gestalt psychologists the re-representation of a problem takes place outside the conscious thought. This view of the problem contradicts Newell and Simon's (1972) theory as it suggests that insight is a unique phenomenon which cannot be accommodated within the modern information processing model of problem solving without auxiliary assumptions (Ohlsson, 1992). Nowadays, numbers of researchers believe that insight is just another type of a cognitive process and can be explained in terms of the information-processing model of problem solving (Kaplan & Simon, 1990; Keane, 1989; MacGregor, Omerod & Chronicle, 2001; Ohlsson, 1992). Representational change theory (RTC,) proposed by Ohlsson (1992), suggests that people have to rearrange their initial erroneous problem representation which arouse as a product of past experience in order to solve an insight problem (Knöblich, Ohlsson, Haider, & Rhenius, 1999). Subramaniam, Kounios, Parrish and Jung-Beemans (2008) claimed that insight problems can only be solved by means of re-arranging the initial problem representation and recognizing unusual relations between the problem components. Kaplan and Simon (1990) stated that the only 'special characteristic' of insight problems is their search space, which compared with the ordinary analytical problems, is too big to be managed. Moreover, with insight problems there are not enough constrains imposed on the problems. Therefore re-arranging the problem representation when solving insight problems is necessary as it helps to establish those constrains and narrows the problem space.

It is important to note as well that insight itself is a type of idiosyncratic experience, and can also appear when solving multistep, deductive types of problems rather than typical insight ones (Chu & MacGregor, 2011). The rationale behind this is that peoples' past experience varies significantly, and so is the organization of their knowledge and the constraints it imposes upon their problem solving abilities (Glaser, 1984). In other words, people who have frequently been exposed to problems requiring creative solutions will be better in solving insight problems than people who have not faced

so many ‘outside the box’ challenges. Additionally, insight is not entirely limited to problem solving. One can experience insight during any sensual process (sudden recognition of a smell or an object in an ambiguous picture) or by unexpectedly realizing the meaning of a joke or a metaphor (Bowden & Jung-Beeman, 2007).

On the other hand, many typical insight problems may be solved by engaging in gradual, step-by-step processing as opposed to through the insight (Chu & MacGregor, 2011). However, the way in which these types of problems are designed makes it much easier and quicker to solve them by re-arranging the problem representation than by taking a trial-and-error approach (e.g. the mutilated chequer board problem in Robertson, 2001, p.50). Therefore researchers usually classify insight problems as problems more often solved with insight than other type of processing (Subramaniam et al, 2008; Dow & Mayer, 2004; Bowden & Jung-Beeman, 2007).

Dow and Mayer (2004) have suggested that insight problems, just like other types of problems, can be domain specific and therefore it should be possible to teach individuals to solve them. In their study participants were asked to group insight problems into different categories. Most popular groupings listed by participants were verbal, spatial, mathematical and a combination of verbal and spatial insight problems. Secondly, participants were divided into groups, and every group was trained to solve one type of insight problems listed above. As predicted, Dow and Mayer (2004) found that participants trained to solve spatial insight problems performed better when solving these types of problems than the others. Moreover, those participants performed better on solving spatial problems than participants who were trained to solve other types of problems.

Insight and non-insight or analytical problem solving strategies are thought to be associated with different patterns of brain activity (Subramaniam et al, 2008). Bowden and Jung-Beeman (2000) based on their studies of processing information in left versus right visual hemifield, proposed that right hemisphere (RH) is generally involved in coarse semantic coding and forming distant associations while left hemisphere(LH) is engaged in finer coding of information and processing closely associated

chunks of knowledge. Therefore semantic activation of the alternative interpretations of insight problems may occur in the RH while LH would involve processing of dominant interpretations (which usually prove to be successful when solving analytical but not insight problems). Indeed research using neuroimaging methods including fMRI and EEG have showed that processing and solving insight problems is associated with greater neural activity in the RH than processing and solving non-insight problems (Bowden & Jung-Beeman, 2007; Bowden, Jung-Beeman, Fleck & Kounios, 2005). Bowden and Jung-Beeman (2007) have also found a significant activation in anterior cingulate cortex (ACC) amongst participants solving insight problems. ACC is commonly thought to be involved in cognitive control – a process of detecting various problem solving strategies and chains of associations available, and ability to switch between them.

Positive affect (PA), described by Estrada, Isen and Young (1994) as ‘pleasant feeling state or good mood’, was found to facilitate solving insight problems, to increase people’s tendency to engage in productive thinking processes, and probability of choosing creative problem solving strategies as opposed to noncreative ones (Subramaniam et al, 2008). In a number of studies participants in whom PA was induced showed greater cognitive flexibility in tasks involving classifying material (Isen & Daubman, 1984), forming associations to neutral words (Isen, Johnson, Mertz & Robinson, 1985), solving Remote Associates Tests (RAT, Isen, Daubman & Nowicki, 1987; Bowden & Jung-Beeman, 2003; Rowe, Hirsh & Anderson, 2007), overcoming functional fixedness when solving Duncker’s candle task (Isen et al. 1987) and in solving other creative, insight problems (Isen & Daubman, 1984; Isen et al., 1985; Subramaniam et al, 2008). The effect was also found in Estrada, Isen and Young (1997) study where the researchers were looking at more real-life type of problem-solving and asked physicians to make a diagnosis of a patient based on fictitious medical notes. Participants had to think aloud while they were looking at the case and two raters were assessing the subjects’ clinical reasoning, focusing especially on the time frame necessary for the participants to propose the correct diagnosis and the amount of anchoring they exhibit when thinking aloud. Anchoring is a type of distortion in thinking processes caused by the fact that people tend to rely on a small piece of information when solving a problem and their interpretation of any additional evidence is biased in a

way that they only accept the information which fits their initial theory while ignoring the contradictory or conflicting arguments. Researchers have found that physicians in whom PA was induced considered the correct diagnosis significantly earlier and showed significantly less anchoring than participants in the control group.

