

# Dreams stimulate waking-life creativity and problem solving: Effects of personality traits

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**Summary.** Well-known examples, e.g. Paul McCartney who composed “Yesterday” because of a dream, have shown how dreams can inspire creativity. In a sample population of 2492 participants who completed an online questionnaire the goal of this study was to examine the frequency of dreams which stimulate creative ideas and help solving problems. Participants had on average both creative ideas and problem solving help by dreams once every other month. Factors such as gender, age, attitude towards dreams and personality traits influenced the frequency. Although all personality traits showed an impact on the frequency, Openness to Experience and Neuroticism had the strongest influence. Agreeableness and Conscientiousness showed negative correlations only with the creative ideas by dreams item. Persons with higher scores of Openness to Experience and Neuroticism were more often influenced by their dreams. Further research could have a look at persons working in creative fields and possible results of creative and problem solving dreams, e.g., new music, advertising slogans, website designs, and poems.

**Keywords:** Creative dreams, problem solving dreams, personality traits, Openness to Experience, Neuroticism, dream recall frequency, attitude towards dreams

## 1. Introduction

Dreams are defined as the recollection of subjective experiences that occurred during sleep after awakening (Schredl, 2018). They influence the waking lives of human beings, for example, in day time mood, decision making, work, problem solving and creative ideas (Pagel & Vann, 1992; Schredl, 2000a; Schredl & Erlacher, 2007). The term creative dream as used in the present study designates particular dreams which give rise to ideas that enable a creative act e.g. a novel, a poem or a song. Creative dreams are regarded as dreams that provide useful ideas related to dream content. This influence on waking life can be illustrated by several well-known individuals: Mary Godwin, later Mary Shelley, had a nightmare containing the uncommon content of her novel “Frankenstein” (Poovey, 1980). Stephen King had a dream to complete his book “It” after being stuck in the story (Barrett, 2001). One of the members of the Beatles, Paul McCartney, heard the entire melody of the song “Yesterday” in a dream in 1965 (Barrett, 2001).

The above mentioned examples are only anecdotal accounts and it is interesting to have a look at empirical studies examining the creative dream frequency and influencing factors: Kuiken and Sikora (1993) as well as Schredl (2000b) examined how many persons obtain artistic ideas through dreams. 20% and 28% in samples with an average

level of creativity received such ideas at least twice a year. In a study of Schredl and Erlacher (2007), 486 out of 1076 (45.16%) participants reported to have had creative ideas via their dreams at least twice a year; about 7.8% of all dreams affected waking-life creativity. In a large scale study of Schredl, Berres, Klingauf, Schellhaas, and Göritz (2014b), 30.8% indicated that they had had creative dreams at least twice a year. Besides Schredl et al. (2014b), these samples were restricted to students. These studies show creative dreams occur also in populations with average creativity.

As shown above, the frequency of creative dreams varies between different studies (Kuiken & Sikora, 1993; Schredl, 2000b; Schredl et al., 2014b; Schredl & Erlacher, 2007). Therefore, the factors that mediate creative dream frequency have been examined: for instance, dream recall frequency has been shown to be strongly correlated with creative dream frequency (Schredl et al., 2014b; Schredl & Erlacher, 2007). Because the ratio between creative dreams and all remembered dreams is rather small, remembering more dreams increases the number of remembered creative dreams. Further factors are thin boundaries, a positive attitude towards creative activities as well as visual imagination (Schredl & Erlacher, 2007). A possible explanation could be that persons with these traits have a tendency to like and do art. Therefore it is possible that they pay more attention to their dreams and are thus more often influenced by them. This is supported by research on another impact factor: creative interest. In a study of Pagel and Kwiatkowski (2003) the creative dream frequency average of a creative group was significantly higher compared to a no creative interest group. Dream recall frequency, however, was not taken into account as a possibly confounding variable as creative persons simply tend to recall their dreams more often and, thus, also remember more creative dreams. The idea that more creative persons get more influenced by their dreams

