Accurate Judgment by Dementia Patients of Neutral Faces with Respect to Trustworthiness and Valence

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Accurate Judgment of Neutral Faces with Respect to Trustworthiness and Valence in Dementia

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Affective judgment in dementia

Abstract

Main aim of the present study was to investigate if dementia patients can make accurate social and affective judgments of face stimuli. We used verbal material as a control condition to see if dementia patients are capable of using the ratings scales the same way as controls. We compared trustworthiness, valence and arousal ratings of dementia patients with a healthy control group. Participants rated pictures of young and old, female and male neutral faces and two fictitious biographies. The results indicate that dementia patients make accurate judgments of unfamiliar faces with respect to trustworthiness and valence. Results concerning arousal ratings suggest that the corresponding scale might be difficult to use for dementia patients and possibly for older participants as well.
Accurate Judgment of Neutral Faces with Respect to Trustworthiness and Valence in Dementia Patients

Behavior disturbances such as difficulties in social situations and inappropriate affective behavior are well known in dementia patients (Lyketsos et al., 2000). They can be a great burden for patients and caregivers. However, it is not clearly understood what causes these problems. Cognitive deficits have been studied extensively in this population and may contribute to behavior disturbances; patients have problems remembering names and events for example, which may lead to failures in social situations. Social withdrawal and depressive symptoms may arise in consequence. On the other hand deficits in emotion processing could be relevant for the occurrence of behavior disturbances as well, but little is known about emotion processing capacities of dementia patients. Dementia patients might for example have difficulties to interpret facial expressions of emotion or they might have difficulties in making accurate social and affective evaluations, which may both lead to inadequate reactions in social situations. Hence, the aim of the present study was to examine how dementia patients evaluate social and affective stimuli.

To examine differences in emotion processing between healthy participants and individuals with dementia, face stimuli seem ideal, because they are of high relevance for social interactions. Results from studies focusing on the recognition of emotional facial expressions in dementia patients, however, are inconclusive: Some of the studies found a deficit in emotion recognition, others did not find such a deficit, and some attributed problems in emotion discrimination as shown by some patients to their deficits in other cognitive domains, or to global cognitive deterioration. For instance, Roudier et al. (1998) reported that AD patients are impaired in discriminating face stimuli, but are able to discriminate expressions of emotions.
Luzzi, Piccirilli, and Provinciali (2007) found that the ability to identify positive and negative emotions on chimeric faces is largely preserved in AD patients. In fact, impaired performance was found in only 27% of the subjects. Since the impaired participants had lower scores on constructional praxis and nonverbal memory tasks, the authors hypothesized that these patients represent a sub-group with predominant right-hemisphere dysfunction. Cadieux and Greve (1997) report a deficit in emotion recognition in AD and intact facial identity recognition. They attributed the deficits in emotion recognition to deficits in verbal and spatial processing in AD patients. Hargrave, Maddock, and Stone (2002) demonstrated that patients with AD have deficits in recognizing emotional facial expressions, and they concluded that these might be independent of their impairment in recognizing non-emotional features of faces.

The recognition of emotional facial expressions is a critical aspect in social interactions and so is the accurate social judgment of other individuals based on their facial appearance. To our knowledge, no study has addressed the evaluation of face stimuli with regard to trustworthiness and the experience of adequate emotional reactions in dementia patients. However, difficulties of dementia patients in accurate social and affective judgment of other individuals on the basis of their facial appearances appear likely, given findings of amygdala damage in dementia patients (e.g., Kromer Vogt, Hyman, Van Hoesen, & Damasio, 1990). Studies with brain-damaged patients suggest that the amygdala is a critical structure for the accurate evaluation of neutral face stimuli with respect to trustworthiness and approachability (Adolphs, Tranel, & Damasio, 1998). Imaging studies also show that the amygdala is automatically activated in social judgment tasks (Winston, Strange, O’Doherty, & Dolan, 2002).

An important aspect in the investigation of affective and social judgments and possible differences between groups is the potential dissociation between face stimuli and verbal material.
Adolphs et al. (1998) reported that three patients with bilateral amygdala damage judged faces of unfamiliar people to be more trustworthy and approachable than controls. The impairment was greatest for faces to which normal subjects assigned the most negative ratings. However, there was no impairment when verbal descriptions of people were evaluated. The amygdala seems to be necessary to trigger the retrieval of information that is based on prior experience with certain stimuli or - potentially - an innate response bias (Damasio, 1995). Verbal information seems to evoke enough information to perform judgments accurately without the assistance of the amygdala. Thus, accurate judgment of verbal material seems to rely more on cognitive processes.

