Levels of processing and memory for emotional words

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In two experiments we tested the influence of levels of processing on memory for emotional and neutral words. Emotional words were recalled better than neutral words when the level of processing was low (orthographic or phonetic features). Recall for emotionally neutral words was either better (emotional valence rating) or the same (assigning colors or imagery rating) as for emotional words under deep levels of processing conditions. These results led to the interpretation that the emotional features of a word only have a memory-enhancing effect in the case of poor conceptual learning of item material. This fits well with Bower's (1981) network theory of emotion which would predict an influence of emotional valence on recall only when few retrieval cues are available. When there is a high level of conceptual learning, the emotional valence of words should not influence memory performance.

Research on the influence of emotional material on memory performance has a long tradition in psychology. Ebbinghaus (1910) already stated that memory for emotionally toned material is better than for emotionally neutral material. This result has been found in many studies on the recall of emotional words (see Rapaport, 1942).

Direct experimentation on the effects of emotional valence and memory performance has been neglected in the last decades. Instead there has been an interest in finding factors modulating the effects of emotion on memory. Two such factors have been found: The interval between learning and recall (Kleinsmith & Kaplan, 1963) and mood (Blaney, 1986; Bower, 1981; 1992; Morris, 1989). Kleinsmith and Kaplan (1963) have shown with a pair association learning paradigm that memory performance for emotionally neutral words is better than for emotional ones if the memory test is conducted immediately after learning. After twenty minutes both emotional and neutral words show the same memory performance. With an interval of one week performance for emotional words is better than for neutral words. Similarly, Yoder and Elias (1987) have shown that the superior recall of emotional compared to neutral story sequences becomes more important when the recall is tested after three days and not immediately. Mood congruent learning refers to the correspondence of a person's mood state and the emotional valence of the stimuli, mostly words. Mood-congruity effects on memory have been found by several authors (e.g., Bower, Gilligan & Monteiro, 1981; Clark, Milberg & Ross, 1983; Clark & Teasdale, 1985).

The modulating effects of the learning-test interval and mood on the influence of emotional valence on memory performance can be explained by the network theory of emotion (Bower, 1981). According to this theory, the emotional valence of a word is a node of the semantic network. If a person is in a particular mood, it is more probable that a node of the same emotional valence will be activated than a node of a different emotional valence. At this time it is not quite clear whether it is the mood per se, or the activated knowledge about the mood of the subjects that is responsible for the mood congruity effect in learning. Perrig and Perrig (1988) showed mood congruity effects also in the case where the subjects were instructed only to behave "as if they were" happy or depressed. In this case the dimension of depression seems to function as an organizational framework integrating the mood-congruent words during encoding, and as a retrieval scheme in recall. Also in this interpretation the network assumption can be used to explain the mood congruity effect. In this case mood does not refer to some uncertain rational state, but rather to a process organizing the knowledge about.
words

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It is highly plausible to assume that emotion is connected to different representational levels, from sensory-motor programs to conceptual knowledge (Izard, 1993; Leventhal & Scherer, 1987), and it will be an urgent need for mood research, to relate specific behavioral characteristics and phenomenological experiences to these different representational levels. There is some evidence from the literature which suggests that emotional components only have organizational power leading to memory effects when no other more evident organizational principle governs the material to be learned. Fiedler and Stroebel (1986) and Perrig and Meier (1989) have shown that mood congruity effects only appear when no other categorical structure is imposed on the material. These results support Bower’s (1981) assumption that mood congruity only plays a role if there are few other retrieval cues available.

To explain the interaction of the emotional valence of words and the learning-test interval found by Kleinsmith and Kaplan (1963) and Yoder and Elias (1987) the network theory can again be used. The fact that immediate recall there is a less superior memory performance for emotional words than for neutral words or even a superiority of neutral words, and that there is a clear superiority in recall of emotional over neutral words in delayed recall, may be due to different representational characteristics of the material immediately after learning and one week later. We may conclude that recall performance for emotional words is better when few retrieval cues are available after one week. This would mean that emotional valence of the item material per se has organizational power, not only in connection with a person’s mood. As it has been shown for mood congruity effects, it is plausible to assume that the emotional valence of words only has an effect on memory if no other organizing principles are available, i.e. if the conceptualization of item material is relatively poor.

