

Humor as a Facilitator of Insight Problem Solving

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Abstract

Humor can improve a performance of creative problem solving; this phenomenon was repeatedly demonstrated in various studies. However, mechanisms underlying this phenomenon are still unclear. We analyze the possible mechanisms of how humor facilitates creative problem solving. The experiment demonstrates that preliminary humor production facilitates insight problem solving. There is no such an effect in noninsight problems. Humor and stress relief similarly facilitate visual insight problem solving. We suggest that facilitation effect of humor and stress relief is based on the attentional mechanisms of defocusing.

Keywords: insight, humor, problem solving, facilitation

Research problem

A few studies have shown that an affective influence facilitates the creative problem solving and creativity (Isen, Daubman, Nowicki, 1987; O'Quin, Derks, 1997; Ziv, 1976). The correlation between creative problems solving and humor is repeatedly confirmed (Gick, Lockhart, 1995; Korovkin, Nikiforova, 2014; Kozbelt, Nishioka, 2010; Martin, 2006). An understanding of humor, humor production, "sense of humor", humor as a heuristic for problem solving are analyzed in the context of problem solving. A number of theoretical models consider a humor as a component of creative thinking (Koestler, 1964; Mednick, 1962; Torrance, 1966).

Humor can not be unambiguously attributed to the affective or cognitive processes; hence definition and operationalization of humor and its effects on solver are strongly hindered. To understand the possible mechanisms of relationship between humor and problem solving process we should compare their psychological components. Processes underlying humor production and understanding are similar to insight problem solving process in many ways. The list of similarities include affective and cognitive processes, which, in our opinion, are related to common nature of humor and insight.

A number of common features can demonstrate structural and phenomenological similarity of insight and humor. First, an instantaneous understanding is the basis of humor and insight (Kozbelt, Nishioka, 2010). Traditionally, both humor and insight are associated with

the instantaneous restructuring of representation, which is necessary to understand a problem or a joke. The study of relations between humor comprehension and humor production showed weak correlation (Kozbelt, Nishioka, 2010). Participants' appraisal of cartoon funniness is negatively correlated with "latent content" cartoon comprehension in humor comprehension tasks. This fact, according to the authors, supports an insight nature of humor comprehension. At the same time, results of the humor production tasks show smaller support for insight nature of humor production. The instantaneity of problem and joke grasp is associated with gestalt-principle of restructuring of representation. However, it was found that the less time is given to comprehension and appraisal of joke, the funnier the joke becomes. In other words, funniness of the joke is negatively correlated with the effort for its comprehension and explanation. However, phenomenological instantaneity of insight apparently is not associated with the speed of problem understanding. Insight requires long preparatory phase, which is referred to as an incubation of solution.

Second, insight and humor are accompanied by positive emotions, which are connected with the understanding of a problem or a joke. The positive emotion can persist even after an experimenter told a right answer or explained a joke, when a solver was not able to understand a joke or a problem. A special genre of creative (insight) problems, which has a common structure with a verbal joke, is funny riddles (Smullyan, 1978). A funny riddle has attributes of a creative problem and a verbal joke in its structure. If the problem cannot be solved independently, and an answer will soon be told, this problem turns into a joke, because the solver perceives the problem or the answer as inappropriate and dishonest. Common experience of humor comprehension and "aha-reaction" has similar components, such as unexpectedness and astonishment. In both cases, an emotional state and emotions are positive. Insight problem solving can be presented as sudden restructuring of representation, frame shifting or script switching.

Third, problem solving and understanding of jokes are based on the internal conflict or collision between at least two cognitive schemes. A text can be interpreted as a humorous, if two conditions are observed: 1) text is

