Anima, Indonesian Psychological Journal
2013, Vol. 28, No. 4, 179-191

Taking Humor Serious: Effects of Humor on Anxiety, Motivation, and Learning in Statistics

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Research has shown that humor and the resulting laughter can reduce tension and increase well-being. If humor could also reduce anxiety the use of it may be especially beneficial for the students in dread courses like statistics. This paper reviewed studies about the effect of humor used in statistics lectures on motivation, statistics anxiety, and learning. Results showed that humor has a positive effect on motivation and it further can reduce anxiety. Humor has also been shown to have a memory-enhancing effect but findings about the effect on learning and recall in statistics classes are inconsistent and require further research.

Keywords: humor, anxiety, motivation, learning, statistics

Penelitian menunjukkan bahwa humor dan tawa yang dihasilkan dapat meredakan ketegangan dan meningkatkan rasa nyaman. Bila humor juga dapat mengurangi kecemasan, pemanfaatannya mungkin bermanfaat khususnya untuk para mahasiswa dalam kuliah menakutkan seperti statistik. Artikel ini mereview kajian-kajian tentang efek humor yang dipakai dalam kuliah statistik terhadap motivasi, kecemasan terhadap statistik, dan belajar. Hasil menunjukkan bahwa humor menimbulkan efek positif terhadap motivasi dan selanjutnya mampu mengurangi kecemasan. Humor juga telah menunjukkan mampu meningkatkan ingatan, namun temuan tentang efek terhadap belajar dan mengingat kembali dalam mata kuliah statistik tak konsisten dan membutuhkan penelitian lebih lanjut

Kata kunci: humor, kecemasan, motivasi, belajar, statistika

During adolescence the students' motivation and academic achievements tend to decline (Peetsma, Hascher, van der Veen, & Roede, 2005). This is especially the case after the transition from elementary to junior high school (Eccles & Midgley, 1989). What might be the reasons for this motivational decline? Eccles & Midgley proposed that this decline may be explained by an interaction between physical maturation and the changes in the social environment that adolescents experience. But when we think about how school was in elementary school and how it became in secondary school one may get a gist to understand this motivational decline. In elementary school children are taught with play, school is "fun" and children are eager to learn more. Thus, intrinsic motivation is much supported in the first years of elementary school. By the transition from elementary to junior high school the pupils' confidence in their math abilities and their interest in learning mathematics dramatically declines (Eccles & Midgley). Eccles and Midgley proposed that systematic differences between elementary schools and junior high schools may account for the motivational problems. However, the authors were not able to specify what exactly those systematic differences are. But one could expect that it may have to do with the instructions at school which may not wake as much interest in pupils as it is the case for instructional material in elementary school. Another possibility may be that the role of extrinsic rewards (e.g. good grades, social comparison) after the transition to junior high school decreases the pupils' intrinsic motivation for learning mathematics (Myers, 2010).

Intrinsic motivation has often been associated with interest, because intrinsically motivated people do things out of interest and not because they are expecting a reward (Carr, 2011). The behavior of the intrinsically motivated

The Author thanks Loes Kessels, who supervised wholeheartedly during the preparation of this article.

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person during that special task is usually characterized by concentration and engagement (Carr). The strongest form of interest is what Csikszentmihalyi (1990) has termed "flow", a state wherein a person is totally absorbed by an activity and experiencing total awareness to the activity. "Flow" is a state which probably only the minority of let's say undergraduate psychology students experience while working with statistics.

Another factor that is important for the development of interest for a specific task is perceived competence. Research has often indicated that perceived competence is in fact correlated with interest and intrinsic motivation (Renninger, Hidi, & Krapp, 1992). 'Perceived competence' is also the keyword that leads us to the first problem in this matter, because it may be a tumbling block on the path of interest at school. This may for example be the case when it comes to abstract subjects like mathematics. Geist (2010) emphasizes that negative attitudes – like perceived competence – towards mathematics arise already in childhood. This is especially the case when math teachers begin to use 'timed tests' to improve mathematical skills in pupils. This is unfortunate for those children who may have the competence to solve mathematical problems but may need more time to finish. This additional time-problem may in turn reinforce the child's negative attitude of perceived incompetence once more (Geist). Thus, negative attitudes like perceived incompetence can be a threat to intrinsic motivation and interest.

Geist (2010) also emphasizes that gender plays an essential role regarding mathematical achievements. It is generally assumed that girls have lower mathematical abilities than boys (Bukatko & Daehler, 2004). Regard-less whether this statement is true or false, this stereotyping may lead to a perceived incompetence in girls which in turn worsens their mathematical problems (Spencer, Steele, & Quinn, 1999). This may also be the reason why girls tend to form the majority of students in non-mathematical subjects like psychology or sociology. Unfortunately, even in these non-mathematical academical fields, students cannot avoid mathematics. The devil just comes in another appearance: statistics or some students may call it 'sadistics'. The most students view statistics courses as the most anxiety-provoking courses in their academic curriculum. Statistics courses are often followed by students with less inte-rest and more self-critique (Macher, Paechter, Papousek, & Ruggeri, 2011). Statistics may be a course that discourages students to either choose for an academic pro-gram without obligatory statistics courses or to drop their studies when failing at a statistics course once or twice.

Fear for statistics and fear in general, is not a good base for learning and for academic achievement (Hembree, 1990; Ma, 1999). Fear further does not foster intrinsic motivation or perceived competence. An anxious student needs more processing capacities to concentrate on the school task compared to a non-anxious student (Ashcraft & Moore, 2009). Research has shown that general well-being at school is positively correlated with academic achievement (Thoonen, Sleegers, Peetsma, & Oort, 2011). Conversely, it can be assumed that a student who is afraid of a course may also not experience general well-being. Hembree (1990) and Ma (1999) indeed found that anxiety was negatively correlated with math grades. Thus one may expect that this is also the case in statistics.