The goal of this study was to test this assumption by the use of an incidental learning task, and the manipulation of levels of processing (Craik & Lockart, 1972). Subjects had to solve orienting tasks for positive, negative and neutral words. One group of subjects had to write down the vowels of the presented words (vowel group); for this group only processing of orthographic features was necessary. The second group had to assign colors to the words (color group), the third group had to rate words for their emotional valence (emotional valence group). Both, color assigning and emotional valence rating included processing of the meaning of a word. There was no reference to the emotional valence of words in the orienting task of the color group. The orienting task of the emotional valence group however included processing of the emotional valence of words.

We expected that only poor conceptual learning would lead to an advantage in memory performance for emotional words. If this is true, memory performance should be uninfluenced by emotional valence when learning is conceptual and many connections are built up, and the emotional valence should only play a role as a retrieval cue if learning is poor in terms of conceptual structure. In the levels of processing approach (Craik & Lockart, 1972) a deep level of processing should not result in an advantage of emotional words whereas a low level of processing should lead to higher recall for emotional words.

Experiment 1

Experiment 1 contains three tasks: (1) incidental learning task; (2) mood evaluation and (3) free recall after a delay of thirty minutes.

Method

Subjects

48 students of a Bernese secondary school aged between 13 and 15, participated in the experiment. The experiment was performed class wise at the beginning and at the end of a normal lesson. There were sixteen students in each class. One class was assigned to the vowel group, one to the color group and one to the emotional valence group.
In the learning trial, 48 words were presented: 36 words entered data analysis, the other 12 words were filler words — six at the beginning and six at the end of the list — to prevent primacy and recency effects. Half of the filler words had four, the other half had eight letters; there were four emotionally positive, neutral and negative filler words. One third of the 36 words had five, six or seven letters, respectively. 12 words were emotionally positive, 12 neutral and 12 negative. There were four words each of the same length and emotional valence. The item list can be seen in Appendix 1.

The emotional valence of the words was verified by 15 adult subjects who didn’t participate in the experiments described here. They rated all words for emotional valence on a seven point scale, which ranged from -3 (very negative valence) to +3 (very positive valence). Zero stood for a neutral emotional valence. An analysis of variance over all word groups showed a highly significant effect for emotional valence, $F(2,33) = 137.47, p < .001$. A further analysis using the Scheffé Test revealed significant differences for all three comparisons. Means were +1.74, +0.21 and -1.70 for positive, neutral and negative words, respectively, the critical difference (5%) was 0.31. The mean word frequency in the German language according to Meier (1964) was balanced over the three emotional valence groups (one-factorial ANOVA for independent groups: $F(2,33) = 0.03$). To prevent satiation effects, the list of the learning trial was presented in reverse order to half the subjects. For mood evaluation, a bipolar scale as described by Spiegel (1988, p. 67ff.) was used. This scale was constructed to test tiredness, concentration, attention and mood and is mainly used in psychopharmacological research. Only the mood dimension entered data analysis.

This yielded a 3x3-factorial design, the factor Levels of Processing (vowels vs. colors vs. emotional valence) being between subjects, and the factor Emotional Valence (positive vs. neutral vs. negative) within subjects. The dependent variable was the free recall score, i.e. number of words recalled.

### Procedure

The experiment had three parts: (1) Incidental learning task at the beginning of a school lesson. After thirty minutes (2) Mood evaluation; and (3) Memory test.

In the incidental learning task subjects were presented 48 words on one page with the instruction (a) to write down the vowels (a, e, i, o, u) of the words (vowel group); (b) to think about what color a word has for the subject and to write down this color (color group); (c) to decide whether a word evokes emotionally positive, neutral or negative feelings (emotional valence group). After completion of this task the school lesson continued normally. Thirty minutes later the subjects had to evaluate their own mood and subsequently write down all the words they could remember (free recall instruction).