compatible and actualizes two different scripts; 2) these scripts are opposite (Attardo, Raskin, 1991; Raskin, 1985). The scripts contradiction provides perception of the text as humor by three basic oppositions: 1) real - unreal situation, 2) expected - abnormal, unexpected situation, and 3) possible - impossible situation. Verbal jokes consist of several components. The components or knowledge resources can be presented as a hierarchy, which defines variability of jokes. These knowledge resources are script opposition (SO), logical mechanism (LM), situation (SI), target (TA), narrative strategy (NS) and language (LA) (Ruch, Attardo, Raskin, 1993). Hypothetically, the components of logical mechanism and situation are closely related to problem solving. Logical mechanisms of jokes are a variety of logical errors, such as straightforward juxtapositions, false analogies, figure-ground reversals etc. Scripts of jokes, which are perceived as comic, often involve limited number of binary categories: real/unreal, true/false, good/bad, death/life, obscene/decent, rich/poor, etc. According to Wyer and Collins (1992), humor involves simultaneous activation of two schemes of one situation. However, situation becomes comic and humorous if a new scheme, which causes reinterpretation, is perceived as less serious and less informative. Moreover, the situation is perceived as more humorous when activation of the alternative scheme requires more effort and time, i.e. more semantically distant schemes are perceived as more comic.

4. Humor and insight problem solving are likely to involve a violation of prohibitions. One of the possible mechanisms of thinking “outside the box” and functional fixedness overcoming in insight problem solving is relaxation of constraints in strategies and problem representation (Knoblich et al., 1999; Öllinger, Jones, Knoblich, 2008). Verbal joke can be perceived as humorous under the following conditions: 1) two contradictory ideas must be actualized; 2) the actualization should be carried out in a playful state in unserious and secure conditions (Apter, 1982), 3) content of jokes must be associated with prohibitions and restrictions (with threats, norms and taboos) (McGraw, Warren, 2010; Minsky, 1984). These necessary for humor conditions are also typical for insight problem solving in some sense. One of the hypothetical mechanisms of impasse in problem solving is constraint on the possible solution consideration, which can be overcome by constraint relaxation (Knoblich et al., 1999). The content of funny humor is close to the constraints, taboos and experience of possible consequences. However, humorous reaction to possible threat manifests of this threat become softened and located at the safe distance (McGraw, Warren, 2010). Both the content of jokes and frames collision as insoluble logical paradox can cause a threat. In this case, humor is an emotional form of thinking process and logical problem solving cancellation (Minsky, 1984).

Cognitive mechanisms are associated with the actualization of contradictory scripts and ways of solving the two scripts collision. These mechanisms may contribute to overcome the limitations in problem solving by variation of a set of heuristics and problem elements. They can create presetting of remote associations searching and contribute to “go beyond” in representation of a problem. The impact of cognitive mechanisms can be content specific and content nonspecific.

Affective (affective-regulatory) mechanisms of humor, in its turn, aim to reduce emotional strain in a situation of problem solving, as well as contribute to increase the overall level of resources, which it related with the efficiency of problem solving.

In this experiment, we planned to reproduce the effect of facilitation of insight problem solving by humor and to answer a number of potential objections to this phenomenon. First, the standard research paradigm of humor and affective facilitation studies involves the presentation of positively stained stimuli (such as video fragments). In this case, we observe a passive perception of humor and emotional reaction to a joke. Participants in positive mood respond more originally and creative; they set remote associations and solve insight problems more sufficiently. In this study, we plan to test a reproducibility of the effect of facilitation provided by participant’s humor production. Humor production can include additional cognitive mechanisms of joke generation, which can affect the problem solving in another way.

Second, humor facilitates insight problem solving, but its specificity for insight problem requires verification. We need to compare how humor affects the insight and noninsight problem solving. In addition, humor can differently facilitate different types of representation formats that can indicate different mechanisms of facilitation. In this study, we decided to compare textual format (semantic processes) and visual format (perceptual processes).

Third, the humor has a social nature, and insight can be a phenomenon of social interaction. The situation of the experiment, which tests the participant’s ability to solve creative problems, itself, can be a source of frustration, stress, and excessive motivation, which can reduce an effectiveness of insight problem solving. Hence, facilitation may be a consequence of stress relief in the situation of communication with an experimenter. We have tried to include the variable of stress relief via a confidential conversation between the subject and the experimenter. According to our idea, such a conversation can reduce motivational and emotional stress in respect of problem solving as well as a humor.

Hypothesis

The hypotheses are:

1. Humor production facilitates insight problem solving.

2. The effect of facilitation of insight problem solving is a result of stress relief in the situation of interaction with an experimenter.