Since statistics anxiety is a great problem for many students in non-mathematical curriculums, it is important to help those students to overcome their anxiety and find ways to make them comprehend abstract material better. Humor seems to be a good recipe for general well-being, as it has also been shown to reduce tension and increase well-being (Berk, 2003). Thus one could expect that humor in the classroom or in lectures could reduce tension (e.g anxiety for statistics) and increase well-being - good predisposition for academic achievement since well-being has been shown to be positively correlated with academic achievement (Thoonen, Sleegers, Peetsma, & Oort, 2011). From the studies by Hembree (1990) and Ma (1999) one can also expect that reducing the fear for mathematics or statistics, could increase well-being of the student and further increase the students' academic achievement.

The research question this study aims to answer is whether humor can help students to motivate for abstract and 'dread' courses like statistics and whether this may also lead to more learning and therefore better examination scores. In the first section of this article the role of motivation and interest in learning will be discussed. In the second section information will be provided about the problem of mathematics and statistics anxiety, and then in the third section studies about the benefits of humor in the classroom will be presented. In a final section this paper will aim to answer the question whether humor may also enhance memory and thus learning.

How to Motivate Students for Statistics?

During adolescence the students' motivation and academic achievements tend to decline (Peetsma, Hascher, van der Veen, & Roede, 2005). Thoonen et al. (2011) found out several motivational factors that can influence motivational behavior. Motivational factors contain an affective component, an expectancy component and a value com-

ponent (Thoonen et al.) The affective component is about the students' feelings about school in general. Research has found that general well-being at school is positively correlated with academic achievement (Thoonen et al.). An anxious student is generally not being well. Thus one may expect a negative correlation between anxiety and academic achievement. The expectancy component, also called 'academic self-efficacy', is about the students' belief to perform a task well and is related to the students' level of effort (Thoonen et al.). This approximates the idea of perceived competence. People usually have more interest in tasks if they perceive themselves as competent in those tasks (Bergin, 1999). Perceived competence is further positively correlated with interest and intrinsic motivation (Renninger, Hidi, Krapp, 1992). Finally, the value component is about how important and interesting the task is for the student to the extent that the student wishes to master this task (Thoonen et al.). In their study, Thoonen et al. found that a connection to the personal world of the students affected the students' motivation significantly. That will say, making the lessons interesting for the student by relating it to the student's personal life increases the students motivation to learn. Now we want to summarize the motivational factors mentioned by Thoonen et al. and relate them to a subject like statistics. Thus, according to Thoonen et al. students need to feel comfortable and well at school (affectional component) and should not be afraid of school.

Statistics anxiety seems not compatible with well-being at university. The affective component is thus threatened. Second, the student has to believe in his/her own abilities to master school tasks (the expectancy component). Thus the student has to feel competent in a given subject. Unfortunately, statistics is one of the most feared courses in for example the bachelor of psychology. It seems unlikely that students who fear a course at the same time feel competent do master it. It can especially be expected that especially female students may perceive themselves as incompetent in statistics because of a stereotype effect (Spencer, Steele, & Quinn, 1999). This negative attitude of perceived incompetence may lead to a decrease in interest (Renninger, et al.) and probably decrease in scores on statistics exams (Spencer, et al.). Third, the task at school has to be interesting for the student in order to give the student a motivation to learn (value component). The value component seems to lie in the hands of the teachers or lecturers who should present the topic in a matter that is interesting for the students.

But what can lecturers or teachers do to make a subject interesting for the students? In his review about the influences on classroom interest, Bergin (1999) differentiates between individual and situational factors that influence interest in the classroom. One important individual factor mentioned here is emotion. Students who are often criticized for their performance or often fail in a subject may develop negative emotions towards this subject and may try to avoid it in the future. In contrast, positive feelings, like euphoria or happiness may link the subject to positive emotions and lead to more interest in that subject (Bergin). A further important individual factor that influences interest is the so-called 'utility-goal relevance'. That means that the students must know what the knowledge they have to learn is good for. Further, the learning material should be relevant to them (Bergin). Situational factors that can lead to classroom interest are for example the use of fantasy, puzzles and games, etc. Finally Bergin mentions also humor as a situational factor that has an impact on interest. Bergin hypothesizes that humor may raise the attention of inattentive students and this higher alertness may facilitate further learning (Bergin).

In sum, Bergin differentiates between personal and situational factors that can have an influence on classroom interest. Individual factors are for example positive feelings towards the subject. This approximates the affective component by Thoonen et al. (2011) which requires having a positive feeling about a course. Statistics anxiety may rather lead to an opposite effect. A second individual factor is utility-goal relevance. It could be assumed that this factor should be given in a course like statistics, given its obvious use in psychological research. Further Bergin also mentions situational factors that can raise interest in students. Those are the factors that a teacher has the most influence on (Bergin, 1999). Bergin supposes puzzles and fantasy games to raise interest in students, but this seems more appropriate for elementary school. Rather, Bergin hypotheses that humor may motivate students to learn. This is what this study aims to verify. It is expected that humor can increase well-being (Berk, 2003) and thus promote the affective component of motivation (Thoonen et al., 2011). Further it may promote the value component by changing situational factors in a way which promotes motivation in students (Thoonen et al.). It is expected that humor may increase the attention of the student, and the additional positive atmosphere in the classroom created by humorous instructors may motivate students to attend to classes with more interest and a positive feeling.

However, there is one factor that may threaten all motivational factors and that is statistics anxiety. The next section will give an overview over antecedents, the extents and consequences of statistics anxiety.