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can be connected to the influencing factor of creative work activity. This has been examined by Pagel, Kwiatkowski, and Broyles (1999) who had a look at dream use in a population of film makers. Dream recall as well as the effects on waking behavior was higher for a creative group consisting of directors, screen writers and actors than for a control group, the crew. Filmmakers also were shown to use dreams significantly more often for creative activity than a general population. This study did not control for dream recall frequency but the effect size (Cohen's *d*) for group difference of creative dream frequency is larger than the effect size for group difference of dream recall frequency. The larger effect size indicates the group differences alone cannot be explained by different dream recall frequency. The MADRE questionnaire showed significant correlations of creative dreams with age and gender (Schredl et al., 2014b). The finding for age has been supported by Pagel and Vann (1992). A possible explanation for the significant age differences could be different attitudes towards dreams. Positive attitude declines with age and so does the number of creative dreams. When having a look at gender differences, inhomogeneous results have been found (Pagel & Vann, 1992; Schredl et al., 2014b; Schredl & Erlacher, 2007). More research is needed to have sufficient certainty if gender influences creative dream frequency. These studies were mostly restricted to student samples and correlations have been calculated to indicate a relation between different items and creative dreams and therefore no causality can be shown.

In a study by Schredl and Erlacher (2007) participants had to give examples of creative dreams which the researchers classified into different categories, one of them being problem solving. This classification indicates how close both phenomena are. Dreams stimulate problem solving e.g. for the question of the correct arrangement of the periodic table of the elements which was seen in its complete form by Dmitri Mendeleev in his dreams (Trimble, 1981). August Kekulé dreamed of the structure of the now named Benzene molecule while taking a nap (Forrer, 2014). Srinivasa Ramanujan became motivated to do research in the field of mathematics and later obtained insights into complex mathematical formulas via his dreams (Rajendran, 2012). Although it is still unclear which functions dreams have, it seems problem solving could be one of them (Barrett, 2017); A different point of view can be adopted due to the great differences between awake-thinking and dream-thinking. Furthermore, continuity between waking and sleeping experience is assumed so that problems existing in real life can be solved (Wright & Koulack, 1987). Like creative dreams, problem solving dreams are also regarded as remembered dreams that give ideas related to dream content.

Several studies have been published to show that dreams stimulate problem solving in waking life. Kuiken and Sikora (1993) and Schredl (2000b) investigated whether dreams help to solve a personal problem, which 32% and 44% of the participants indicated to have happen at least twice a year. Schredl (2000b) examined whether dreams trigger actions. 47% indicated this to happen. In another sample, 31.48% reported to have had a problem solving dream at least twice a year (Schredl et al., 2014b). The frequency of problem solving dreams is in most samples slightly higher than the creative dream frequency (Kuiken & Sikora, 1993; Schredl, 2000b; Schredl et al., 2014b).

Barrett (1993) asked participants to think about a personal problem nightly for one week until they had a dream which

felt like a solution to the problem. 49% of the participants said they had a dream related to the topic of their problem while 34% of the total sample thought there was a solution in their dreams. Problems of personal nature were much more likely to be solved than academic problems and open-ended problems without preconceived alternatives were slightly less likely to be solved when compared to problems with two fixed alternatives (Barrett, 1993). Stumbrys and Daniels (2010) showed lucid dreams to have an impact on creative problem solving by coming up with helpful metaphors. In Schredl, Berres, Klingauf, Schellhaas, and Göriz (2014a) the same influences on problem solving as on creative ideas have been found: age, gender and dream recall frequency are significantly correlated with problem solving dreams. Dream recall frequency shows the strongest correlation with problem solving dreams. This can be explained by the relatively small number of problem solving dreams. If you can remember more dreams, the number of problem solving dreams increases as well. For age and gender only small correlations could be found and more research is needed to explain them. Although it has been shown that dreams stimulate problem solving, the relation to personality traits has not yet been examined.

Overall, the existing data indicates that the general population is influenced by their dreams. The presented examples show that dreams can contribute to problem solving, e.g. mathematical problems, raise new ideas for art, e.g. songs, and stimulate to do something new in waking life, e.g. approaching a person. It should be noted that most of the presented studies only showed their results in student samples and calculated correlations to show the relationship between different items and creative dream or problem solving dream frequency.