PA was also found to promote creative thinking and improve problem solving in children, who performed significantly better on word generation task and Duncker's candle problem while in PA-induced group than in neutral condition (Greene & Noice, 1988). Therefore it can be claimed that the effects of PA on creative problem solving and cognitive flexibility were observed in a variety of settings and among diverse populations.

Few theories have been proposed to explain these effects. Firstly, PA has been found to promote more global scope of attention (Rowe et al., 2007). According to the researchers, attention processes, which can be described as types of cognition that aid control of perception, thinking and behavior, depend on executive - or more specifically - inhibitory control. In their experiments Rowe and associates (2007) have shown that PA improved participant's ability to produce remote associations in a RAT task by increasing their scope of semantic access. The researchers also discovered that the same tendency took place when subjects were solving a visual selective attention task. Rowe and colleagues (2007) proposed that PA reduces inhibitory control, promotes relaxation of attentional selection and therefore increases the scope of attention. In other words, PA increases the breadth of attentional selection in participants, and therefore makes it easier for them to form distant or atypical associations between insight problems' elements and engage in search for creative solutions to the problems.

Dreisbach and Goschke (2004) proposed that PA has also an important role in regulating cognitive stability-flexibility equilibrium. They claimed that human beings continuously have to balance between distractibility and behavioral rigidity. PA, by the means of increasing the dopamine (DA) levels in the frontal brain areas, promotes engaging in impulsive but also broad range of behaviors. Indeed, in their experiment Dreisbach and Goschke (2004) have found that individuals in relatively high PA show greater cognitive flexibility but also increased distractibility, than individuals in

relatively high negative affect (NA) or even neutral affect. Both Rowe and associates' (2007) and Dreisbach and Goschke's (2004) theories suggest that PA promotes openness to the novel or non-dominant stimuli, increases chances of forming unusual associations, and enhances switching between different perspectives of looking at the problem and different problem solving strategies.

Ashby, Isen and Turken (1999) in their meta-analytic study have shown that facilitative effects of PA on creative problem solving may be accounted for the accompanying increase in dopamine release into the ACC. In numerous studies ACC was found to modulate attention (Ashby et al, 1999), cognitive control (Braver & Cohen, 2000) and to generally be involved in insight problems solving (Bowden and Jung-Beeman, 2007). Subramanian and colleagues (2008) hypothesized that as PA increases activity in ACC the participants who are in relatively good mood are biased toward engaging in creative processing prior to actually seeing the task. Using both fMRI and EEG neuroimaging methods researchers have confirmed their hypotheses and showed that rostral portion of ACC manifested the mood-insight relationship. Participants higher in PA displayed increased activity in ACC before and during creative problems solving and solved more problems with insight than by engaging in step-by-step strategies.

In the studies presented above, PA was induced in participants in a number of ways, e.g. by giving them compliments and small gifts (Greene & Noice, 1988; Estrada et al, 1997) or candies and refreshments (Isen et al, 1985; Isen et al, 1987), by showing them pictures from the International Affective Picture System (IAPS, Dreisback & Goshke, 2004), by providing booklets containing PA inducing words (Isen et al, 1985), by playing specially selected music (Rowe et al., 2007) or by showing 5 minutes of funny bloopers and movie errors (Isen et al, 1985; Isen et al, 1987). Some of the methods used by the researchers are more controversial than the others, for example rich in calories snacks might have had an additional effect on participants' behavior by increasing their levels of arousal, showing pictures or playing music relies solely on only one of the senses and as well as showing video-clip can be very prone to subjective tastes and preferences and may not necessarily induce the desired effect.

Researchers have also used a variety of tasks to measure creative thinking. In some of the studies the problems used were only supposed to be representative of the creative types of problems because of the way they were designed and used in the past. In other studies researchers actually trained participants on how to recognize creative problems and asked them to report with each question whether they have solved it with insight or by engaging in analytical thinking (Bowden & Jung-Beeman, 2003; Bowden & Jung-Beeman, 2007; Subramaniam et al, 2008). While the last method significantly increases the power of the findings and the experiment's validity, it is quite complex and imposes some statistical and interpretational difficulties upon the researchers.

This study seeks to replicate the previous findings in the area and to show the facilitative influence of PA on insight problems solving in a sample of young and middle-aged adults working and living in Dublin, Ireland. The study also aims to extend the existing literature by examining the relationship between the skills most often used by the participants to solve problems at work and the participants' scores on the types of insight problems corresponding to those skills. Two video-clips will be used in the experimental between-groups condition to influence participants' mood. Dara Ó Briain's approx 4min.-long stand-up will be used to induce positive affect in the experimental group participants. Equally long part of a Mark Thoma's lecture on econometrics will be presented as a neutral stimulus to the participants in a control group. Subjects will complete PANAS mood questionnaire (Watson, Clark, & Tellegen, 1988) after watching the video-clips and prior to solving a selection of 15 insight problems adapted from Dow and Mayer's (2004) study: Five problems from each category (verbal, spatial, and mathematical).

Participants will also complete a short demographic survey, which will provide the basic demographic information about the subjects in the study as well as present a breakdown of different types of skills used by the participants to solve problems at work.