Since the aim of our study was to investigate social and affective judgments that are based on prior experience with certain stimuli or an innate response bias in dementia patients we used unfamiliar neutral faces as stimuli. We did not use faces displaying emotions in the present study, because a previous study (Winston et al. 2002) found correlations between perceived trustworthiness ratings and facial expressions of some emotions. To ensure that ratings are not influenced by participants’ ability to recognise facial expressions of emotions we used only neutral faces. Verbal material was used as a control condition. If ratings of face stimuli of healthy subjects and dementia patients do not differ, this would indicate that affective evaluation is intact in dementia patients. However, if ratings of dementia patients and controls differ on certain dimensions, this could be due to cognitive deficits, that is difficulties using rating scales or affective processing deficits. We hypothesized that if the dementia patients in our study are unable to make accurate affective and social judgments of verbal material, their difficulties might be related to general cognitive decline and associated difficulties using rating scales. However, if they do not judge face stimuli accurately, but are able to accurately judge the verbal material, this would indicate emotion processing deficits in dementia patients.
We compared affective evaluations of patients with dementia with those invited from a healthy, age-matched control group using both verbal material and face stimuli. Participants rated pictures of 12 young and old, female and male neutral faces on the dimensions of valence, arousal and trustworthiness, and two fictitious biographies, one containing positive the other negative traits.

Design and Methods

Participants

Demographical data and clinical characteristics are listed in table 1. The study included 18 dementia patients (diagnosed as AD (N = 14) or mixed dementia (N = 4)). Patients were recruited in a regional facility at the time of testing. All patients were diagnosed by a multidisciplinary team of the hospital ward using ICD 10 criteria (Dilling, Mombour, & Schmidt, 2000). The diagnosis was based on general medical, neurological and neuropsychological examinations. All patients had received medical attendance including computerized tomography or magnetic resonance imaging and specific screening blood tests, in order to exclude syphilis, diabetes, thyroid disorders and vitamin B12 and folic acid deficiency.

The control group comprised eighteen healthy older participants. Controls were non-institutionalised and managed their own household. They reported that they had no known CNS diseases, contact with toxic substances or substance abuse. Patients and controls did not differ in age ($t(34) = 1.09; \ p > .28$) and education ($t(34) = 1.43; \ p > .16$). As expected, the mean MMS (Folstein, Folstein, & Mc Hugh, 1975; Tombaugh & McIntyre, 1992) of participants in the control group was higher than that of patients ($t(34) = 6.80; \ p < .01$). All participants gave written informed consent. Testing protocol was approved by the local ethics committee.

Material
Pictures. Test stimuli were twelve pictures of neutral and unfamiliar male (N = 6) and female (N = 6) faces of young (N = 6) and old (N = 6) adults selected from the Productive Aging Laboratory Face database (Minear & Park, 2004; Pictures: EMW female 18 neutral, EMW female 19 neutral, EMW female 27-2 neutral, WW male 19 neutral, WW male 20-1 neutral, WW male 28-2 neutral, JWF female 79-4 neutral, JWF female 80 neutral, JWF female 80-2 neutral, TSWF male 79 neutral, TSWF male 79-2 neutral, TSWF male 88 neutral). All stimuli were printed in US letter format on white paper.

Fictitious biographical information. We created two fictitious biographies that differed in terms of socially acceptable behavior. Whereas one person was for example described as a good student who helped his mother a lot, the other persons’ biography contained elements like he beat his wife.

Emotional ratings. Valence and arousal ratings were obtained via a Self-Assessment Manikin (SAM; Lang, 1980). The SAM was designed to assess subjective ratings of participants’ emotional responses and minimize the influence of language and culture on ratings. Its dimensions of valence (ranging from pleasant to aversive) and arousal (ranging from low to high intensity) have shown reliable relationships with other measures of emotional responses such as physiological and behavioral parameters (Greenwald, Cook, & Lang, 1988). The SAM rating scale has been successfully used in previous studies with dementia patients (e.g., Blessing, Keil, Linden, Heim & Ray, 2006). Using the paper-pencil version of this instrument, participants rated the stimuli as to their emotional valence and arousal. We created a nine-point paper and pencil rating scale to assess participants’ ratings of trustworthiness (ranging from very untrustworthy to very trustworthy).
Procedure

Each participant viewed the pictures and was asked to rate them in terms of trustworthiness, valence and arousal. After the rating of the pictures the investigator placed the written fictitious biographical information in front of them and read it out loud. The same ratings as used for the pictures were used for the biographical information.

Pictures were presented in four different pseudorandom sequences and the fictitious biographies were presented in two orders (negative, positive and positive, negative). The same sequences were used in the AD patients and the healthy controls and no combination was used more than five times in any group.