The aim of the present study is to deepen our view of the influencing factors on frequency of creative dreams and problem solving with the help of a larger sample. It is suggested that people with higher scores in the personality dimension Openness to Experience also show a higher frequency in creative dreams because they are perceived as more creative as well as they show higher scores in tested figural creativity (Kandler et al., 2016). This raises the presumption that people with higher scores in Openness to Experience have more creative interests and are more open to being influenced by dreams and therefore also by creative dreams, problem solving dreams and impulses and pointers by dreams. The other personality variables were tested and correlated with creative dream and problem solving dream frequency in an exploratory analysis. Especially because there is scarce research on the relation between problem solving dreams and personality, no hypotheses are suggested.

## 2. Method

### 2.1. Participants

In total, 2492 persons consisting of 1437 females and 1055 males completed the online survey. The average age of the sample population is 47.75 years with a standard deviation of 14.41, whereas the ages ranged between 17 and 93 years. The level of education varied such that 20 persons (0.80%) had not graduated from school, 261 (10.47%) had 9 yrs. of education, 706 (28.33%) had 10 yrs. of education, 648 (26.00%) completed their A-levels, 790 (31.70%) had

graduated from university, and 67 (2.69%) had a doctoral or higher degree.

### 2.2. Research Instruments

Participants filled in the MADRE questionnaire (Schredl et al., 2014b) which contains the items “How often do your dreams give you creative ideas?” and “How often do your dreams help you to identify and solve your problems?” Both questions had the response options which are coded in the following way: 0 – never, 1 – less than once a year, 2 – about once a year, 3 – about two to four times a year, 4 – about once a month, 5 – two to three times a month, 6 – about once a week and 7 – several times a week. Retest reliability for creative idea ( $r = .709$ ) and problem solving item ( $r = .702$ ) has been high (mean interval about 2 weeks) (Schredl et al., 2014b). The scale has been recoded, using class means to obtain units in frequency per month for both items (0 → 0.1, 1 → 0.042, 2 → 0.083, 3 → 0.25, 4 → 1.0, 5 → 2.5, 6 → 4.0, 7 → 18.0). Furthermore, participants were asked how often they remember dreams on a 7-point scale (coded as 0 = never, 1 = less than once a month, 2 = about once a month, 3 = about 2-3 times a month, 4 = about once a week, 5 = several times a week, 6 = almost every morning). Retest reliability was high ( $r = .756$ ; mean interval about 2 weeks) (Schredl et al., 2014b). To receive units of mornings per week, the scale has been recoded using the class means (0 → 0, 1 → 0.125, 2 → 0.25, 3 → 0.625, 4 → 1.0, 5 → 3.5, 6 → 6.5). To compute the proportion of dreams with creative ideas and problem solving to all dreams, the converted average of these items has been divided by the number of recalled dreams per week multiplied by 4.345 which is the average number of weeks per month in a non-leap year. In addition participants had to respond to the item: “Do you have the impression that dreams provide impulses or pointers for your waking life?” which has been measured on a 5-point-Likert-scale (0 – not at all, 1 – not that much, 2 – partly, 3 – somewhat, 4 – totally). Six items which have been averaged were used to measure attitude towards dreams. There high internal consistency ( $r = .905$ ) and high retest reliability ( $r = .73$ ) for the original scale could be shown which has been specifically designed for students. The used items were measured on a 5-point scale, e.g. “I think that dreaming is in general a very interesting phenomenon.” Response possibilities have been 0 – not at all, 1 – not that much, 2 – partly, 3 – somewhat, 4 – totally. This adapted version showed high ( $r = .910$ ) internal consistencies (Cron-

bach’s alpha) as well as high retest reliability over a 2-week interval (Schredl et al., 2014b).

To measure the Big Five personality factors, the German version of the NEO-Five-Factor-Inventory (NEO-FFI-30) by Körner et al. (2008) has been used. Each factor has been computed as a sum score out of six corresponding items for each trait. Internal consistencies (Cronbach’s alpha) for this version of the NEO-FFI ranged between  $r = .67$  (Openness to Experience) and  $r = .81$  (Körner et al., 2008).

### 2.3. Procedure

Between March 23, 2015 and April 8, 2015, 2492 participants completed the online survey containing the Dream Recall Frequency Scale, MADRE and NEO-FFI-30 on the webpage: www.wisopanel.net. They participated voluntarily without any financial reward.