3. Humor specifically facilitates insight problems of various representation format.

Participants

The main study sample consists of 36 participants, aged 17 to 45 years ($M = 24.3$, $\sigma = 6.96$). The study involved university and school students, people with secondary and higher education. All participated on a voluntary basis, without additional motivation. The preliminary study sample consists of 10 participants, aged 20 to 22 years ($M = 20.8$, $\sigma = 0.79$), to equalize the difficulty of problems.

Procedure

Before the experiment, a set of six problems was established. According to results of the preliminary study with 10 participants who did not participate in the main series, we selected four problems with equal time of solution to control difficulty for the main series of the experiment. We used two types of problems: insight and noninsight problems and two types of representation format: textual and visual format. The textual insight problem: “Two men play five games of checkers. Each man wins the even number of games. There are no ties. How is that possible?” The textual noninsight problem: “There are five bulbs: red, green, yellow, blue and gold. How many ways are there to decorate five trees if you want each tree to wear only one bulb?” The visual insight problem: “Remove three matches to get only three triangles”. The visual noninsight problem: “Find the perimeter of the given figure. The dimensions are 1 cm x 1 cm. Give an answer in square centimeters.”

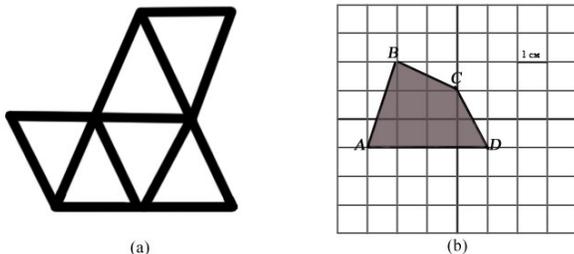


Figure 1. Visual insight (a) and noninsight (b) problems.

Participants of the main series of the experiment were divided into three groups: two experimental and one control conditions. In the first experimental condition (humor production), participants performed a humor priming tasks: humorous questions (example: “What bookworm does while fishing?”) and joke completion task (example: “Holiday romance in Thailand...”). Participants had to complete jokes or answer the questions originally and unusually. The second experimental condition (stress relief) was designed to relieve participant’s stress during the communication with the experimenter. Stress relief was carried out by means of a confidential conversation

using the sentence completion test (examples: “Most of all, I would like...”, “I hope that...”). Two experimental conditions were equalized by using the same number of statements for the completion. In the control condition (neutral condition) participants did not receive stimuli for emotional priming.

Each group of participants received four problems to solve. In each group, the emotional priming corresponding to the condition was presented before each problem solving. The duration of problems and priming tasks performance was pre-equalized. The sequence of priming tasks and problems was randomly varied. Time of each problem solving is the efficiency parameter of the experimental exposure. Statistical analysis was performed using ANOVA with repeated measures, Mann-Whitney U-test, Wilcoxon T-test.

Results

Participants solved the presented problems completely. According to the ANOVA with repeated measures, the factor of problems type significantly affects the time of solution ($F(1, 144) = 12.15$, $p < .001$, $\eta_p^2 = .27$). Humor significantly facilitates insight problem solving. There are significant differences in solution time between insight and noninsight problems in the stress relief condition ($T(24) = 43$, $p < .01$) and humor production ($T(23) = 49$, $p < .01$), whereas there are no such differences in neutral condition.

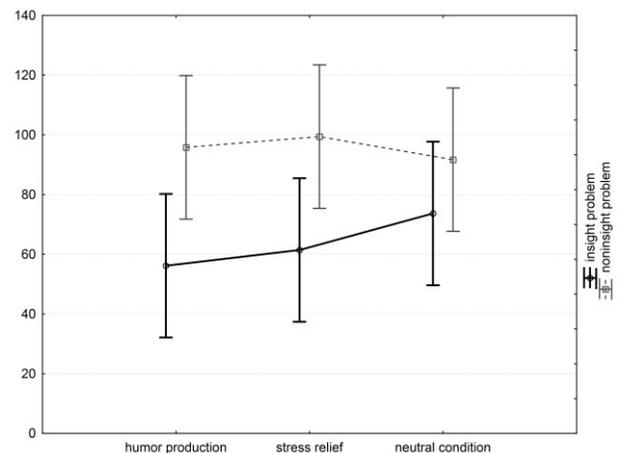


Figure 2. The solution time (sec.) of insight and noninsight problems in experimental conditions. Vertical bars denote 0.95 confidence intervals.