### Results

#### Learning task and mood evaluation

Performance in the vowel task was very high (99% correct). As only six mistakes were made, the data was not analysed statistically. The color ratings were not analysed either. The frequencies of the valence rating were counted for every word. As can be seen in table 1, the frequencies are distributed clearly according to the experimental categories. Analysis of the distribution by $\chi^2$-test revealed a high significance ($\chi^2[4] = 447.09, p < .001$).

#### Table 1: Frequencies of positive, neutral and negative ratings for positive, neutral and negative words

<table>
<thead>
<tr>
<th>Rating</th>
<th>Emotional valence of words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td>Positive</td>
<td>160</td>
</tr>
<tr>
<td>Neutral</td>
<td>27</td>
</tr>
<tr>
<td>Negative</td>
<td>5</td>
</tr>
</tbody>
</table>

The self-rated mood was evaluated by a bipolar scale ranging from 1 to 6 containing four word pairs (sad/happy; anxious/confident; excitable/well-balanced; in a bad mood/in a good mood). The total mood of a person could range from 4 to 24. No significant between the three groups cc a one-way ANOVA for inc (Means for the vowel, the emotional valence group were 19.31, respectively, $F(2,45)$.

#### Table 2: Means and standard-deviations of positive, neutral and negative words

<table>
<thead>
<tr>
<th>Processing</th>
<th>Emotiv</th>
<th>Negativ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vowel detection</td>
<td>Mean</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.53</td>
</tr>
<tr>
<td>Color assigning</td>
<td>Mean</td>
<td>2.19</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.64</td>
</tr>
<tr>
<td>Emotional valence judgement</td>
<td>Mean</td>
<td>2.31</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.87</td>
</tr>
</tbody>
</table>

A 3x3-factorial (Level Emotional Valence) ANOVA measures on the second factor main effects for Level $[2,45]= 52.42, p < .001$, and Valence, $F(2,90) = 4.13, p < .05$ interaction (Levels of Proc Valence), $F(4,90) = 4.56, p < .05$ were further eva.

Total memory perform group was significantly low or and the emotional valence were 1.06, 7.50, and 8.63, a real difference (5%) was 2.31 for testing the with main effect of the emotional significant, $F(2,30) = 7.78$, with high emotional valence negative — were contrasted words. The contrast was $9.31, p < .01$, i.e. neutral word better than emotional difference in the recall of words, $r(15) = 0.49$. The six the color group was not $r(1.39$. As no neutral word in the vowel group, analysis o
mood evaluation

The vowel task was very high only six mistakes were made, analysed statistically. The color analysed either. The frequency ratings were counted for in be seen in Table 1, the fre- buted clearly according to the groups. Analysis of the distribution revealed a high significance <.001).

Table 2: Means and standard-deviations for free recall of positive, neutral and negative words for the three levels of processing groups

<table>
<thead>
<tr>
<th>Level of processing</th>
<th>Emotional valence of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vowel detection</td>
<td>Negative</td>
</tr>
<tr>
<td>Mean</td>
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<tr>
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</tr>
<tr>
<td>SD</td>
<td>0.87</td>
</tr>
</tbody>
</table>

A 3×3-factorial (Levels of Processing x Emotional Valence) ANOVA repeated measures on the second factor showed significant main effects for Levels of Processing, F (2,45) = 52.42, p < .001, and for Emotional Valence, F (2,90) = 4.13, p < .05, and a significant interaction (Levels of Processing x Emotional Valence), F (4,90) = 4.56, p < .01. The Levels of Processing were further evaluated by a Scheffe test. Total memory performance for the vowel group was significantly lower than for the color and emotional valence groups. Means were 1.06, 7.50, and 8.63, respectively, the critical difference (5%) was 2.02. Analysis of variance for testing the within-subjects simple main effect of the emotional valence group was significant, F (2,30) = 7.78, p < .01. The words with high emotional valences – positive and negative – were contrasted with the neutral words. The contrast was significant, F (1,15) = 9.31, p < .01, i.e. neutral words were remembered better than emotional ones. There was no difference in the recall of positive and negative words, t (15) = 0.49. The simple main effect of the color group was not significant, F (2,30) = 1.39. As no neutral word was remembered in the vowel group, analysis of simple factors by ANOVA was impossible for this group. Instead, paired t-tests were calculated. These tests were significant for the positive vs. neutral, t (15) = 2.61, p < .05, and negative vs. neutral comparisons, t (15) = 2.78, p < .05. There was no significant difference in the recall of positive and negative words, t (15) = 0.82.