Three main hypotheses of the study are as follows:

1. Participants who watch funny video-clip will perform significantly better on insight problems test than participants who watch neutral video-clip.

2. There will be a correlation between participants' mood and their score on insight problems test.
3. Participants who have reported to use verbal, spatial or mathematical skills in their workplace will solve more insight problems of a type corresponding to those skills.

Method

Participants

Forty five subjects volunteered to participate in the study (29 women, 16men). All of them were adult ($M_{age} = 33,3$ years; age range: 20-60years), working and living in Ireland. More than a half of participants were native English speakers ($N=25$), less than a half were foreign nationals ($N=20$). Participants came from a varied educational background, but majority of them (35%) completed 3 or 4-year degree (BA, BS). Subjects reported to use analytical and verbal skills most often when solving problems at work, less often mathematical skills and creative thinking and hardly ever spatial skills. Participants were selected from the population of employees of Dublin-based companies. Invitations to participate in the study were sent in a form of email letters, facebook messages and conventional mobile phone text messages. Supplementary email letters with consent forms attached were provided to those individuals who showed interest in the study and wished to participate.

Materials

- *Consent form*

The consent forms (see Appendix A) were provided to the participants prior to the study as well as during the experiment to ensure that subjects understand the voluntary and anonymous nature of the study as well as the possibility to withdraw from the experiment at any stage (yet prior to the data collection). The consent forms briefly

described the experimental procedure, and addressed possible risks and discomforts to the participants. Moreover, individuals who wished to get more information about the study or were seeking help or advice after the study, could find all the appropriate contacts numbers and email addresses within the consent form as well.

- ***Stimuli***

Two video-clips were used in the experiment to influence participants' mood. Dara Ó Briain's 3min.45sec. stand-up was used to induce positive affect in the experimental group participants. Equally long part of a Mark Thoma's lecture on econometrics was presented as a neutral stimulus to individuals in the control group. Both video-clips were examples of audio-visual stimulation, in which a male individual is giving a speech of either scientific or amusing nature. The video-clips were played online from the youtube.com website. No ads preceding the clips were shown to the subjects in either of the groups.

A questionnaire used for data collection contained of 4 sections (see Appendix B): a brief demographic survey, video-clip (stimulus) rating scale, PANAS mood questionnaire and insight problems test.

- ***Demographic survey***

The first section of the questionnaire aimed to obtain the basic demographic information about the participants such as their gender, age, native language and educational background. The last question in the survey was looking to establish what types of skills are usually used by the participants to solve their problems in the workplace (verbal skills, mathematical skills, spatial skills, analytical skills or creative thinking).

- ***Stimuli rating scale***

Video-clip rating has been designed to establish how funny, interesting, positive or boring, obscure and negative, according to participants, was the video-clip stimulus presented in the experiment. Subjects rated the movie in every category on a scale varying from 'Very much so' (5pts), 'Yes' (4pts), 'Hard to say' (3pts), 'Not really' (2pts) to 'Not at all' (1pt). A total score on the movie rating scale was obtained by extracting the ratings of negative values (boring, obscure, and negative; $\alpha = .75$) from the ratings of positive values (funny, positive, and interesting; $\alpha = .83$). No pilot study was conducted prior to the experiment to determine the emotional response of the participants to the stimuli which was to be presented in the experiment. The role of the stimulus rating scale was therefore to establish if the experimental group rates the stimulus high on the positive values and low on the negative values on the rating scale, and the control group rates the stimulus low on the positive values and high on the negative ones, as well as that the total video-clip rating of the experimental group is significantly higher than the rating of the control group. If such an effect was found it could have been assumed that there is a considerable chance for the stimuli used to induce the desirable affect in the participants (PA significantly higher in the experimental group than in the control group).

- ***PANAS mood questionnaire***

PANAS scale, adapted from Watson and associates (1988), was used to measure participants' affect or mood. The scale consists of 20 items (10 items representing PA, e.g. 'enthusiastic', 'interested' or 'alert', and 10 items representing NA, e.g. 'hostile', 'distressed' or 'afraid') randomly distributed. Subjects in a study are asked to rate the extent to which they have experienced particular mood state during a specified time

frame (for a purpose of this study participants were instructed to report their mood ‘at this moment’, which was the time of testing). Participants rate every item on a 5-point scale (1- very slightly or not at all’, 2- ‘a little’, 3- ‘moderately’, 4- ‘quite a bit’, and 5- ‘very much’). Appropriate scores are summed up to give indicators of PA and NA. The PANAS scale reliability is acceptably high, Cronbach’s alpha (α) ranges from .86 to .90 for PA and from .84 to .87 for NA. Scale has also been found to be internally and externally consistent and was claimed to be the most efficient mean of measuring the positive and negative dimensions of mood (Watson et al., 1988). Adapting the approach of Subramaniam and associates (2008), participants’ mood has been assessed in two ways. Firstly, subjects’ total score on the PA part of the PANAS scale has been used as an indicator of positive mood. Secondly, participants’ total score on PANAS scale obtained by extracting the NA scores from PA scores was used as an indicator of the ‘total mood’. This approach should provide a better measurement and understanding of the influence of mood on insight problems solving.

- ***Insight problems test***

Final section of the questionnaire used for data collection was insight problems test. Fifteen insight problems (verbal, mathematical and spatial; five of each category; mixed on the test sheet) were randomly selected from a sample of 67 insight problems used by Dow and Mayer (2004) in their study. Every question had only one correct answer. Participants were given 1 point for every correct answer and 0 points for every incorrect answer or no answer. Total verbal, spatial, mathematical and overall scores were calculated for every participant.