The Impact of Anxiety on Academic Achievement

Research has shown that anxiety reduces the processing capacities and concentration of students (Ashcraft & Moore, 2009). Fear is thus not a good predisposetion for learning and motivation. This is in line with a study by Hembree (1990) and Ma (1999), who examined the relationship between math anxiety and a variety of personal and educational factors. They found that math anxiety correlated negatively with motivation in mathematics (- .64), with high-school math grades (- .30) and college math grades (- .27). In a study by Ashcraft and Kirk (2001) students were asked to solve mathematical problems and simultaneously remember a row of letters. The results showed that the higher the math anxiety, the more mistakes were made in the subsequent letter recall task. The authors suggested that the working load of the math task, the additional letter task and their anxiety has lead to an 'affective drop' in performance. This suggests that the math anxiety plays a strong role in the drop in performance of students with math anxiety (Ashcraft & Kirk, 2001). This hypothesis is strongly supported by the findings of Hembree (1990) who found that math-anxious individuals who followed a cognitive behavioral therapy for their anxiety, subsequently showed math scores in the 'normal' range compared to the scores before the therapy. Thus one may assume that once the anxiety is decreased, the processing capacities and concentration would increases again and this in turn could have a positive effect on subsequent test scores.

Even thought mathematics anxiety seems to differ from statistics anxiety, it has shown to be a predictor of statistics anxiety (Onwuegbuzie & Wilson, 2003). Therefore it seems appropriate to compare results from studies about mathematics anxiety with those from studies about statistics anxiety. Statistics forms for many students the most anxiety-provoking course in their curriculum (Onwuegbuzie & Wilson, 2003). About two-thirds of those students experience statistics anxiety (Onwuegbuzie & Wilson). Statistics courses are often followed by students with less interest and more self-critique towards mathematics (Macher, Paechter, Papousek, & Ruggeri, 2011). As a consequence many students postpone their enrollment in statistics courses as long as possible and attend those courses with a negative attitude (Onwuegbuzie & Wilson). Zeidner (1990) defined statistics anxiety as:

> "...performance characterized by extensive worry, intrusive thoughts, mental disorganization, tension and physical arousal … when exposed to statistics content, problems, instructional situations, or evaluative contexts, and is commonly claimed to debilitate performance in a wide variety of academic situations by interfering with the manipulation of statistics data and solution of statistics problems."

To combat math and statistics anxiety, it is important to know where this anxiety comes from. Onwuegbuzie and Wilson (2003) proposed the presence of situational, dispositional and environmental antecedents of statistics anxiety. Situational antecedents are statistics prior knowledge, statistics course grade, the status of the course (voluntary or mandatory), attitudes towards calculators, course and instructor evaluation, and satisfaction with the statistics course (Onwuegbuzie & Wilson). Dispositional antecedents of statistics anxiety are perceived level of mathematics self-concept and perfectionism (Onwuegbuzie & Wilson). Environmental antecedents are for example gender and age differences, with girls and older students tending to report the highest level of statistics anxiety compared to males and younger students, respectively (Onwuegbuzie & Wilson).

Similar as in mathematical anxiety (Hembree, 1990; Ma, 1999), which is a precursor of statistics anxiety, could the latter also have serious consequences for the student's academic achievement. Onwuegbuzie and Wilson (2003) proposed that statistics anxiety may reduce the efficiency of memory processes when trying to understand and learn new statistical material (Onwuegbuzie & Wilson)**.** Blalock (1987) further proposed that the anxiety may lead students to memorize every detail of statistical procedures without grasping the general principle. These behaviors generally result in bad grades because of a lack of understanding. This is in line with a study by Macher et al (2011) who tested 147 undergraduate psychology students enrolled in a statistics course. The researchers measured statistics anxiety, trait anxiety, interest in statistics, mathematical self-concept, learning strategies, and procrastination. Further, the students' grades in their statistics examination were recorded. The results indicated that staistics anxiety was a strong predictor of performance. Students with higher statistics anxiety had lower grades in their examination and showed higher procrastination scores.

In conclusion, many students are affected by statistics anxiety which can have negative consequences for academic achievement as it disturbs the processing capacities of students when trying to understand statistical concepts (Ashcraft & Moore, 2009). Further is statistics a course followed by most students with a lack of interest and a perceived incompetence (Onwuegbuzie & Wilson, 2003). Thus, several motivational factors are absent when it comes to statistics. The affective component is disturbed by the fear for statistics, and

the expectancy component is threatened by a perceived incompetence (Thoonen et al., 2011).

In the next section it will be discussed whether humor can decrease these motivational constraints and the fear for statistics.

The Humor Effect on Anxiety and Motivation

Research has shown that laughter (the typical behavioral response to humor) appears to improve mood, reduces stress and the perception of pain (Bennett, Zeller, & Rosenberg, 2003). Based on those findings, Bennett et al. hypothesized that laughter has a positive effect on immune function by blocking the production of stress hormones (e.g. cortisol) and increasing endorphins. In their study 33 female participants (individuals with mood or personality disorders were excluded) were randomly selected for a humor and a control condition, in which they were either presented with a humorous or a distracting video. With the Stress Arousal Check List (SACL) levels of stress and arousal were measured. Further the extent of laughing was rated. To measure natural killer cell activity, a modified version of the standard 4-hour radiolabeled chromium (51Cr) release assay was used. Stress scores decreased in both groups after watching the video, but significantly more in the humor condition. There was no difference found in natural killer cell activity between the two groups. But those participants who showed mirthful laughter in response to the humorous videos showed increased post-natural killer cell activity compared with their baseline natural killer cell activity (Bennett et al.). Thus humor per se must not have a positive effect on health, it rather depends on the extent to which it elicits laughter in an individual. Thus humor as a "medicine" should be tailored to the sense of humor of the individual.

Anyhow, there are several other findings regarding the positive effects of humor or laughing. Based on the results of scientific research, Berk (2003) summed up several findings about the positive effects of humor. As psychological effects Berk mentions – among others – that humor can decrease anxiety and stress, improve self-esteem, and increase motivation. As physiological benefits Berk mentions – among others – that laughing relaxes muscles, stimulates circulation, improves respiration and exercises lungs and chest muscles.