Discussion

Levels of processing clearly modulate the effects of emotional valence on memory. Subjects who wrote down vowels remembered more emotionally positive and negative words than neutral words. In fact they did not even remember one neutral word. They recalled some but not many emotionally positive and negative words. Subjects of the color group didn’t show any influence of emotional valence, whereas the emotional valence group remembered neutral words better than emotional words. These results are compatible with Bower’s (1981) assumption that emotions only play a role if the other retrieval cues are poor.

Although the results are clear-cut, there are several problems yet unsolved: (1) The three groups had different kinds of orienting tasks. One group had to copy vowels, the other to assign colors, the third to rate emotional valence. (2) The results of the emotional valence group could be due to the difficulty of judging neutral words on the dimension of emotion. This difficulty may have led to more attention focussed on neutral words than on the emotional ones. This assumption (a) is compatible with results by Craik and Tulving (1975) who showed that more time needed for yes-answers in the learning trial led to higher memory performance; and (b) is supported by the fact that the simple main effect for the color group is not significant, indicating that neutral words per se are not more recallable at a deep level. (3) Subjects were between 13 and 15 years old, representing a rather young age group. (4) Grouping was by classes; this may have led to effects of classes rather than levels of processing and emotional valence.

To test the validity of our data we therefore performed a second experiment with university students and different orienting tasks.
Experiment 2

In this experiment we varied levels of processing by using a rating task for both groups: One group had to judge sound brightness, implicating processing on a purely phonetic level (sound group), the other group judged imagery, implicating the processing of meaning components (imagery group).

Method

Subjects

38 students of a psychology lecture on adolescence participated in the experiment. 19 subjects were randomly assigned to the sound group, 19 to the imagery group. The study was conducted in a group session in a lecture room at the University of Berne.

Material and design

The word material in the learning trial was similar to that of experiment 1, but some different words were used (see Appendix 2). The average number of letters per word was balanced across the three emotional valences. To prevent seriation effects, the learning list was presented in reverse order for about half of the subjects. Six filler words – three at the beginning and three at the end – were presented to prevent primacy and recency effects.

The emotional valence of the words was verified by 17 social workers in education who did not participate in the experiments described here. They rated all words for emotional valence on a seven-point scale, which ranged from -3 (very negative valence) to +3 (very positive valence). Zero stood for a neutral emotional valence of a word. An analysis of variance over all word groups showed a highly significant effect for emotional valence, $F[2,33]=67.79, p<.001$. A further analysis using the Scheffé-Test revealed significant differences for all three comparisons. Means were +1.83, +0.38 and -1.44 for positive, neutral and negative words, respectively; the critical difference (5%) was 0.73. The mean word frequency in the German language according to Meier (1964) was balanced over the three emotional valence groups (one-factorial ANOVA for independent groups; $F[2,33]=0.28$).

This yielded a $2 \times 3$-factorial design, the factor levels of processing (sound vs. imagery rating) being between subjects, and the factor item's emotional valence (positive vs. neutral vs. negative) within subjects. The dependent variable was the free recall score, i.e. number of words recalled.

Procedure

The procedure was the same as in experiment 1, but mood evaluation was not administered. At the beginning of a lecture, subjects had to rate words either for sound brightness or imagery on a seven-point scale, ranging from 1 (very low sound brightness resp. imageability) to 7 (very high sound brightness resp. imageability). For sound rating, subjects were told that words have different degrees of sound brightness. As examples "aha" was given as a bright and "uhu" as a dark word. The subjects were instructed to mentally rehearse a word two or three times and then to judge its sound brightness. For imagery rating, subjects were told that words have different degrees of imageability. As examples "apple" was given as easily and "democracy" as a badly imageable word. The subjects were instructed to imagine a word and then to judge its imageability. Both groups were told not to use more than ten seconds per word. After the learning trial the lecture was held normally for thirty minutes. Then the lecture was interrupted and subjects had to write down all the words they could remember from the beginning of the lesson.

