

**Critical Review:**  
**What is the Evidence for Deficits in Decoding Emotion through Facial Expressions  
in Parkinson's Disease?**

Atteslander, E.  
M.Cl.Sc. (SLP) Candidate  
School of Communication Sciences and Disorders, U.W.O

This critical review examines the ability to decode emotional facial expressions (EFEs) among individuals with Parkinson's disease. Study designs include: case controls and a critical review. Overall, research is inconclusive regarding deficits in decoding EFEs in Parkinson's disease. Results are mixed, ranging from non-specific impairments, to emotion-specific impairments, to an intact ability. Recommendations for future research and clinical practice are provided.

*Introduction*

Parkinson's disease (PD) is a degenerative disorder of the basal ganglia, resulting in dopamine depletion (Pell, 1996; Zgaljardic, Borod, Foldi, & Mattis, 2003). The basal ganglia, located deep within the cerebral hemispheres, include the striatum, which is composed of the caudate nucleus and putamen, and the lentiform nucleus, composed of the putamen and globus pallidus. The basal ganglia maintains complex interconnections with various areas of the brain including the frontal lobe of the cerebral cortex (Duffy, 2005). PD is predominantly recognized by its effects on the motor capacity of those affected (Pell, 1996).

Although PD has typically been considered a movement disorder, the effects are not limited to motor disturbances. PD causes a range of mild cognitive deficits and there is growing interest in impaired emotional and social behaviour in this patient population. Particularly, impairments in the recognition of EFEs have been demonstrated in several investigations (Suzuki, Hoshino, Shigemasu, & Kawamura, 2006).

Research studying the processing of EFEs in PD has been initiated due to evidence suggesting that the perception of facial expressions of disgust is impaired in other disorders involving frontal-striatal regions of the brain and the basal ganglia (e.g., Huntington's Disease, Obsessive-compulsive Disorder), fMRI studies showing activation of the putamen in response to faces

portraying disgust, as well as deficits in EFE recognition observed following focal lesions to the basal ganglia (Dujardin et al., 2004; Sprengelmeyer et al., 2003).

**Objectives**

The primary objective of this paper is to critically evaluate existing literature regarding the impact of PD on the processing of emotion portrayed through facial expressions. The secondary objective is to propose evidence-based recommendations for future research as well as clinical implications of the findings.

*Methods*

**Search Strategy**

Computerized databases, including PubMed, CINAHL, Cochrane Library, Medline-OVID, Psychinfo, and CommDisDome, were searched using the following search strategy:

(Parkinson's Disease) AND (Emotional Processing) OR (Emotion Perception) OR (Facial Expression Recognition).

The search was limited to articles written in English.

**Selection Criteria**

Studies selected for inclusion in this critical review were required to focus their investigation on the impact of PD on the processing of EFEs. No limits were set on the demographics of research participants.

## Data Collection

Results of the literature search yielded five articles that were identified for review based on the above selection criteria. All of the studies employed a case-control study design. One additional study, a systematic review, did not meet the specific selection criteria; however, it was included in the review as it contained valuable evidence regarding the overall findings in this area of literature.

## Results

Jacobs, Shuren, Bowers, and Heilman (1995) evaluated the ability of patients with PD to perceive EFEs. In addition, based on the hypothesis that individuals with PD may be impaired at imaging emotional faces, researchers also tested emotional facial imagery. Patients with PD were compared to matched controls and findings from Wilcoxon rank sum tests showed impairments in participants with PD in perceiving EFEs as well as on a task of emotional facial imagery. Performance on the perceptual task was significantly correlated with performance on the emotional facial imagery task, which suggests a link between the ability to produce emotional facial imagery and process EFEs. These results suggest basal ganglia involvement in emotional facial tasks. The results of this study provide evidence for deficits in decoding emotions through facial expressions in PD; however, these findings should be interpreted with caution as there appear to be significant methodological weaknesses.

Based on past research pointing to basal ganglia involvement in the recognition of facial expressions of disgust, Sprengelmeyer et al. (2003) used a three group comparison in order to investigate the recognition of EFEs in individuals with medicated and unmedicated idiopathic PD and matched controls. By comparing PD patients with and without dopamine replacement medication, they were able to look at the contribution of the dopaminergic system to the processing of EFEs. Data was analyzed using multiple two-way repeated measure ANOVAs and results indicated that for both PD groups, there was evidence of impaired recognition of EFEs,

especially fear. In addition, these deficits were more consistently observed in the unmedicated group who, in comparison to the medicated group, performed worse for the recognition of disgust and anger. These results provide evidence for deficits in decoding EFEs in individuals with PD, and support the hypothesis that the dopaminergic system is involved in the recognition of emotions, particularly disgust.