Two representative samples (Schredl, 2008, 2013) have been included in the analysis to compare the distribution of the Dream Recall Frequency Scale. These samples consisted of 1841 participants (993 women, 848 men) with a mean age of  $48.01 \pm 18.36$  years (age 14-95). Response rates have been 67.9% in the study of 2008 and 67.8% in the one in 2013.

Statistical analyses have been carried out with SAS 9.4 software package for Windows. Ordinal regressions (cumulative logit analyses) were used for analyzing the effect of different predictors on dream variables. For interval scales, linear regression analyses have been computed. Dream recall frequency as well as age, gender and attitude towards dreams have been used as control variables. Because 24 tests have been computed in the exploratory analysis, we interpreted only findings with a significance level below  $\alpha = .002$  ( $.05/24$ ) as meaningful.

## 3. Results

The distribution of the dream recall frequency scale for this sample in comparison with two representative samples (Schredl, 2008, 2013) is shown in Table 1. The mean of the recoded dream recall frequency has been  $1.78 \pm 1.95$  dreams per week in the present study. The representative studies showed a mean of  $0.80 \pm 1.48$ . The ordinal regression analysis showed a significant decline in dream recall frequency with age (standardized estimate:  $-.1086$ ,  $\chi^2 = 52.8$ ,  $p < .0001$ ) and a significant gender difference (standardized estimate:  $.0996$ ,  $\chi^2 = 44.6$ ,  $p < .0001$ ) with women tending to report more dreams than men when merging the present and the representative samples. Additionally, a signifi-

Table 1. Distribution of the dream recall frequency scale of the present sample and two representative samples

| Category                | Present sample<br>N = 2492 | Representative Sample (Schredl, 2008, 2013)<br>N = 1841 |
|-------------------------|----------------------------|---------------------------------------------------------|
| Almost every morning    | 8.47%                      | 3.53%                                                   |
| Several times a week    | 25.60%                     | 9.67%                                                   |
| About once a week       | 19.98%                     | 10.05%                                                  |
| About 2-3 times a month | 14.57%                     | 12.76%                                                  |
| About once a month      | 9.03%                      | 9.40%                                                   |
| Less than once a month  | 15.21%                     | 23.30%                                                  |
| Never                   | 7.14%                      | 31.29%                                                  |

Table 2. The Big Five factors of the NEO-FFI representative population sample (Körner et al., 2008) and the present sample

| Scale                  | Körner et al. (2008)<br>N = 1908 | Present sample<br>N = 2491 |
|------------------------|----------------------------------|----------------------------|
| Neuroticism            | $1.52 \pm 0.77$                  | $1.48 \pm 0.91$            |
| Extraversion           | $2.28 \pm 0.62$                  | $2.10 \pm 0.65$            |
| Openness to experience | $2.04 \pm 0.64$                  | $2.44 \pm 0.74$            |
| Agreeableness          | $2.79 \pm 0.65$                  | $2.86 \pm 0.66$            |
| Conscientiousness      | $2.96 \pm 0.62$                  | $2.95 \pm 0.62$            |

M = Mean, SD = Standard Deviation

Table 3. Distribution for getting creative ideas by dreams and help for problem solving by dreams

| Category               | Creativity<br>N = 2492 | Problem solving<br>N = 2491 |
|------------------------|------------------------|-----------------------------|
| Several times a week   | 0.96%                  | 0.88%                       |
| About once a week      | 1.85%                  | 1.73%                       |
| 2-3 times a month      | 5.22%                  | 4.62%                       |
| About once a month     | 6.78%                  | 7.87%                       |
| About 2-4 times a year | 12.04%                 | 12.61%                      |
| About once a year      | 9.39%                  | 8.99%                       |
| Less than once a year  | 17.42%                 | 17.30%                      |
| Never                  | 46.35%                 | 46.01%                      |

cant group difference has been shown when controlling for age and gender (standardized estimate: .3857,  $\chi^2 = 603.7$ ,  $p < .0001$ ) with higher dream recall in the present sample which is reflected by the large effect size ( $d = 0.814$ ). The gender difference in dream recall frequency (effect size) within both data sets was comparable (online sample:  $d = .170$ ; representative samples:  $d = .245$ ). The decline of dream recall frequency with age was also quite similar (online sample:  $r = -.125$ ;  $p < .0001$ ;  $N = 1841$ ; representative samples:  $r = -.109$ ;  $p < .0001$ ;  $N = 2492$ ).