With respect to the manifold psychological and physiological benefits of humor just mentioned above, one may assume that using humor in the classroom may reduce stress and anxiety (Bennett et al., 2003; Berk, 2003), increase motivation (Berk, 2003; Bergin, 1999) and may lead to a positive learning atmosphere (Berk). Friedman, H., Friedman, L., and Amoo (2002) discussed reasons why humor should be used in statistics courses. Their first hypothesis was that humor could decrease anxiety in students. This is in line with a study by Burkhart (1998) who measured the heart rates of students who had to give a presentation about a complex topic in front of a camera. Before giving the presentation, one group of students were allowed to watch a comedy show before giving the presentation. Compared to the control group, who did not watch comedy before the presentation, the comedy group showed a lower heart rate when giving the presentation, implicating that this group had a reduced level of anxiety. However, the reduction of anxiety may also be explained by the fact that the comedy group was able to distract themselves and may have released tension by distracting themselves. It may be that the group had also been relaxed if they watched non-humorous TV-programs. Thus, humor may have an anxiety-reducing effect but the found effect in the study by Burkhart may be confounded by the more general effect of distraction. Thus one cannot make causal inferences from this study.

Concerning statistics, Friedmann et al. (2002) hypothesized that humor could make a boring subject more interesting to the students and additionally reduce stress and enhance recall. Schacht and Steward (1990) tested this hypothesis in an undergraduate statistics class at Colorado State University by using cartoons in their lectures. At the end of the course, the students had to fill in a questionnaire with questions about the effect of humorous material on anxiety reduction, about whether humor was able to create an enjoyable learning environment, and to what extend humor helped the students to remember the material. The rating scales to rate the effect of humor in a given domain, ranged from 0=F (worst grade) to 4=A (best grade). The impact on anxiety reduction was rated by the students with mean 3.78, positive impact on learning environment was rated with mean 3.74, understanding of material was rated with mean 2.86, and the effect on retention was rated with mean 2.83. Thus the students perceived the use of humor in the classroom as having positive effects on the learning atmosphere and a positive but smaller effect on learning. A limitation of this study is, that the scores were self-reports. However, the authors also used the Math Anxiety Rating Scale (MARS) to measure levels of math anxiety before and after the statistics course. Results showed that moderate to high levels of math anxiety were present before the course started and low to moderate levels of math anxiety were present after the statistics course. Thus there was a significant reduction in the levels of math anxiety after

the use of humorous material in the statistics course, when comparing anxiety scores from the beginning of the course to those at the end of the course. Anyhow, the authors also recognized limitations in these results. First limitation is the lack of a control group. Further it may it be that the reduction of anxiety was not due to the humor application but rather because the students were happy that they finished the course (Schacht & Steward, 1990).

Neumann, D., Hood, and Neumann, M. (2009) came to a similar result. The authors studied the impact of humor in a first year psychology research methods and statistics course for 13 weeks. 200 to 225 students were enrolled in this course. From those students, 40 students were randomly selected for the study. After the course, the selected students were asked questions about the effect of humor in the course via phone on a semi-structured interview. The students had to answer questions about motivation, how it helped learning the material and whether there are negative aspects of humor. The following percentages between brackets inform about how often a specific answer have been given by students. The majority of the students reported amusement (53%) and mood-enlightenment (47%) as the main effects of humor. Further, students reported that humor would help maintain attention (45%), provide a mental break (34 %), reduce monotony (24 %), break up content into more manageable amounts of information (18%), helped learning (16%) and motivated to stay and attend class (11%). As negative effects of humor students reported that funny material in a lecture would lead to chatting and laughing and could distract other students. Further humor that was not relevant to the topic was perceived as less positive (Neumann et al.). Thus, most students in this study thought that humor used in lectures would have a positive effect on mood and attention. However, only less than 20 % of the statements were about a positive effect of humor on learning and motivation. Disrgarding the limitation that the results are based on self-reports, the results seem to promote a mood enhancing and anxiety-reducing effect of humor. Anyhow, the effect on motivation and learning seems rather small (Neumann et al.).

Thus all in all studies show that humor can reduce tension in statics courses - especially in those students who suffer from statistics anxiety - and thereby enhance attention and interest. But from the studies about humor in the classroom, the effect on learning and remembering the material seemed marginal and not the focus of the most studies.

Further, the drawbacks of humor need also be mentioned. Humor should be used with caution because not all types of humor have those positive effects on the atmosphere of the class and subsequent learning. Powell and Andresen (1985) warn in their article about the ‚darker side of humour'. Humorous material may amuse some people, but at the same time may offend others. Thus humor should not contain so called 'insiders' which are incomprehensible for some groups of people. Neither should humor be used in a discriminating way. Thus sexist humor, racist humor or humor about out-groups should be avoided. Otherwise, students would feel offended and may develop an emotional block that may hinder subsequent learning. (Powell & Andresen). Powell and Andresen also advise to pay attention to the 'dose' of humor used in the classroom. If humor is used too excessively, students may concentrate only on the humor part of the lectures but not on the material they have to learn. Humor could also undermine the seriousness of the lecturer (Powell & Andresen). Neumann et al. (2009) also found that students who were already motivated and interested in statistics perceived humor in statistics courses as irrelevant and distracting. Some students also reported that humor in lectures that leads to laughing may also lead to subsequent chatting between students and thereby disturbing other students (Neumann et al.).

It can be concluded from all these studies that humor – used in an appropriate form and with a healthy dose – can reduces stress and anxiety (Bennet, et al., 2003; Schacht & Steward, 1990) and further can have a positive effect on mood. The effect on learning and retention has not yet been tested in a controlled study in the context of statistics or another academic course. Thus especially the affective component of motivation is positively influenced by humor, because perceived humor seems to result in well-being (Neumann et al., 2009; Schacht & Steward, 1990).