Apparatus

Due to the limited scope of time and resources, the experiment took place in three different locations (① - school classroom: $N=17$; ② - company meeting room: $N=17$; and ③- home offices: $N=11$, 2×4 participants and 1×3 participants). However, all efforts have been made to ensure the locations are as similar to one another as possible and that the time of testing is the same across different settings (1pm). All premises were equipped with chairs and desks arranged in the same way: Participants were facing the 40'' LED television set (locations ② & ③) or a board (location ①) onto which bigger but less vivid (than the one in locations ② & ③) image was displayed with a projector. Audio transfer was equally audible in all premises. Additionally, in every location rooms were well illuminated (with both natural and artificial light), relatively spacious and quiet.

Procedure

Before gaining a sample for the study and conducting an experiment Psychological Society of Ireland Code of Professional Ethics (rev. Nov, 2010) and the Dublin Business School Ethical Guidelines for Research with Human Participants & Procedures for Ethical Approval (rev. Jan, 2012) have been read and analyzed by the researcher.

On the day of testing, participants were randomly assigned to experimental and control conditions. One group was requested to stay in the initial room, when the other group was asked to move to another, similar room. Participants in both groups received consent forms to sign and demographic surveys to fill in. Next appropriate movie was projected for each group after which video-clip rating scales, PANAS mood questionnaires and insight problems tests were handed out. Subjects were requested to fill in the scales and questionnaires, and solve as many problems on the test sheet as they can in 30minutes time. Participants were also

informed that there is no need to solve the problems in the order they are in, and that it is allowable for them to skip the questions they cannot answer and proceed to the next ones. After the 30min. (or once all the participants handed in the questionnaires) debriefing procedures took place, the experiment was explained in a detail and all participants' questions were answered.

Design

Firstly, a between-subject experimental design was used to examine the impact of the funny video-clip versus the neutral video-clip on participants' scores on the insight problems test. An independent samples t-test was conducted in order to find a significant difference between the 2 groups. Secondly, a within-subjects correlational design was used to examine the relationship between participants' scores on the PANAS scale (PA, and PA-NA) and their scores on the test. Pearson's product-moment correlation coefficient (r) has been employed for this purpose. Finally, quasi-experimental between-subject design was used to establish whether there is a difference in total scores for each insight problem category (verbal, mathematical, and spatial) between participants who did and did not report to use verbal, mathematical and spatial skills (respectively) in their workplace. A Mann-Whitney U test was computed three times to assess if there is a significant difference between the groups.

Results

There were 45 subjects in the study (29 women, 16men). Mean age of the participants was 33,3years and their age ranged between 20 and 60years. Twenty-five subjects reported to be native English speakers and the remaining twenty claimed to be foreigners. Participants came from different educational backgrounds, but majority of them completed 3 or 4-year degree (BA, BS - 35%), some college (22%) or Master's degree (20%; see Figure1.).

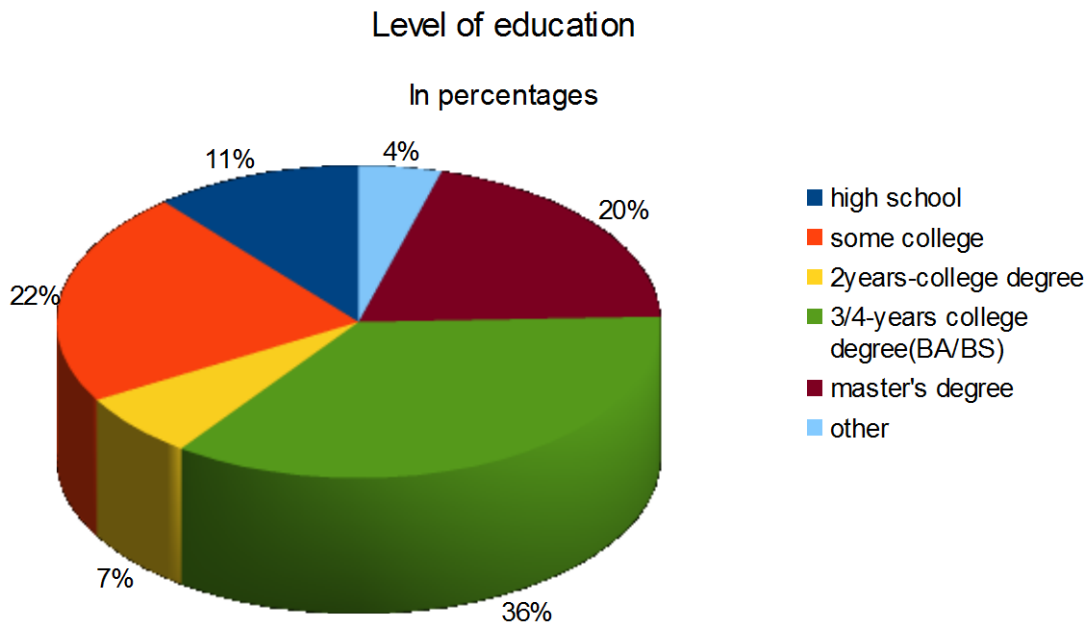


Figure1. A breakdown of the highest level of education completed by the participants in the study.

Participants answered a multiple choice question dealing with the type of skills they use most often in their workplace. The descriptive statistics presented below are the result of analyses of all five variables separately:

More than a half of the participants reported to use analytical or verbal skills when problem solving problems work. Mathematical skills and creative thinking were used by 35% of the participants each, and spatial skills were the least popular, used by only 4 subjects in the study.