Data Analysis

Repeated measures Analyses of Variance (ANOVAs) were conducted for the valence, arousal and trustworthiness ratings of pictures. For each of the dependent variables the different pictures were used as within-participant factors and group was included as a between participant factor. Ratings of stories and pictures were analysed separately.

Results

Pictures (facial stimuli)

Trustworthiness ratings. The repeated measures ANOVA revealed a main effect of pictures ($F(11,24) = 4.14; p < .01, \eta^2 = .66$; see Fig. 1). Thus, participants rated the different pictures differently. No interaction between pictures and group ($F(11,24) = 0.68; p > .74, \eta^2 = .24$) and no main effect of group appeared ($F(1,35) = 0.07; p > .79, \eta^2 = .01$). This indicates that dementia patients and healthy controls did neither differ in their ratings of individual pictures nor in their mean rating over all pictures.

Valence ratings. The repeated measures ANOVA showed a significant main effect of
pictures \( (F(11,24) = 9.01; \ p < .01, \ \eta^2 = .80; \) see Fig. 2) but no interaction between pictures and group \( (F(11,24) = 1.21; \ p > .33, \ \eta^2 = .36) \), and no main effect of group \( (F(1,35) = 0.04; \ p > .53, \ \eta^2 = .01) \).

**Arousal ratings.** The repeated measures ANOVA indicated a significant main effect of pictures \( (F(11,24) = 2.62; \ p < .02, \ \eta^2 = .54; \) see Fig. 3) along with an interaction between pictures and group \( (F(11,24) = 4.23; \ p < .01, \ \eta^2 = .66) \). This suggests that dementia patients and healthy controls differed in their arousal ratings of individual pictures. However, no main effect of group emerged \( (F(1,35) = 25.04; \ p > .29, \ \eta^2 = .03) \), indicating that mean ratings of both groups did not differ.

**Verbal material (fictitious biographies)**

**Trustworthiness ratings.** The repeated measures ANOVA showed a significant main effect of biographies \( (F(1,34) = 570.72; \ p < .01, \ \eta^2 = .94) \). The negative biography was rated lower on the trustworthiness dimension than the positive one. There was no interaction between biographies and group \( (F(1,34) = 0.59; \ p > .45, \ \eta^2 = .02) \). We found a main effect of group \( (F(1,35) = 5.17; \ p < .03, \ \eta^2 = .13) \) indicating that the mean trustworthiness ratings of biographies differed between groups. More precisely, dementia patients rated the fictitious biographies lower on the trustworthiness dimension than healthy controls.

**Valence ratings.** The repeated measures ANOVA revealed a significant main effect of biographies \( (F(1,34) = 333.53; \ p < .01, \ \eta^2 = .91) \). The negative biography was rated lower on the valence dimension than the positive one. No interaction between biographies and group \( (F(1,34) = 3.28; \ p > .08, \ \eta^2 = .09) \), and no main effect of group appeared \( (F(1,35) = 0.29; \ p > .87, \ \eta^2 = .00) \).

**Arousal ratings.** The repeated measures ANOVA indicated a significant main effect of
the biographies ($F(1,34) = 15.16; p < .01, \eta^2 = .31$). The negative biography was rated higher on the arousal dimension than the positive one. The interaction between biographies and group was at trend level ($F(1,34) = 3.87; p < .057, \eta^2 = .10$), suggesting that the groups tended to rate the two biographies differently on the arousal dimension with the dementia group showing stronger differences between ratings of the two biographies. We found no main effect of group ($F(1,35) = 0.00; p > .96, \eta^2 < .00$).

Discussion

The main aim of the present study was to investigate if dementia patients make accurate social and affective judgments of other individuals based on their facial appearance. In the present study neutral pictures of faces and fictitious biographies were presented to patients with dementia and healthy controls. All participants rated the stimuli with respect to valence, arousal and trustworthiness. Valence and trustworthiness ratings of pictures did not differ between dementia patients and healthy controls. However, the arousal ratings of individual pictures differed between groups. The biographies were rated equally by both groups on the valence dimension but dementia patients mean trustworthiness rating was less positive than that of controls. The two groups tended to rate the biographies differently on the arousal dimension, with dementia patients showing stronger differences between ratings of the two biographies in the expected direction, that is fictitious biographical content containing socially unacceptable behavior was rated higher on the arousal dimension than content containing socially acceptable behavior.