The assumption that remained unclear until now is whether humor has also positive effects on memory and learning. In the next section this problem will be discussed.

The Humor Effect on Learning

The previous section discussed several studies supporting the positive effect of humor used in the classroom (Berk, 2003; Burkhart, 1998; Schacht and Steward 1990; Neumann, et al., 2009). However, concrete findings regarding the effect of humor on learning are sparse and inconsistent. Summerfelt, Lippman, and Hyman Jr. (2010) supposed that humor may not directly have an influence on memory but indirectly through other mechanisms. Rehearsal may be one of these possible mechanisms (Summerfelt et al.). A person laughing about a joke may rehearse that joke in order to keep it

in memory to share it with other persons later. It is assumed that active rehearsal can strengthen memory by increasing connections among stored memories. This produced web of connections may in turn facilitate later retrieval of the information (Gluck, Mercado, & Myers, 2008).

There may also be an emotional mechanism that enhances memory for funny material (Summerfelt et al., 2010). It is already known that strong emotions enhance encoding of memories (McGaugh, 2003). Research here over has mainly focused on negative emotions. But why would strong positive emotions like the joy after a big laugh not enhance memory? To answer this question, more research about the effect of positive emotions on memory is needed. Schmidt and Williams (2001) suggested that surprise may be one such memory-aid because this emotion is often followed by focused attention. Arousal is also known as a memory aid and may also play a role in the memory enhancing effect of humor (Summerfelt et al., 2010). Thus a person's attempt to understand a joke may lead to moderate levels of arousal and thus better encoding of the material (Summerfelt et al.). Research has shown that arousal leads to a release of cortisol (a stress hormone) and this leads to a better consolidation of the memory (Gluck, et al., 2008).The question is whether the arousal arising from the effort to understand a joke is intense enough to lead to a consolidation effect as described above.

Another term often mentioned in humor research is incongruity. Incongruity appears when information is presented within a non-matching context. Incongruity is often the best recipe for a good joke. The story is for example "A statistician is someone who can have his head in an oven and his feet in ice…". One may think "Ouch…" And then the punch-line is something that one might not have expected: "…and say that on the average he feels great." Here the emotion of surprise may play a role and may enhance memory for the incongruent information (Summerfelt et al., 2010). Thus, the punchline of the joke may elicit surprise because of the unexpected – incongruent – elements (Summerfelt et al.). Research has shown that unexpected events are more likely to be remembered compared to predictable events (Axmacher et al., 2010). The brain constantly makes predictions about future events by comparing present situations with stored patterns from previous situations. When actual events are not in line with the brain's predictions, a distributed network is activated to attend to and encode the novel events. This process is assumed to enhance the memory formation for that unexpected event (Axmacher et al., 2010).

Regarding jokes one other characteristic, constraints, may be important for the memory enhancing effect. A piece of information is constrained when individual parts of the information (e.g. words of a sentence, or syllables of a word) cannot be changed without the information losing its meaning. If you change a word in a poem, this poem may not rhyme anymore and thus may lose its meaning as a poem. Rubin (1995) argued that the more constraints are present in a piece of information, the more likely is the recall of this information. Jokes are sometimes constrained to the extent that if one changes one word, it would neither make sense anymore nor would it provoke any laughter (Summerfelt et al., 2010). These constraints are especially present in pun jokes which should make the pun more prone to be remembered. Summerfelt et al. tested the effect of incongruity and constraints in pun jokes on memory. Incongruity and constraints are both given in pun jokes. Pun jokes are for example knock-knock jokes which have both incongruity (the punchline is not what one expected, at least not before your one reads his first knock-knock joke), and constraints. Puns contain constraints in the sense that if one changes one word in the pun, the pun does not make sense anymore (Summerfelt et al.). Here is an example of a knock-knock-joke used in the study by Summerfelt to make this point clear:

"Knock knock!
Who's there?
Oswald.
Oswald who?
Oswald my chewing gum!"

Summerfelt et al. (2010) conducted in total 4 pun-experiments with introductory psychology students from Western Washington University. In all experiments the experimenters used 'funny' knock-knock jokes and modified knock-knock jokes where the last sentence was rewritten in a way that the wit of the pun dissappeard. The example above had been modified like this:

"Knock knock!
Who's there?
Oswald.
Oswald who?
Oswald eats vegetables!"

The 15 original and 15 modified jokes were presented in a slide show to the participants. After reading the stimuli, participants had to do a distracter math-task. After this, in the first experiment, the participants had to write down all the names they had remembered from the puns. In a subsequent recognition test, participants had to indicate whether names on the list had been previously presented in the slide show. The list consisted of 30 items from

the slide show and 30 additional names not presented in the slide show. The results showed that the participants recalled the names from the original jokes significantly better than the rewritten jokes. The same effect was present in the recognition test.

In the second experiment, the participants remained untouched by the math task and the memory task but rather had to rate on a scale how many effort it took for them to interpret the final sentence of the pun and whether they repeatedly re-read the final sentence of the joke. Participants reported that they used more effort to interpret the rewritten jokes compared to the originnal jokes and they also reported repeating the punch lines of rewritten jokes more often than those of the originnal puns. The results indicated a memory effect for the original puns. The researchers ruled out arousal as a memory enhancing mechanism. The arousal hypothesis assumes that as humor in a joke is harder to find, the effort to understand the joke increases whereby arousal increases. Thus according to this hypothesis one may expect the rewritten jokes to elicit more arousal, because they are harder to understand. This in turn should lead to a better memory for these jokes. This was not the case in this experiment. To find out whether rehearsal of the original puns facilitated memory, the second experiment was conducted.