As mentioned before in the method section, participants were tested in three different locations, school classroom ($N=17$), company meeting room ($N=17$), and in home offices ($N=11$). One-way ANOVA was computed to determine if the three groups differed significantly in their mean scores on the insight problems test. One-way ANOVA found there was a no significant effect of the location of testing on the participants' scores on the insight problems test [$F(2, 42) = 2.687, p = 0.080$]. However, because the significance value was not considerably higher than the acceptable .05, post hoc comparisons were used to examine

which groups varied the most between each other. Tukey HSD indicated that the biggest difference ($p=.073$) was found between mean scores of the group tested at work (company meeting room, mean =5.06, SD=3.11) and the group tested at home (home offices, mean =7.82, SD=2.48).

There were no significant differences in the participants' ratings of the experimental and neutral stimuli (on a video-clip rating scale) between the groups tested in different locations. Therefore it can be assumed that the slight differences of apparatuses used in the three locations had no effects on the results of the study.

Three main hypotheses of the study were as follows:

1. Participants who watch funny video-clip will perform significantly better on insight problems test than participants who watch neutral video-clip.
2. There will be a correlation between participants' mood and their score on insight problems test.
3. Participants who have reported to use verbal, spatial or mathematical skills in their workplace will solve more insight problems of a type corresponding to those skills.

Dependent variable in the first two hypotheses is a total score on the insight problem test.

Appropriate tests were conducted to establish if the distribution of the 'total score' variable is normal, so that parametric tests can be employed. 'Total score' variable was found to be normally distributed (Shapiro-Wilk sig. = .333), showed normally distributed Q-Q Plots and a bell-shaped histogram with a slight positive skewness ($s = .128$).

Independent samples t-test was employed to test the first hypothesis. The 'total score' was used as an independent variable (IV), and a group into which participants were randomly assigned to (control group or 'neutral movie group' versus an experimental or 'funny movie

group') was used as a dependent variable (DV). The 'funny movie group' ($N=23$) was found to score slightly better on the insight problems test (mean=6.48, $SD=3.26$) than the 'neutral movie group' ($N=22$, mean= 6.18, $SD= 3.36$). The 95% confidence limits showed that the population's mean difference of the variables lies somewhere between -1.69 and 2.29. An independent samples t-test found there was no statistically significant difference between the total score on the insight problems test between the two groups ($t(43) = .3$, $p=.765$).

Therefore the null hypothesis1 cannot be rejected. Three additional independent-samples t-tests were computed for total scores on different insight problems categories (DVs) and the group variable (IV). No significant difference was found in the participants' total scores on verbal, mathematical or spatial insight problems between the experimental and control conditions. The tests were computed in order to exclude the possibility of the experimental stimuli to influence participants' ability to solve one type of insight problems but not the others, and therefore biasing the result of the first independent-samples t-test conducted.

A Pearson product-moment correlation coefficient was computed to assess the relationship between the PA score on the PANAS scale (predictor variable – PR) and the total score on the insight problems test (criterion variable – CR) as well as the relationship between the total score on the PANAS scale (PA-NA – PR) and the 'total score' (CR). Pearson's r found there is a medium positive correlation between total score on the PANAS scale and the total score on the insight problems test ($r(45) = .378$, $p = .01$) and a slightly lower but still significant positive correlation between PA score on the PANAS scale, and the total score on the insight problems test ($r(45) = .314$, $p = .036$). Therefore the null hypothesis2 can be rejected. Overall, it can be seen that increases in the positive affect of participants as well as increases in the total score on the PANAS scale were positively correlated with increases in participants' scores on the

insight problems test. Interestingly, a weak negative but not significant correlation was found between the participants' NA and their scores on the insight problems test.

Considering that there was a positive correlation between the PA and the total score, it is hard not to wonder why the experimenter's intervention was unsuccessful. One reason for such an effect might have been the fact that the experimental group participants did not find the video-clip funny, or that the control group participants did not find the video-clip neutral.

Independent samples t-test were employed to determine if there was a significant difference in the stimuli ratings between the 'funny video-clip' and 'neutral video-clip' groups. Both groups differed significantly ($p < .01$) when rating the movie on every single dimension in a way it would be expected: experimental group rated the movie higher on positive values (interesting, positive, funny) and lower on the negative values (boring, obscure, negative) than did the control group. Independent samples t-test also found a significant difference of the total stimuli ratings between the experimental (mean=7.17, SD=2.06) and the control group (mean=-2.36, SD=4.21; $t(43)=9.576$, $p < .01$).

Distributions of participants' total scores in the three different insight problems' categories were examined. None of these arrangements was found to be normally distributed. Therefore non-parametric tests had to be used to test the hypothesis³. A Mann-Whitney U test was computed three times to assess if there is a significant difference in the total number of spatial/verbal/mathematical insight problems' scores between participants who reported to use spatial/verbal/mathematical skills (respectively) to solve problems in the workplace and participants who did not report to use this type of skills.

Participants who use mathematical skills to solve problems at work had a mean rank of 26.97, compared to the mean rank of 20.81 for the participants who do not use mathematical skills at

work. Therefore participants who use this type of skills at work, as compared to participants who do not, scored better on the mathematical insight problems tasks. However, Mann-Whitney U test revealed the two groups did not differ significantly ($z = -1.533$, $p = .125$).