Table 2 shows the frequency and standard deviation of the Big Five personality dimensions in comparison with a representative sample (Körner et al., 2008). Scores for Openness to Experience differ in comparison to the representative sample. Attitude towards dreams had a mean score of  $2.40 \pm 0.94$  ( $N = 2490$ ).

For the item "How often do your dreams give you creative ideas?" the distribution of answers is shown in Table 3. Overall, only few participants answered that they get creative ideas via their dreams several times a week. On the other hand, almost half of the participants reported that they never got creative ideas. The average is  $0.49 \pm 1.89$  creative ideas by dreams per month. The percentage of creative dreams of all recalled dreams is 6.34%.

In the area of problem solving, on the extreme ends, very few participants said dreams help them to identify and solve

Table 4. Distribution of the item: "Do you have the impression that dreams provide impulses or pointers for your waking life?"

| Category      | Impulses and Pointers<br>N = 2483 |
|---------------|-----------------------------------|
| Totally       | 9.18%                             |
| Somewhat      | 23.60%                            |
| Partly        | 28.96%                            |
| Not that much | 24.29%                            |
| Not at all    | 13.98%                            |

problems several times a week and almost half indicated that they never get help for problem solving by dreams. Results are shown in Table 3. The recoded frequency of problem solving dreams was in average  $0.47 \pm 1.82$  dreams per month. These are 6.08% of all remembered dreams.

To the question of impulses and pointers for waking life, only few people decided on the extremes - not at all or totally. The distribution for all answers can be found in Table 4. The average on this 5-point-scale has been  $1.90 \pm 1.18$ .

Furthermore, Spearman's Rho between the main variables impulses, problem solving and creative ideas show large size correlations. Impulses and creative ideas correlated with .465. Impulses and problem solving correlated with .540, whereas creative ideas and problem solving correlated with .658.

Parametric regressions for the item "Do you have the impression that dreams provide impulses or pointers for your waking life?" with the 5 NEO-FFI traits as independent variables and gender, age and dream recall frequency as confounding variables (adjusted  $R^2 = .2026$ ) have been calculated. Participants with higher scores in Neuroticism, Extraversion and Openness to experience showed higher scores for this item. Attitude towards dreams has been added as an additional variable: Neuroticism and Agreeableness showed significant effects (adjusted  $R^2 = .5116$ ). Results can be found in Table 5.

The ordinal regression for the item "How often do your dreams give you creative ideas?" shows similar correlations while it has been statistically controlled for gender,

Table 5. Parametric regressions for impulses and pointers for waking life by dreams

| Genre                   | Analysis 1<br>N = 2472 |      |        | Analysis 2<br>N = 2472 |      |        |
|-------------------------|------------------------|------|--------|------------------------|------|--------|
|                         | SE                     | t    | p      | SE                     | t    | p      |
| Age                     | -.0742                 | -3.9 | .0001  | -.0007                 | -0.1 | .9628  |
| Gender (1 = f, 0 = m)   | .0958                  | 5.0  | <.0001 | .0360                  | 2.4  | .0164  |
| Dream Recall Frequency  | .1867                  | 9.8  | <.0001 | .0238                  | 1.6  | .1188  |
| Attitude towards dreams |                        |      |        | .6758                  | 40.3 | <.0001 |
| Neuroticism             | .2011                  | 9.1  | <.0001 | .0579                  | 3.3  | .0010  |
| Extraversion            | .0705                  | 3.5  | .0005  | .0413                  | 2.6  | .0089  |
| Openness to experience  | .2261                  | 11.9 | <.0001 | .0126                  | 0.8  | .4214  |
| Agreeableness           | -.0085                 | -0.4 | .6705  | -.0474                 | -3.1 | .0022  |
| Conscientiousness       | .0144                  | 0.7  | .4791  | -.0156                 | -1.2 | .2169  |

SE = Standardized estimates, Analysis includes age, gender, Dream recall frequency and all five personality factors entered simultaneously, for Analysis 2 attitude towards dreams was added.