In the third experiment the constraint hypothesis was tested. According to this hypothesis it was predicted that participants would remember punchlines from original puns better, because the names used in the pun would for m a memory-constraint in the sense that the punch-line would only be funny in combination with the correct pun-name. The procedure was the same as in experiment 1, thus 15 original and 15 modified puns were presented in a slide show. After this a math-task followed and subsequently the free recall memory task plus recognition task was conducted. The participants further had to do an additional free recall task where participants were instructed to write down all the punch-lines of the jokes they could remember. They were encouraged to guess. The results showed that the participants were more likely to recall the punch-line of the original jokes than that of the rewritten ones. Thus, the hypothesis that the pun name represented a strong constraint for the participants to remember the punch-line had been confirmed by the results. In the 4th experiment the role of incongruity as a memory aid in jokes was tested. The experiment was the same as experiment 1 with one difference: the proportion of original and re-written jokes was different for 3 groups of participants. In the balanced condition, the ratio of original and rewritten jokes was balanced. In the 80% puns condition, there were 80% original puns and 20% rewritten puns presented. And in the 80 % non-pun condition, rewritten puns were in the majority (80%). The unbalanced conditions were aimed to create incongruity, because real puns appeared unexpectedly in the slide shows between rewritten puns. The surprise-effect resulting from this incongruity was assumed to result in a stronger memory for that pun. The results of this last experiment showed that in all conditions, participants were more likely to recall the original puns than the modified ones. Only in the 80% pun condition, the difference was not significant. This has lead the authors to the conclusion that incongruity contributed significantly to memory enhancement.

The authors concluded from the four experiments that the constraints in the pun jokes that only a specific name goes with a specific punch-line formed a strong memory aid. Further, the feature of incongruity present in jokes also seemed to have a positive effect on recall. In contrast, a memory-enhancement through rehearsal or arousal could not been supported by the results. Even though the rewritten puns had been rehearsed more often than the original puns in the hope to find the punch-line (which was actually not present), and this extensive search and rehearsal should have also increased arousal, the original puns were still remembered better (Summerfelt et al., 2010).

Carlson (2011) also tried to explain the positive effect of humor on memory. He critically reviewed hypotheses about the memory effect on humor. These are the 'incongruity resolution hypothesis' and the perceived humor hypothesis'. The 'incongruity resolution hypothesis' states that resolving semantic incongruities would enhance memory for humorous material. An example for resolving semantic incongruities is trying to understand an incongruent statement like a joke or a proverb. This may imply that incongruent but non-humorous material would also enhance memory. Schmidt and Williams (2001) compared the memory effect of humorous vs. 'weird' stimuli, because the latter could also be classified as incongruent. But the humorous material was still recalled better. This result did not support the 'incongruity resolution hypothesis'. The 'perceived humor hypothesis' suggests that only when perceiving stimuli as humorous would enhance memory for that material. Thus when a joke is not rated as funny by an individual, this individual will probably not remember this joke better than any other joke. Thus, individual differences in the perception of humor seem to mediate the effect of humor on memory. One may perceive a joke as very funny, another person may perceive it as not funny at all. Schmidt and Williams also found a

positive relationship between humor ratings and recall. In his own study, Carlson tested the two before mentioned hypothesis plus an additional hypothesis called the 'context-dependent elaboration hypothesis' which proposed that humorous material are processed more elaborately than control stimuli and thus lead to better recall. Carlson used a set of either inspirational or humorous stimuli, because both stimuli would require semantic elaboration and could be perceived as incongruent. The stimuli consisted of humorous vs. inspirational posters containing a photograph and a matched phrase with a keyword. The pictures and keywords were the same in all conditions, but the phrases differed. For example: 'Dreams are like rainbows, only idiots chase them' (humor condition) vs. 'Dreams are like rainbows, they lead to treasures' (inspirational condition). undergraduate psychology students (N=221) either viewed the inspirational (n=107) or the humorous pictures (n=114). Subsequently, all participants had to rate how humorous or inspirational they perceived each calendar sheet. After a distracter task, participants were asked to recall the photographs and the phrases. The results showed that humorous pictures or phrases were recalled more often, compared to the inspirational material. Moreover, pictures with humorous captions were recalled better than pictures with non-humorous captions. Further, the more humorous a stimulus was rated, the more likely it was recalled. Thus the results were in line with the perceived humor hypothesis. The data did not support the incongruity hypothesis, because there was a greater effect for humorous material than for inspirational material, even though both can be viewed as incongruent. The incongruity hypothesis would have predicted the absence of a memory effect and instead no difference between the humor vs. the inspirational condition. Thus the incongruity-effect seems to be present only in humorous incongruent material.

In sum, humor, but only when it is perceived as funny (Carlson, 2011), can enhance memory for written text. Especially the constraints and the feature of incongruity present in pun jokes seem to enhance subsequent recall of those jokes (Summerfelt et al., 2010). Thus it seems helpful to translate factual knowledge, e. g. for statistical concepts, into a pun-joke form. It may be hard to imagine how those jocular memory aids could be used in statistics course. However, Friedman et al. (2002) and Berk (2003) provide many examples herefore. The concept of translating factual knowledge into a pun approximates the concept of mnemonic rhymes, which are also used as memory aids, with an extra portion humor.

During adolescence the students' motivation and academic achievements tend to decline (Peetsma, Hascher, van der Veen, & Roede, 2005). This is especially the case after the transition from elementary to junior high school (Eccles & Midgley, 1989). What might be the reasons for this motivational decline? Eccles & Midgley proposed that this decline may be explained by an interaction between physical maturation and the changes in the social environment that adolescents experience. But when we think about how school was in elementary school and how it became in secondary school one may get a gist to understand this motivational decline. In elementary school children are taught with play, school is "fun" and children are eager to learn more. Thus, intrinsic motivation is much supported in the first years of elementary school. By the transition from elementary to junior high school the pupils' confidence in their math abilities and their interest in learning mathematics dramatically declines (Eccles & Midgley).