Participants who use verbal skills to solve problems at work had a mean rank of 21.44, compared to the mean rank of 24.95 for the participants who do not use this type of skills at work. Therefore, interestingly, participants who use verbal skills at work scored worse on the verbal insight problems tasks than participants who do not use verbal skills in the workplace. Although, Mann-Whitney U test found the two groups did not differ significantly ($z = -.915$, $p = .360$).

Finally, participants who use spatial skills when solving problems at work had a mean rank of 26.25, compared to the mean rank of 22.68 for the participants who do not use this type of skills to solve problems in the workplace. Therefore, participants who use spatial skills at work (although it has to be mentioned there were only 4 such participants) scored better on the spatial insight problems tasks than participants who do not use spatial skills when solving problems at work ($N = 41$). Mann-Whitney U test found the two groups did not differ significantly ($z = -.569$, $p = .569$). Therefore the null hypothesis³ could not have been rejected.

An independent samples t-test was computed to examine if there was any difference between male and female participants in the mean scores on the insight problems test (see Figure 2.). Mean score for males (mean = 15.19, SD = 9.06) was found to be significantly higher than the mean score for females (mean = 11.55, SD = 9.29; $t(43) = 3.613$, $p = .001$). However, when the data was split into the experimental and the control group conditions, and then retested, the gender difference between the mean scores on the insight problems test was only significant

for the experimental group. When analysing males and females' scores on PANAS questionnaire, men were found to score higher on the PA and lower on the NA than the female participants. However, independent samples t-tests found that the differences between the scores were not significant ($t(43) = .757, p = .453$ for PA; $t(43) = -.986, p = .330$ for NA).

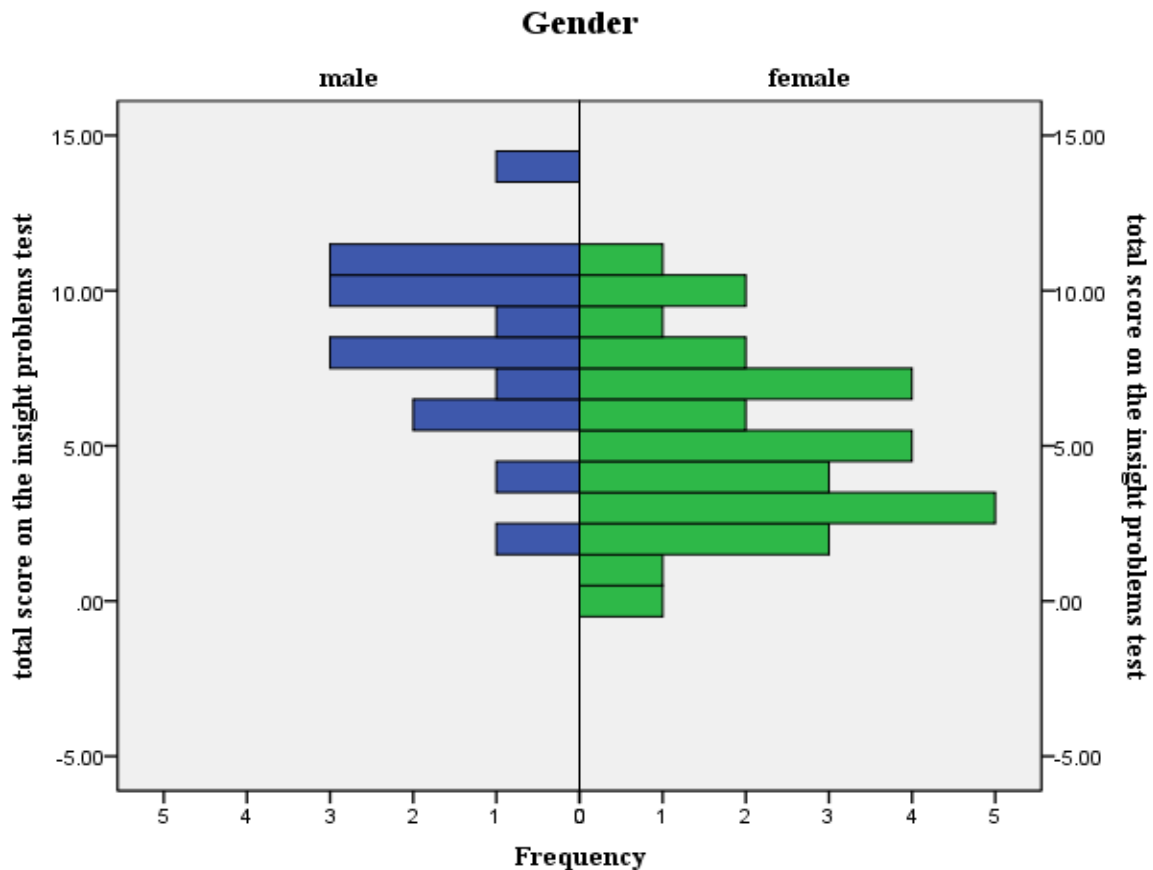


Figure 2. Presents the gender differences in frequencies of total scores on the insight problems test

Additionally, independent samples t-tests were conducted to examine if there are differences in the total scores of participants who did and did not report to use analytical skills or creative thinking when solving problems at work.

Participants who reported to think creatively when solving problems at work scored slightly better on the insight problems test (mean=6.81, SD=3.88) than participants who did not report to engage in creative thinking (mean= 6.07, SD= 2.93), although the difference was not

significant ($t(43) = .725, p=.472$). However, inversely to what would be expected, participants, who reported to use analytical skills to solve problems at work scored significantly better on the insight problems test (mean=7.14, SD=3.18) than participants who did not report to use analytical skills when problem solving at work (mean=5, SD=3.06). An independent samples t-test found there was a significant difference between the two groups ($t(43)=2.22, p=.032$).