Table 6. Ordinal regressions for creative ideas by dreams

| Genre                   | Analysis 1<br>N = 2481 |          |        | Analysis 2<br>N = 2479 |          |        |
|-------------------------|------------------------|----------|--------|------------------------|----------|--------|
|                         | SE                     | $\chi^2$ | p      | SE                     | $\chi^2$ | p      |
| Age                     | -.0936                 | 17.5     | <.0001 | -.0612                 | 7.1      | .0076  |
| Gender (1 = f, 0 = m)   | -.0690                 | 9.2      | .0024  | -.1021                 | 19.3     | <.0001 |
| Dream Recall Frequency  | .4245                  | 303.5    | <.0001 | .3643                  | 211.8    | <.0001 |
| Attitude towards dreams |                        |          |        | .3749                  | 117.8    | <.0001 |
| Neuroticism             | .0728                  | 7.7      | .0055  | .0062                  | 0.1      | .8200  |
| Extraversion            | .1199                  | 25.2     | <.0001 | .1131                  | 21.8     | <.0001 |
| Openness to experience  | .3042                  | 166.0    | <.0001 | .2018                  | 66.0     | <.0001 |
| Agreeableness           | -.0939                 | 16.01    | <.0001 | -.1182                 | 24.5     | <.0001 |
| Conscientiousness       | -.0864                 | 13.1     | .0003  | -.1108                 | 20.7     | <.0001 |

SE = Standardized estimates, Analysis 1 includes age, gender, Dream Recall Frequency and all five personality factors entered simultaneously; for Analysis 2 attitude towards dreams was added.

age and dream recall frequency (adjusted  $R^2 = .2586$ ). As can be observed in Table 6, Extraversion demonstrates a small positive correlation with this item. Agreeableness and Conscientiousness show negative correlations with creative ideas via dreams, i.e. less agreeable and less conscientious participants showed a higher creative dream frequency. Openness to Experience shows a medium sized positive correlation with creative ideas via dreams. When attitude towards dreams has been added as an additional variable in a second analysis, the relation to Openness to Experience is minimized, whereas the relation to Conscientiousness, Extraversion and Agreeableness which are still significant do not demonstrate such a profound change. The explained variance is increased when attitude towards dreams has been added as a confounding variable ( $R^2 = .3160$ ).

For the item “How often do your dreams help you to identify and solve your problems?” which is called problem solving in the following, a significant positive correlation with Neuroticism has been shown ( $R^2 = .2513$ ). Like the variables impulses for waking life and creative ideas, problem solving is related to Openness to Experience. A small but significant effect can be seen in relation with Extraversion.

When attitude towards dreams is added to the confounding variables ( $R^2 = .3350$ ) Neuroticism, Openness to Experience and Agreeableness show significant correlations.

All the considered items show a significant positive correlation with dream recall frequency. The variables indicate under all circumstances a negative connection to age, which demonstrates that older persons have fewer impulses and pointers, creative ideas and help for problem solving in waking life that are provided by dreams. Furthermore under most conditions, women are more often affected than men by their dreams in the form of creative ideas and problem solving.

#### 4. Discussion

Overall, it has been shown that not only extraordinarily creative persons but also persons with a large age range and diverse social backgrounds are influenced by their dreams which could be demonstrated for creative ideas, impulses for waking life as well as problem solving. This happened significantly more often for participants with higher scores in Openness to Experience but the effect decreased when atti-

Table 7. Ordinal regressions for problem solving by dreams

| Genre                   | Analysis 1<br>N = 2480 |          |        | Analysis 2<br>N = 2478 |          |        |
|-------------------------|------------------------|----------|--------|------------------------|----------|--------|
|                         | SE                     | $\chi^2$ | p      | SE                     | $\chi^2$ | p      |
| Age                     | -.1028                 | 21.1     | <.0001 | -.0611                 | 7.0      | .0081  |
| Gender (1 = f, 0 = m)   | -.0704                 | 9.6      | .0024  | .0360                  | 2.4      | .1217  |
| Dream Recall Frequency  | .3867                  | 261.5    | <.0001 | .3207                  | 167.6    | <.0001 |
| Attitude towards dreams |                        |          |        | .4614                  | 254.6    | <.0001 |
| Neuroticism             | .1842                  | 49.8     | <.0001 | .1129                  | 17.5     | <.0001 |
| Extraversion            | .0678                  | 8.2      | .0042  | .0637                  | 7.0      | .0083  |
| Openness to experience  | .2585                  | 124.8    | <.0001 | .1315                  | 28.7     | <.0001 |
| Agreeableness           | -.0429                 | 3.3      | .0670  | -.0708                 | 8.8      | .0030  |
| Conscientiousness       | -.0287                 | 1.5      | .2275  | -.0053                 | 5.2      | .0232  |