As discussed above, changes in affective reactions could be expected in dementia patients due to amygdala damage. Subjects with amygdala damage judge faces of unfamiliar people to be more trustworthy and approachable than healthy subjects (Adolphs et al., 1998). However, since
ratings of dementia patients and healthy older individuals did not differ on the dimensions of trustworthiness and valence, we conclude that dementia patients make adequate social and affective judgments of face stimuli with respect to trustworthiness and valence. The results on arousal ratings are difficult to interpret. The ANOVA indicates an interaction between group and picture rating on the arousal dimension. Results seem to suggest that dementia patients have a specific deficit in making adequate arousal judgments of social stimuli. This deficit could be a consequence of amygdala damage and a related reduction or disturbance of emotional arousal in response to social stimuli. Findings on the enhancing effect of emotion on memory in dementia patients are in line with this notion. The enhancing effect of emotion on memory is called emotional memory effect. The emotional memory effect largely depends on emotional arousal (Buchanan, 2007). Some studies show that the emotional memory effect is impaired in dementia patients (e.g., Kensinger, Anderson, Growdon, & Corkin, 2004). However there are conflicting findings (e.g., Kazui et al. 2000), for a review on the emotional memory effect in AD patients see Blessing, Martin, Wenz, and Zöllig (2006). Another possible explanation for the findings concerning arousal ratings in the present study could be that it is quite difficult for some individuals to use the scale correctly. Participants were invited to use the scale to indicate whether they were themselves aroused by a certain picture, but not if the picture displayed something or someone arousing. The differences in arousal ratings might be related to the use of the scale and not to deficits in affective reactions in response to facial stimuli in dementia patients. One result that points in this direction is that the two groups tended to rate biographies differently on the arousal dimension as well. Dementia patients showed stronger differences between ratings of the two biographies in the expected direction, and, thus, seem to have been influenced more strongly by the affective content. As studies with brain-damaged patients have
shown (Adolphs et al., 1998), it is easier to make accurate social and affective judgments of verbal material compared to face stimuli, since ratings can be more obviously derived from the information presented. On a neurophysiological level, the amygdala seems to be involved in the social judgment of face stimuli, but not verbal material. Verbal information seems to evoke enough information to perform judgments without the assistance of the amygdala. We found that the two groups rated individual face stimuli differently on the arousal dimension and for the biographies we found a tendency in the same direction. This could indicate that the differences are not due to amygdala dysfunction in dementia patients which should leave ratings of verbal material unaffected. Thus, difficulties of dementia patients using the arousal scale might be related to general cognitive decline and its associated difficulties using rating scales. Older adults may have problems using the arousal rating scale as well due to age related cognitive changes. Our results do not clearly indicate whether only dementia patients had problems using the arousal scale or if both groups had difficulties using this scale in our experiment.

With respect to the trustworthiness dimension, the mean ratings of biographies differed between controls and dementia patients. Dementia patients tended to rate both biographies less trustworthy than controls. Perhaps dementia patients have problems making accurate judgments on the trustworthiness dimension based on verbal information. However, the ANOVA indicated a main effect of biographies, but no interaction between group and biographies, showing that ratings for the two biographies differed in both groups as predicted. Perhaps dementia patients used the scale not in the same way as controls but they could use the scale consistently for different stimuli.

In summary, results of our study suggest that dementia patients can make accurate affective and social judgments of face stimuli compared with healthy controls. Our study
indicates that behavioral disturbances as a consequence of failures to make adequate social and affective judgment of other individuals based on their facial appearance can not be expected in dementia patients. However, results concerning arousal ratings suggest that dementia patients may have problems using this scale due to general cognitive impairment. Older adults may have problems using the arousal scale as well. Our results are in line with results of previous studies with dementia patients and amnesic MCI patients making adequate affective judgments of visual stimuli (Burton & Kaszniak, 2006; Döhnel et al., 2008). The present study suggests that behavior disturbances in dementia patients are not caused by difficulties in social and affective judgment of faces of other people since dementia patients rate the same persons as approachable as do older controls.
References


### Table 1

**Demographical parameters and clinical characteristics in the study groups**

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Figure Captions

Figure 1. Interaction plot showing mean ratings of trustworthiness for patients and controls. Note that low ratings indicate high trustworthiness. Means are shown for twelve face stimuli (1-3: faces of young females, 4-6: faces of young males, 7-9: faces of old females, 10-12: faces of old males).

Figure 2. Interaction plot showing mean ratings of emotional valence for patients and controls. Note that low ratings indicate high pleasure. Means are shown for twelve face stimuli (1-3: faces of young females, 4-6: faces of young males, 7-9: faces of old females, 10-12: faces of old males).

Figure 3. Interaction plot showing mean ratings of emotional arousal for patients and controls. Note that low ratings indicate high arousal. Means are shown for twelve face stimuli (1-3: faces of young females, 4-6: faces of young males, 7-9: faces of old females, 10-12: faces of old males).
Figure 1.
Figure 2.

- AD
- elderly controls

Mean valence rating vs. Face stimulus
Figure 3.

[Graph showing mean arousal rating against face stimulus. The graph compares AD and elderly controls with dots and squares respectively.]