Participants, who have accomplished 2-years college degree had the highest mean score on the insight problems test (mean=10.33, SD=1.15), participants with MA degree had the second highest mean score (mean=9.11, SD=2.98), while the lowest mean score was found in the participants who reported to accomplish 'Other' type of education (mean=3.5, SD=.707). The mean score on the insight problems test was therefore not determined by the level of education completed by the participants in the study. It has to be taken into an account, however, that some of the groups had only few participants in them, and therefore the results of the study in this case can be biased.

A correlation between participants' age and their total score on the test was slightly negative but not significant ($r(45)=-.068, p=.657$).

Discussion

The current study looked at the effects of positive video-clip versus neutral video-clip on participants' ability to solve insight problems. Participants who have watched a comedian's stand up prior to solving problems scored slightly better than participants who have watched equally long part of an econometrics' lecture, however, no significant difference was found between the two groups. No pilot study was conducted prior to the experiment to determine if the emotional response of the participants to the stimuli will be the one desirable, but stimuli

rating scale was filled in by the subjects after showing the movies and significant differences were found between the video-clip ratings given by the participants in the control and the experimental condition. Yet, watching the video-clips differing in the amount of positive emotional stimulation did not influence participants' affect. It can be assumed that the clip used in the study was too short to induce a considerable mood change. However, in Isen and associates' studies (1985; 1987) the comedy movies or tv bloopers were presented to the participants over a 5min.-period, therefore only 1min longer, though they significantly improved the participants' mood. Nonetheless, it cannot be omitted that Isen and associates (1985; 1987) withdrew their participants from a population of college students, which group may be (due to e.g. the young age, hormone fluctuations, etc.) especially prone to mood swings and changes. Young students can be also more stimulated by a type of the entertainment such as comedy film than the middle-aged participants. Therefore it can be assumed that either the results presented by Isen and colleagues (1985; 1987) apply exclusively to the students' sample or that relatively broad age range used in the current study accounted for the lack of significant results. Hence if the study was to be replicated, it would be highly recommended to use a bigger sample size.

The study was also looking to find a correlation between the participants' mood and their scores on the insight problems test. Indeed, medium positive correlation was found between the participants PA (as well as PA-NA) and the number of correct answers given to the insight problems tasks. Therefore the previous findings suggesting facilitative effects of the PA on insight problem solving abilities seem to be applicable to the population of professional adults living in Dublin.

The final hypothesis in the study stated that participants who have reported to use verbal, spatial or mathematical skills in their workplace should solve more insight problems of a type corresponding to those skills. No effect was found in the line with this hypothesis. It can be assumed that this part of the study could have been influenced by the fact that participants reporting what types of skills they use in the workplace, might not have been fully conscious of the meaning behind the labels presented to them for each set of the skills. A greater depth of information may have been obtained in the study if appropriate descriptions and explanations of different types of problem solving skills have been offered to the subjects.

Other limitation to the study, but also a great inspiration for a further research, was the use of different testing locations. It could have been seen that the mean scores of the group tested at work and the group tested at the home office differed between each other, even though not significantly. Although, statistical analyses found there was no difference in terms of the emotional impact of either experimental or neutral stimulus between the different locations, therefore another extraneous variable might have an effect on the participants' performance. If a further research was to be conducted it would be advised to look at, for example, differences in stress, arousal, motivation, attention, distractibility or relaxation between the participants tested on the insight problem solving abilities in work and home settings.

An unexpected effect found in the study was the significant difference between the individuals who reported to use analytical skills at work and their total score on the insight problems test, which was significantly higher than the score of participants who did not report to use analytical skills in the workplace. This pattern was just the opposite of what would be expected. Participants, who engage in analytical problem solving on a daily basis, should be more inclined to use this type of reasoning rather than creative thinking while solving insight

problems, and therefore should be less successful on the test than participants who did not report to use analytical skills at work. Again, however, the finding can be accounted for the lack of appropriate explanation of the skills presented in the question. On the other hand, though, it cannot be asserted that participants did not use analytical skills to solve the problems in the test, and that indeed, those skills have proved to be helpful. Participants, unlike in the Bowden and Jung-Beeman's (2003; 2007) or Subramaniam and associates' (2008) experiments, were not asked to report whether they solved the problem with or without insight. Thus it may be possible that participants managed to solve the insight problems using analytical reasoning as opposed to creative problem solving.

The data analysis revealed there was a significant gender difference in the total number of successfully solved insight problems. Male participants scored significantly better on the insight problems test than female participants. However, the majority of the male participants have been assigned to the experimental condition, which could hypothetically increase their chances score higher. For this reason split cases analyses had to be conducted to establish if the gender difference would still be present if different experimental conditions were examined. What has been found was that males, again, scored significantly better than women when in the experimental condition, but not in the control group (yet, the result was close to the significant with $p=.06$). The gender difference in the 'funny video-clip' condition may suggest that male participants might have found the experimental stimulus more entertaining than female participants (indeed, higher, however not significant, scores on the PA for men than women) and therefore could have experienced the facilitative effects of PA to the greater extent. Yet, further research would be required to understand the phenomenon.

To conclude, the study provided some evidence in favor of the hypotheses proposed at the beginning and some evidence against them. However, the quantitative data that has been collected during the study provides interesting literature for those who have an interest in the area and indicates where the further research may be required.