Results

Learning task

The subjects' mean rating of every word was calculated. Means for sound rating were 3.83 for negative, 4.75 for neutral and 4.48 for positive words. A one-way ANOVA revealed a significant main effect between word groups, $F[2,33]=3.47, p<.05$. Group the Scheffé test showed a sig between negative and neutral difference (5%) was 0.9. Group's ANS has an influence on between emotional and neu confounded with sound words. Therefore the influence was examined by correling the rating of items with the relation was not significant agery rating of negative words were 4.48, 4.83, and A one-way ANOVA didn't effect, $F[2,33]=0.31$.

Free recall. The results fo ed in table 3.

Table 3: Means and standard-dev. of positive, neutral and negative words in processing groups

<table>
<thead>
<tr>
<th>Level of processing</th>
<th>Emoti</th>
<th>Negati</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound rating</td>
<td>Mean</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.12</td>
</tr>
<tr>
<td>Imagery rating</td>
<td>Mean</td>
<td>1.79</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.23</td>
</tr>
</tbody>
</table>

A $2 \times 3$-factorial (Level Emotional Valence) ANOVA measures on the second factor's main effect for Level [1] = 10.86, $p<.01$, but Valence, $F[2,72]=0.25$, an action (Levels of Processi lence), $F[2,72]=6.11, p<.01$, simple main effects were an oneway ANOVA. This e for the sound group, $F[2,34]$ not for the imagery group.jects of the sound group words – positive and neg better than neutral words, .01, whereas positive and not show a significant differ 0.58.
ling to Meier (1964) was balanced emotional valence groups NOVA for independent groups:

A 2×3-factorial design, the fac-similing sound vs. imagery rating subjects, and the factor
1 valence (positive vs. neutral)
within subjects. The dependent:
free recall score, i.e. number
was the same as in experiment
using was not administered.

4 of a lecture, subjects had to
for sound brightness or im-
point scale, ranging from 1
brightness resp. imageability)
sound brightness resp. image-
rating, subjects were told
2 different degrees of sound
samples "aha" was given as a
dark word. The subjects
3 mentally rehearse a word two
and then to judge its sound
imagery rating, subjects were
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word as a badly imageable
as instructed to imagine
to judge its imageability. Both
not to use more than ten sec-
the learning trial the lec-
ally for thirty minutes. Then
interrupted and subjects had to

d an rating of every word was
for sound rating were 3.83
for neutral and 4.48 for pos-
way ANOVA revealed a sig-
ct between word groups, F
[2.33] = 3.47, p < .05. Group comparisons using
the Scheffé test showed a significant difference
between negative and neutral words, the cri-
cal difference (5%) was 0.92. If sound bright-
ness has an influence on recall, differences
between emotional and neutral words may be
confounded with sound brightness of the
words. Therefore the influence of sound on
recall was examined by correlating sound bright-
ness rating of items with their recall. The cor-
relation was not significant (r(36) = 0.09). Im-
agery rating of negative, neutral and positive
words were 4.48, 4.83, and 4.88, respectively.
A one-way ANOVA didn’t reveal a significant
effect, F[2,33] = 0.31.

Free recall. The results for free recall are list-
ed in table 3.

<table>
<thead>
<tr>
<th>Level of processing</th>
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<tr>
<td></td>
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<td>SD</td>
<td>1.12</td>
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<td>Mean</td>
<td>1.79</td>
</tr>
<tr>
<td>SD</td>
<td>1.23</td>
</tr>
</tbody>
</table>

Discussion

In experiment 2 a very clear replication of how
levels of processing modulate the effect of emo-
tional valence on memory performance could
be shown, using different item material and dif-
f erent instructions for levels of processing.
Negative words were rated lower for sound
brightness than neutral ones, but correlation
with free recall did not reveal any connection
of sound rating and memory performance.