As a result of the one-way ANOVA with repeated measures, we did not found the effect of the type of conditions in general ($F(2, 144) = .15$, $p = .86$, $\eta_p^2 = .002$). At the same time, a pairwise comparison of the time of problem solving in various conditions shows that there are only significant differences between the condition of humor production and neutral condition ($U(24) = 165$, $p = .012$) in insight problem solving. The rest of the pairwise comparisons within insight and noninsight problems are not significant. Comparison of stress relief condition with a neutral condition in insight problem solving also

showed no significant differences ($U(24) = 212, p = .12$). This means that the stress relief is not enough for the effect of facilitation.

In addition to differences between insight and noninsight problems there are significant differences in problem solving of various representation formats ($F(1, 144) = 36.38, p < .001, \eta_p^2 = .52$). Visual problems are solved quickly in general. The interactions between problem type and the type of representation was not found ($F(1, 144) = .35, p = .56, \eta_p^2 = .01$).

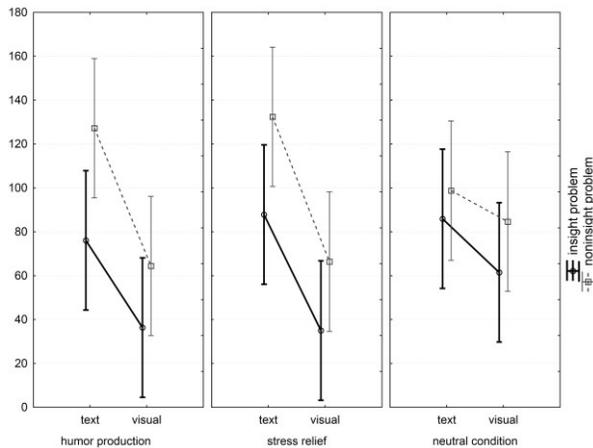


Figure 3. The solution time (sec.) of insight and noninsight problems in experimental conditions depending on the format of representation. Vertical bars denote 0.95 confidence intervals.

Interesting results were obtained in the analysis of the interactions between problem type and the type of representation in each of the three conditions. In neutral condition the effects of problem type ($F(1, 48) = .9, p = .36, \eta_p^2 = .08$), the type of representation ($F(1, 48) = 3.79, p = .08, \eta_p^2 = .26$) are not significant, as well as interaction between factors is not observed ($F(1, 48) = .2, p = .66, \eta_p^2 = .02$). In the stress relief condition there is a significant effect of problem type ($F(1, 48) = 21.96, p < .001, \eta_p^2 = .67$), and type of representation ($F(1, 48) = 31.82, p < .001, \eta_p^2 = .78$), however there is no interaction between these factors ($F(1, 48) = .27, p = .61, \eta_p^2 = .02$). The type of representation significantly affects the solution time in the condition of humor production ($F(1, 48) = 9.63, p < .01, \eta_p^2 = .47$). The value of the level of problem type influence is on the border of significance ($F(1, 48) = 4.76, p = .052, \eta_p^2 = .3$), the interaction of factors is also not observed ($F(1, 48) = .63, p = .44, \eta_p^2 = .05$).

Pairwise comparisons of each type of problems in different conditions show that there is a significant shift in visual insight problem solving compared to the neutral condition under the stress relief ($U(24) = 27.5, p = .011$) and humor production ($U(24) = 36.5, p = .043$). In all other cases, the solution time is not significantly different from the neutral condition.

Discussion

Thus, humor production can facilitate insight problem solving. There is no significant effect of humor production in noninsight problem solving. We found that participants solve insight problems in humor production condition significantly faster comparing to neutral condition. These findings are supported by a) the aggregate data: humor production condition significantly different from the neutral condition without reference to types of representations; and b) visual format of representation data: humor production condition significantly different from the neutral condition in solving of visual insight problems. That means that humor specifically affects creative problems and this supports the assumption about the relationship between humor and the creative process. At the same time, we have not found the facilitation effect in textual insight problem solving.

The most previous studies demonstrated that humor comprehension facilitate insight problems. There was a lack of information about how participant's activity in the humor production influences problem solving. We can conclude that the production of humor can facilitate insight problem solving as well as the humor comprehension. Hypothetically, the mechanisms of facilitation by the humor production and the humor comprehension may be common or similar.