SE = Standardized estimates, Analysis 1 includes age, gender, Dream Recall Frequency and all five personality factors entered simultaneously; for Analysis 2 attitude towards dreams was added.

tude towards dreams was inserted into the analysis. Higher scores in Neuroticism and Extraversion showed an influence on all three variables. The personality traits Agreeableness and Conscientiousness were significantly negatively correlated with creative ideas by dreams.

When considering the representativeness of the sample by looking on the NEO-FFI-scales, the largest difference to the representative sample (Körner et al., 2008) is the factor Openness to Experience. This can be explained by the origin of the sample which consists of persons who are motivated to participate in online surveys. Representativeness is also affected by the overrepresentation of higher education in the present sample (Statistisches Bundesamt, 2018). In comparison with other studies on the topic (Kuiken & Sikora, 1993; Schredl, 2000b; Schredl et al., 2014b; Schredl & Erlacher, 2007) fewer students participated; a larger variation is therefore expected. Studies with representative samples showed no significant influence of education on dream recall frequency (Schredl, 2008, 2013); therefore an influence of education in the present sample should not be discernible. The distribution of the features dream recall frequency, gender and age varies in comparison with two representative samples (Schredl, 2008, 2013). Although the distribution of the present sample is not representative in several aspects, the effect sizes of age and gender as frequency influencing factors are similar for the representative and the present sample. The item impulses and pointers on waking life could be modified by transforming the scale into the one of problem solving and creative dreams. It is not possible to compare these variables and it is not possible to calculate a frequency of impulses and pointers on waking life. Participants could have idiosyncratic understanding of creative ideas or problem solving by dreams, e.g. wake up with an idea and attribute it to a dream but cannot remember any dream. Consequently, the ratio between creative dreams or problem solving dreams and all dreams might be imprecise. It is suggested that the phenomena be defined for the participants. The retrospective nature of the questionnaire approach could be biased because of memory effects. Erlacher and Schredl (2004) and Schredl and Erlacher (2008) compared the findings of dream reports in diaries with an analysis of a questionnaire approach which showed small differences between prospective and retrospective methods; it has been suggested that questionnaire items are valid.

A low frequency of one creative dream every other month and a similar frequency for problem solving dreams were shown in the present sample. In this sample, the average number of creative dreams was lower than the one in the sample population of Schredl and Erlacher (2007) which consisted mostly of students; they found a higher rate for dream recall frequency of three per week in comparison to two per week in the present sample; Creative dreams occurred once per month. It is interesting to see that the creative dream frequency seems to be stable around 6 - 7% although the absolute numbers differ. The high correlations between problem solving, creative dreams and impulses and pointers, show how close those subjects relate to each other. Schredl and Erlacher (2007) asked participants to give examples of creative dreams and obtained answers which could be categorized into creativity and problem solving afterwards. Problem solving is seen by participants as a creative action.

Older people tend to remember fewer dreams and fewer creative and problem solving dreams. This supports earlier findings (Pagel & Vann, 1992; Schredl et al., 2014b). Schredl and Göritz (2017) showed that attitude towards dreams declines with age. The same age effect of attitude towards dreams has been shown in the present study but it does not explain the entire age effect because the influence of age is still significant when attitude towards dreams is used as an additional confounding variable. This study showed women to have in general a higher dream recall frequency which matches earlier findings (Schredl & Reinhard, 2008). Men had a higher creative dream and problem solving dream frequency. Several studies showed inhomogeneous effects of gender on creative dream frequency (Pagel & Vann, 1992; Schredl et al., 2014b; Schredl & Erlacher, 2007). The high creative dream frequency of men cannot be explained by studies on creativity: several studies showed relative equality in creativity between women and men (Baer & Kaufman, 2008; Kogan, 1974). Men have been found to outperform women in advanced mathematical problem solving (Gallagher et al., 2000) but not in social problem solving (D'Zurilla, Maydeu-Olivares, & Kant, 1998). Because of these inhomogeneous findings, it is difficult to explain the higher problem solving dream frequency within the framework of the continuity hypothesis (Domhoff, 1996; Schredl & Hofmann, 2003; Strauch & Meier, 1996). Dream recall frequency had an influence on all variables. Because problem solving and creative dreams are infrequent phenomena, remembering more dreams increased the number of remembered creative and problem solving dreams. An important variable has been attitude towards dreams; people with a more favorable attitude towards dreams tend to receive more ideas from their dreams.