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Appendix A

Consent to be a Research Subject

Introduction

This research study is being conducted by Agnieszka Piecuch at Dublin Business School to determine the link between mood and problem solving.

Procedures

You will be asked to complete a brief demographic survey and 15 problem-solving tasks. The whole study will be entirely anonymous and will not take more than 1hr

Risks/Discomforts

There are minimal risks for participation in this study. However, if you feel emotional discomfort after the study you can email Agnieszka Piecuch directly on [REDACTED] or contact Samaritans on Tel: (01) 671 0071 or E-mail:jo@samaritans.org

Benefits

There are no direct benefits to subjects. However, it is hoped that your participation will help us learn more about the link between the mood and problem solving abilities.

Confidentiality

All information provided will remain anonymous and will only be reported as group data with no identifying information. All data, including surveys will be kept in a secure location and only those directly involved with the research will have an access to them. After a year of the research submission the data will be destroyed.

Participation

Participation in this research study is voluntary. You have the right to withdraw from the study or refuse to participate at any time until the data is collected. After data collection it will be impossible to withdraw from the study due to its anonymous nature.

Questions about the Research

If you have questions or you would like to address any issues in relation to the study you may contact Agnieszka Piecuch on [REDACTED]

I have read, understood, and received a copy of the above consent and desire of my own free will and volition to participate in this study.

Signature:

.....

Appendix B

DEMORGAPHIC SURVEY

1. Are you male or female?
 - a) Male
 - b) Female

2. What is your age?

3. What is the highest level of education you have completed?
 - a) Less than High School
 - b) High School/GED
 - c) Some College
 - d) 2-year College Degree(Associates)
 - e) 3 or 4- year College Degree(BA,BS)
 - f) Master's Degree
 - g) Doctoral Degree
 - h) Professional Degree(MD,JD)
 - i) Other

4. Is English you native language?
 - a) Yes
 - b) No

5. What skills do you use most often to solve problems at work?*[you can choose more than one]*
 - a) Mathematical
 - b) Spatial
 - c) Verbal
 - d) Analytical
 - e) Creative thinking

Video-clip Rating Scale

'Did you find the movie...' [Rate the video by simply ticking an appropriate box in every category]

	Very much so	Yes	Hard to say	Not really	Not at all
• Interesting					
• Funny					
• Positive					
• Boring					
• Obscure					
• Negative					

PANAS Scale

Insight Problems Test

Smith Family: In the Smith family, there are 7 sisters and each sister has 1 brother. If you count Mr. Smith, how many males are there in the Smith family?

Dancing: Three couples went together to a party. One woman was dressed in red, one in green, and one in blue. Each man was wearing one of these colors. When all three couples were dancing, the man in red was dancing with the woman in blue. "Isn't it funny Christine, not one of us is dancing with a partner dressed in the same color." Think about the man who is dancing with the woman in red. What color is he wearing?

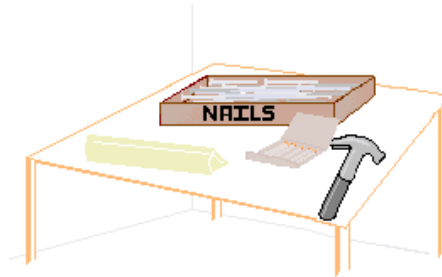
Basketball: Our basketball team won a game last week by the score of 73-49, and yet not even one man on our team scored as much as a single point. How is that possible?

Letter Z: Can you figure out where to put the letter Z, top or bottom line and Why?

A EF HI KLMN T VWXY

BCD G J OPQRS U

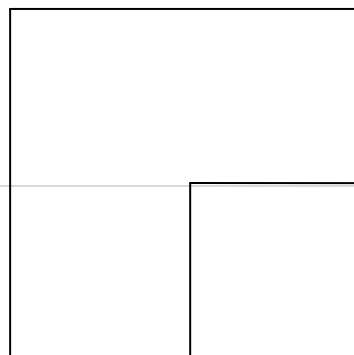
Candle: Given the material below how can you attach the candle to the wall above the table so that the wax does not drip on the table?



Widow: Is it legal for a man to marry his widow's sister? Why or why not?

Coin: One archaeologist reported finding a Roman coin with Julius Caesar's image on it, dated 21 B.C. Another archaeologist correctly asserted that the find was a fraud. Why?

Figure: Show how you can divide this figure into four equal parts that are the same size and shape



Earth: It is estimated that the earth weighs 6 sextillion tons. How much more would the earth weigh if 1 sextillion tons of concrete and stone were used to build a wall?

Water lilies: Water lilies double in area every 24 hours. At the beginning of summer there is one water lily on the lake. It takes 60 days for the lake to become completely covered with water lilies. On which day is the lake half covered?

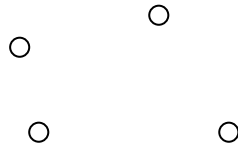
Eyes: Yesterday I went to the zoo and saw the giraffes and ostriches. Altogether they had 30 eyes and 44 legs. How many animals were there?

Trees: A landscaper is given instructions to plant four special trees so that each one is exactly the same distance from each of the others. How is he able to do it?

Horse: A man bought a horse for \$60 and sold it for \$70. Then he bought it back for \$80 and sold it for \$90. How much did he make or lose in the horse trading business?

Captain: Captain Scott was out for a walk when it started to rain. He did not have an umbrella and he wasn't wearing a hat. His clothes were soaked yet not a hair on his head got wet. How could this happen?

4 dots: Without lifting your pencil from the paper, show how you could join all 4 dots with 2 straight lines



THANK YOU!!!