Again, superficial processing, in this experi-
ment sound rating, led to higher recall of emo-
tional words, whereas deep processing led to
the same recall of neutral words as of emotional
ones. This latter result shows that it is quite
possible that the emotional valence rating in ex-
periment 1 led to more attention focused on
neutral words which in turn led to higher recall
scores for these words.

General Discussion

We have been able to replicate an interaction
effect of levels between processing and emo-
tional valence on memory performance. In both
experiments, a low level of processing, which
did not include semantic processing, led to
higher memory performance for emotional
words. A deep level of processing including
processing of the meaning of the word led to
higher (exp. 1, emotional valence group) or the
same recall performance (exp. 1, color group,
and exp. 2) for neutral words. In both experi-
ments the levels of processing main effect
(Craik & Tulving, 1975) could be replicated.

The question remains whether or not factors
other than emotional valence could account for
the effects obtained. Three possible factors are
ruled out because they were controlled: Fre-
frequency in the German language, mood of the
subjects (exp. 1) and imageability of words
(exp. 2). One other possibility would be the cat-
gerization of items: It may well be that words
are categorized according to their emotional
valence. Consequently, positive and negative
words form a stronger category than neutral
words. This however would contradict exper-
imental results obtained by several researchers
who found a superiority of categorized lists
over unrelated words in free recall (Bruce & Fagan, 1970; Kintsch, 1968).

Our results fit in well with the assumptions of Bower's (1981) network theory. The emotional valence of words is merely a weak cue for recall which only becomes relevant if learning is bound to superficial features of the word but not to meaning. If word meanings are elaborated by subjects, the emotional valence of the words doesn't have any effect on memory performance, unless an appropriate mood frame allows the single words to be integrated (cf. Perrig & Perrig, 1988).

References


Author notes

We thank Emma Smith for her help in preparing this manuscript.

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Appendix 1: Word material used in experiment 1: Negative, neutral and positive German words in order of descending frequency in German language after Meier (1964), and their English translations. Filler words are not listed.

<table>
<thead>
<tr>
<th>Negative</th>
<th>Neutral</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krieg [war]</td>
<td>Schrift [script]</td>
<td>Erfolg [success]</td>
</tr>
<tr>
<td>Schmerz [pain]</td>
<td>Dauer [duration]</td>
<td>Engel [angel]</td>
</tr>
<tr>
<td>Angst [anxiety]</td>
<td>Prinzip [principle]</td>
<td>Beifall [acclamation]</td>
</tr>
<tr>
<td>Strafe [punishment]</td>
<td>Eingang [entrance]</td>
<td>Gunst [favour]</td>
</tr>
<tr>
<td>Schande [disgrace]</td>
<td>Platte [plate]</td>
<td>Fleiß [diligence]</td>
</tr>
<tr>
<td>Trauer [sorrow]</td>
<td>Mantel [coat]</td>
<td>Spass [fun]</td>
</tr>
<tr>
<td>Krise [crisis]</td>
<td>Frosch [frog]</td>
<td>Applaus [applause]</td>
</tr>
</tbody>
</table>

Appendix 2: Word material used in experiment 2: Negative, neutral and positive German words in order of descending frequency in German language after Meier (1964), and their English translations. Filler words are not listed.

<table>
<thead>
<tr>
<th>Negative</th>
<th>Neutral</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zweifel [doubt]</td>
<td>Dauer [duration]</td>
<td>Sonne [sun]</td>
</tr>
<tr>
<td>Schmerz [pain]</td>
<td>System [system]</td>
<td>Dank [thanks]</td>
</tr>
<tr>
<td>Zwang [compulsion]</td>
<td>Eingang [entrance]</td>
<td>Gunst [favour]</td>
</tr>
<tr>
<td>Schande [disgrace]</td>
<td>Szene [scene]</td>
<td>Frische [freshness]</td>
</tr>
<tr>
<td>Wunde [wound]</td>
<td>Becher [beaker]</td>
<td>Spass [fun]</td>
</tr>
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