Eccles and Midgley proposed that systematic differences between elementary schools and junior high schools may account for the motivational problems. However, the authors were not able to specify what exactly those systematic differences are. But one could expect that it may have to do with the instructions at school which may not wake as much interest in pupils as it is the case for instructional material in elementary school. Another possibility may be that the role of extrinsic rewards (e.g. good grades, social comparison) after the transition to junior high school decreases the pupils' intrinsic motivation for learning mathematics (Myers, 2010).

Intrinsic motivation has often been associated with interest, because intrinsically motivated people do things out of interest and not because they are expecting a reward (Carr, 2011). The behavior of the intrinsically motivated person during that special task is usually characterized by concentration and engagement (Carr). The strongest form of interest is what Csikszentmihalyi (1990) has termed "flow", a state wherein a person is totally absorbed by an activity and experiencing total awareness to the activity. "Flow" is a state which probably only the minority of let's say undergraduate psychology students experience while working with statistics.

Another factor that is important for the development of interest for a specific task is perceived competence. Research has often indicated that perceived competence is in fact correlated with interest and intrinsic motivation (Renninger, Hidi,& Krapp, 1992). 'Perceived competence' is also the keyword that leads us to the first problem in this matter, because it may be a tumbling block on the path of interest at school. This may for example be the case when it comes to abstract subjects like mathematics. Geist (2010) emphasizes that negative attitudes – like perceived competence – towards mathe-

matics arise already in childhood. This is especially the case when math teachers begin to use 'timed tests' to improve mathematical skills in pupils. This is unfortunate for those children who may have the competence to solve mathematical problems but may need more time to finish. This additional time-problem may in turn reinforce the child's negative attitude of perceived incompetence once more (Geist). Thus, negative attitudes like perceived incompetence can be a threat to intrinsic motivation and interest.

Geist (2010) also emphasizes that gender plays an essential role regarding mathematical achievements. It is generally assumed that girls have lower mathematical abilities than boys (Bukatko & Daehler, 2004). Regardless whether this statement is true or false, this stereotyping may lead to a perceived incompetence in girls which in turn worsens their mathematical problems (Spencer, Steele, & Quinn, 1999). This may also be the reason why girls tend to form the majority of students in non-mathematical subjects like psychology or sociology. Unfortunately, even in these non-mathematical academical fields, students cannot avoid mathematics. The devil just comes in another appearance: statistics or some students may call it 'sadistics'. The most students view statistics courses as the most anxiety-provoking courses in their academic curriculum. Statistics courses are often followed by students with less interest and more self-critique (Macher, Paechter, Papousek, & Ruggeri, 2011). Statistics may be a course that discourages students to either choose for an academic program without obligatory statistics courses or to drop their studies when failing at a statistics course once or twice.

Fear for statistics and fear in general, is not a good base for learning and for academic achievement (Hembree, 1990; Ma, 1999). Fear further does not foster intrinsic motivation or perceived competence. An anxious student needs more processing capacities to concentrate on the school task compared to a non-anxious student (Ashcraft & Moore, 2009). Research has shown that general well-being at school is positively correlated with academic achievement (Thoonen, Sleegers, Peetsma, & Oort, 2011). Conversely, it can be assumed that a student who is afraid of a course may also not experience general well-being. Hembree (1990) and Ma (1999) indeed found that anxiety was negatively correlated with math grades. Thus one may expect that this is also the case in statistics.

Since statistics anxiety is a great problem for many students in non-mathematical curriculums, it is important to help those students to overcome their anxiety and find ways to make them comprehend abstract material better. Humor seems to be a good recipe for general well-being, as it has also been shown to reduce tension and increase well-being (Berk, 2003). Thus one could expect that humor in the classroom or in lectures could reduce tension (e.g anxiety for statistics) and increase well-being - good predisposition for academic achievement since well-being has been shown to be positively correlated with academic achievement (Thoonen et al., 2011). From the studies by Hembree (1990) and Ma (1999) one can also expect that reducing the fear for mathematics or statistics, could increase well-being of the student and further increase the students' academic achievement.

The research question this study aims to answer is whether humor can help students to motivate for abstract and 'dread' courses like statistics and whether this may also lead to more learning and therefore better examination scores. In the first section of this article the role of motivation and interest in learning will be discussed. In the second section information will be provided about the problem of mathematics and statistics anxiety, and then in the third section studies about the benefits of humor in the classroom will be presented. In a final section this paper will aim to answer the question whether humor may also enhance memory and thus learning.

Method

Article Search

The goal of this study was to find out whether humor can help students to motivate for abstract and 'dread' courses like statistics and whether the use of humor may also increase learning effects. To find information, theories, and relevant research suitable to answer the research question, an article search was done using the following databases: Psychological and Behavioral Sciences Collection (EBSCO), PsycARTICLES (EBSCO), PsycINFO (EBSCO), PubMed, and Google Scholar. Key terms primarily used in this article search were: motivation, interest, humor and motivation, humor and learning, mathematics anxiety, statistics anxiety, humor and mathematics/statistics anxiety, humor in the classroom, humor and memory.

Results and Discussion

The present literature study examined the effects of humor on motivation, anxiety and learning. It was hypothesized that humor could motivate students to

learn, reduce statistics-anxiety and enhance learning of statistical material.

Research about motivation emphasizes the role of perceived competence, positive feelings about a course and the perceived relevance of the subject for the student (Thoonen, et al., 2011; Renninger, et al., 1992). It was hypothesized that humor could lead to a positive effect on the students' well-being and thus could result in higher motivation for the course. Studies using humor in statistics courses showed that humor has lead to a positive learning environment by enhancing the mood of the students (Schacht & Stewart, 1990; Neumann et al, 2009). However, the reviewed studies are limited because the students' motivation was measured only with self-report. Anyhow it seems difficult to measure motivation other than with self-reports.