We have received conflicting data on the role of stress relief in insight problem solving. On the one hand, the average data show that the stress relief is not sufficient to affect insight problem solving in general. It may be interpreted as stress relief is an important component of humor that can contribute to facilitation in a situation of communication with an experimenter, but simple relaxation is not enough to improve the efficiency of problem solving. On the other hand, an independent review of the data of problem solving with the different formats of representation demonstrates that stress relief as well as humor similarly affects problem solving. Neither stress relief nor humor does not affect the textual insight problem solving. However, both stress relief and humor significantly affect the visual insight problem solving. It means that stress relief and humor affect insight problems the same way. Relaxation (or stress relief under the experimental conditions) can be an important component of the facilitation, particularly, of visual insight problems.

We found that humor specifically facilitates insight problems of the various formats of representation. Humor significantly facilitates only visual insight problem solving. There is no facilitation effect in the textual insight problem. As mentioned above, the stress relief condition demonstrates the same pattern.

These results can be interpreted from the different points of view. First, we assumed that humor as well as stress relief facilitate problem solving via a change in social interaction between participant and experimenter. Relaxation, the tension reducing, and the motivation decreasing must affect insight problems in general.

However, we can see clearly that facilitation effect has representational specificity, which is difficult to interpret solely by social interaction.

Second, we can use the working memory model to understand how different representations of problems are related with independent variables (humor production and stress relief tasks). The problems' formats of representation used in the experiment are correlated with the slave systems of working memory (Baddeley, Hitch, 1974). It can be assumed that the visual problems are related to the visuospatial sketchpad, which is a storage of visual and spatial information in working memory. Likewise, the textual problems are related to the phonological loop, which is a storage of auditory and articulatory information. The experimental impact was performed in textual format (questions and a sentence completion tasks). However, this model can predict inhibition effects of parallel processing of information in the same storage, but it is hard to explain facilitation effects via the storage specificity. Moreover, the generally accepted data that decrease of central executive functions is associated with insight problem solving cannot shed some light on the mechanisms of visual and textual specificity of the insight problems.

Third, one of the possible interpretations of the facilitation effect is arousal increase. Arousal can provide an additional cognitive resource for problem solving. However, arousal should have a nonspecific impact on problem solving. It is not clear why insight problems are more sensitive to arousal than noninsight problems as well as why visual insight problems are more sensitive to arousal than textual insight problems.

Fourth, we assume that a crucial difference between facilitation effect of humor and stress relief is based on the attentional mechanisms. Facilitation effect appears to be associated with low-level perceptual processes, because the effect is significant only in the visual insight problem. Insight problems are related to perceptual processes of gestalt restructuring (Duncker, 1945) and chunk decomposition (Ohlsson, 1992) which are most often referred to insight problem solving. Perceptual mechanisms can influence problem solving indirectly, for example, through the processes of attention. Humor and stress relief can reduce the concentration of attention (Rowe, Hirsh & Anderson, 2007), provide a "peripheral focus" and make perceptive and thought patterns instable. Humor and relaxation reduce a concentration of voluntary attention as the executive function of working memory. These assumptions are confirmed by data showing that participants with low working memory capacity are more sensitive to background hints (Ansburg & Hill, 2003) and patients with lesions of the prefrontal cortex more sufficient in insight problem solving (Reverberi et al., 2005).

Finally, we have to notice some limitations of the research. In our experiment, we used only two insight problems. The visual insight problem can be solved via

defocusing of the visual representation of triangles presented to the participants. Nevertheless, the textual insight problem used in the experiment do not have key markers of representation in text that should be defocused. This problem is based on the biases of mental models of the proposed situation. Thus, the insight problems used in our research have different formats of representation and different structures.

We can conclude that our experiment demonstrated that humor production facilitates insight problem solving. Humor and stress relief similarly affects insight problem solving which allows us to assume the common or similar nature of facilitation mechanisms. Humor specifically facilitates visual insight problem solving. We suggest that facilitation effect of humor and stress relief is based on the attentional mechanisms of defocusing. However, the specific facilitation of the representational format and the problem structure in insight problem solving requires further investigation.

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