According to a hypothesis, persons who are more open towards new experiences receive new impulses and creative ideas more often in their dreams. Persons who have higher scores in Openness to Experience like philosophic discussions, art and nature as well as literature (Körner et al., 2008). It can be hypothesized that persons with higher scores for Openness to Experience tend to have an open attitude towards dreams giving rise to ideas for their waking life also when considering problem solving. The effect of Openness to Experience declines but remains for problem solving dreams and creative dreams when attitude towards dreams has been added as a confounding variable. Other factors seem to be relevant. The item impulses and pointers does not show a significant correlation with Openness to Experience any longer when controlling for attitude towards dreams.

In an exploratory analysis, other personality traits showed significant correlations to creative dream frequency. A negative correlation of Conscientiousness to creative dream frequency has been shown. This finding is supported by a meta-analysis of Feist (1998): creative persons are more open to new experiences and less conscientious. If less conscientious persons are more creative, they will pay more attention to creative ideas from their dreams than more conscientious persons. Creative persons show higher scores in Extraversion (Furnham & Bachtar, 2008) which could indicate that participants with higher scores in Extraversion are more creative and therefore pay more attention to creative ideas via dreams. Because agreeable persons tend to be cooperative (Barrick, Stewart, Neubert, & Mount, 1998), and

have a desire to avoid conflict in their personal relationships (Sung & Choi, 2009), it could be suggested that more agreeable persons have difficulties to express innovative ideas because these could give rise to interpersonal conflicts. Further research has to be done to explain the relationships in detail and to show if they are maintained in a representative sample.

Because this study is the first one examining the correlations between problem solving and personality factors, it is not possible to compare the results with previous findings. The relationship between Openness to Experience and problem solving has already been explained. Extraversion showed a significant correlation with problem solving but this result is no longer valid when attitude towards dreams has been added as a confounding variable. A significant correlation of Neuroticism and help for problem solving by dreams has been shown. As shown by Eysenck (1985), persons with higher scores in Neuroticism experience more stressful events. It is possible to conclude that this group of persons shows more problems and therefore pays more attention to dreams that could influence the problem solving process. The same explanation can be used for the relationship of Neuroticism and the item impulses and pointers for waking life. The correlation of problem solving dreams and Agreeableness reaches significance after controlling for attitudes towards dreams. Further research is needed to explain this finding.

To summarize, personality traits, especially Openness to Experience, affect the frequency of creative and problem solving dreams. Neuroticism and Extraversion showed a significant effect on all three variables. Agreeableness and Conscientiousness were negatively correlated with the item creative ideas by dreams. Although some differences of personality traits influencing problem solving and creative dream frequency have been found, both phenomena seem to be related to each other. Dream recall frequency and attitude towards dreams have been shown to be important influencing variables but other related variables, e.g. waking creativity and ability to solve problems in waking life on creative and problem solving dreams, have to be examined in further research. The amount of time invested in waking life in creative activity could influence the frequency of creative dreams. It has been shown that e.g. the amount of time for sports in waking life, influenced the frequency of dreams which contain sport activity or sport topics (Erlacher & Schredl, 2004). Persons who invest more time in creative activity in waking life could pay more attention on the ideas that could show up in their dreams. A deeper insight of how dreams have affected which kind of creativity, e.g. divided into creative outlet with a creative product such as a writing a song (Pagel & Kwiatkowski, 2003) could be achieved by the use of diary studies with a representative sample. These studies have to be conducted over several months because of the relatively low frequency of the phenomena.

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