The predisposing factors for motivation like perceived competence and positive feelings about a course seem to be threatened by anxiety for statistics courses. This anxiety is highly prevalent in students enrolled in statistics courses (Onwuegbuzie & Wilson, 2003). Given that in courses like psychology or sociology, the majority of students are female, sex-typing may enhance statistics anxiety especially in female students. To combat this anxiety, it was hypothesized that humor used in statistics lectures could be a good help. Previous studies had already shown that humor has a general stress-reducing effect and was assumed to improve mood and general well-being (Bennet et al., 2003). Thus it could be assumed that reducing stress and increasing well-being with the help of humor could decrease the anxiety of students enrolled in a statistics course.

Macher et al. (2011) found a negative correlation between anxiety and exam grades in statistics. Conversely, one may expect that if humor was able to reduce the anxiety, this could lead to better exam grades. This is also in line with the finding of Hembree (1990) that math-anxious individuals who followed a cognitive behavioral therapy for their anxiety, subsequently showed math scores in the 'normal' range. Even though math anxiety is not equal statistics anxiety, the former has been shown to be a precursor of the latter. Therefore one may compare the results of studies about math anxiety and those about statistics anxiety. However, the results concerning the effect of humor on statistics anxiety were promising. Schacht and Stewart (1990) measured statistics anxiety with the MARS scale (Math Anxiety Rating Scale) at the beginning of a statistics course and afterwards. During this statistics course, humorous material had been integrated into statistics lectures. Students exposed to those humorous statistics lectures reported a positive effect on the overall atmosphere, which may have constituted a good anxiety-free atmosphere to learn. The results further showed a significant reduction in anxiety at the end of that course. Anyway, the effect could also be due to the fact that the students were happy and felt relieved that they finished the course (Schacht & Stewart, 1990).

Another limitation of this study was that the authors did not have a control group. Thus one cannot exclude other factors to be responsible for the effects found in this study. These factors may be for example the quality of the statistical material, or the ability of the lecturer to explain statistical concepts. It may also have been the case that the lecturers were over-motivated to find a positive effect and this over-motivation was responsible for the effect rather than the humor itself. The study by Schacht and Stewart (1990) should be replicated but with an additional control group. This control group should attend separate lectures dealing with neutral (thus non-humorous) material. Further, more confounding factors should be controlled. For example the lecturer and the experimenter should not be the same person. Additionally, the lecturer should not be informed about the goal of the study. To exclude the 'relief-effect' as a confounder for a potential humor effect, the final rating scale should be filled in by students before the exam and not afterwards.

Studies about the effect of learning or recall of information after exposure to humor are unfortunately rare. In the study by Schacht and Stewart (1990) the students reported that humor had helped them to understand and remember the material better. A small percentage of students in the study by Neumann et al. (2009) also shared this opinion. However, these studies are limited because they were using self-reports. To test the impact of humor on retention and understanding, statistics exam grades should be compared between a group of students attending humorous lectures and a control group attending neutral lectures.

The effect of humor on learning in academical settings is worth studying given that research has already shown that humor has an effect on memory (Carlson, 2011; Summerfelt et al., 2010). The study by Summerfelt et al (2010) revealed that that incongruity and constraints which are typical elements in humorous material, are good memory aids (Carlson, 2011; Summerfelt, Lippman, Hyman Jr., 2010). Carlson (2011) also found the positive effect on memory for incongruent funny material, but not for other kinds of incongruent materials (e.g. inspirational sentences). Thus it appears that incongruity has only an effect when it is a component of humorous material. Another important aspect about the benefit of

humor as a memory aid is the subjective experience of humor. This is in line with the study by Carlson who was able to confirm the 'perceived humor hypothesis', which states that humor has only a memory enhancing effect when individuals perceive the material they have to remember as funny. Thus it is not per se the humor that has an effect but probably rather the response, either neutral (when not perceived as funny) or in a laughing fashion. Thus to elevate the memory effect of humor, statistical material should contain incongruent humorous elements and constraints and the humorous elements should be perceived as funny by the majority of the students.

Maybe statistical material could be presented for the students in the form of funny mnemonic rhymes. A mnemonic rhyme is constrained by its rhyme (changing words may destroy the rhyme-scheme) and could be created in a way that is perceived as funny. Incongruity seems rather hard to be integrated into mnemonic rhymes, but may be used in lectures in a different form. Anyway, it seems quite difficult and unprofessional for a lecturer to hold a lecture in mnemonic rhyme-form. Thus it seems more promising for lecturers to concentrate on the mood enhancing and stress-reducing effects of humor rather than on the memory enhancing effect. The latter – the funny mnemonic rhymes about statistical material - could rather be used for students as a preparation for exams.

It also seems difficult to find a kind of humor that is perceived as funny for all students. Powell and Andresen (1985) additionally warn that humor should be used with care. Too high doses may have an adverse effect. Further, the humor should not be discriminating or alienating particular groups of students (Powell & Andresen).

Thus after all, the take-home message for math teachers or statistics lecturers is that humor may lead to more frequent visits of students to lectures, because of a positive atmosphere in the lecture hall. Further the entertainment program of the lecturers may lead to the consequence that students may postpone their naps to other lectures and instead may pay more attention to the statistics lecture. Further, those students, who fear statistics, may experience less anxiety when they are confronted with statistics presented with humor. Additionally, it can also happen that students have a better recall of the statistical material when it is presented in a humorous context and with an extra portion incongruity and constraints. The last sentence shows significantly too many 'mays' and 'maybes' because the research about humor in the classroom is sparse and inconsistent mainly due to limitations in the experimental designs. But if humor is used in a proper dose and avoids discrimination, it is rather unlikely that it will have a negative effect on students learning or motivation. So it seems worth to try it out in statistics classes.

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