In their study, Dujardin et al. (2004) aimed to assess the effects of PD on the ability to decode EFEs, and subsequently sought to obtain evidence for the potential involvement of the basal ganglia or dopaminergic system in processing non-verbal, emotional information. Unmedicated patients with PD were compared to a group of matched controls. Data was analyzed using univariate and multivariate ANOVAs, which revealed significantly lower EFE decoding accuracy scores in PD patients in comparison to controls on all evaluated emotions, which included anger, sadness, and disgust. These results provide evidence for a disturbance in emotional processing in patients with PD, suggesting basal ganglia involvement in processing non-verbal emotional information.

Due to unclear conclusions regarding the evidence for and nature of EFE processing deficits in PD, Pell and Leonard (2005) aimed to further evaluate this ability using a comprehensive method in a well-defined patient sample. Sensitivity to EFEs was assessed in individuals with idiopathic PD and matched controls and data was analyzed using tests of difference and ANOVA designs. Results provided limited evidence for differences in the processing of EFEs between participants with PD and controls. However, although not statistically significant, results showed slight indication of selective difficulties in the case group at recognizing facial expressions of disgust. This suggests basal ganglia involvement in the recognition of this facial expression, which is consistent with evidence from other studies in this area (e.g., Suzuki et al., 2006). The present results provide limited evidence for deficits in decoding EFEs in PD, though they do *suggest* disgust-specific impairments.

Suzuki et al. (2006) aimed to clarify whether the processing deficits of EFEs

observed in individuals with PD are emotion-specific. They used a refined assessment method (as well as a conventional method), in which the task-difficulty was controlled and the ceiling effect eliminated, due to reports of studies on emotion-specific impairments being confounded by these methodological problems. Participants with idiopathic PD were compared to matched controls and data was analyzed using MANOVA testing. Results from the refined method revealed significantly lower scores in disgust recognition, whereas conventional methods failed to identify this impairment. These results provide evidence for emotion-specific impairments in processing EFEs in PD. In particular, they provide additional support for disgust-specific recognition impairments in PD and the role of the basal ganglia in EFE processing.

Zjaljardic, Borod, Foldi, and Mattis (2003) conducted a systematic review of studies addressing the cognitive and behavioural sequelae of PD, including emotional processing deficits. The reviewed literature included articles obtained through PSYCH LIT and MEDLINE searches from the past 30 years, with the majority of the articles published within the past 15 years. The review focused predominantly on non-demented individuals with PD with the rationale that they represent the majority of the PD population. Several relevant studies were uncovered and organized by processing mode (39% perception) and communication channel (54% faces). Based on their evaluation of the existing literature, the authors concluded that, in terms of perception of EFEs, half of the studies show deficits in the patients with PD in comparison to controls, resulting in a lack of consensus. Therefore, based on the results of this review, it is fair to state that additional research with refined methodologies is necessary for more consistent conclusions.

### *Discussion*

#### **Appraisal of the Results**

All of the studies reviewed in this critical appraisal, with one exception, provide statistically significant evidence for EFE recognition impairments in PD. Although overall the studies employed sound experimental

designs, methodological weaknesses exist and it is important for these to be taken into account when generating conclusions based on the evidence and prior to adopting these findings into clinical practice.

#### **Subject Selection**

The most common weakness amongst the reviewed studies with regards to subject selection is a lack of information about the process of participant recruitment or participant recruitment from defined geographical locations. This results in a potential subject selection bias and causes concern about the representativeness of the sample and hence the generalizability of the results.

#### **Methodology**

There are methodological flaws shared by all of the case-control studies, which may decrease the strength of the evidence. None of the studies provided information regarding blinding of participants and/or researchers. Therefore, this may have allowed for bias due to researchers' or participants' unconscious expectations influencing the results. An additional concern was the use of static black and white photographs as facial stimuli in all of the studies, with the exception of one, which utilized coloured static photographs. Motionless black and white photographs are not necessarily reflective of live, dynamic facial expressions and therefore, may limit the ecological validity of the results.

One of the studies in particular (Jacobs et al., 1995) contained more notable weaknesses than the others. Information regarding the participants' stage of disease and whether or not they were medicated was not included in the study. Medication intake is a potentially important variable that could influence results. Knowledge of stage of the disease provides valuable information about performance in relation to severity of disease. An additional flaw of this study is the failure to include the results of the depression measures. Depression and other aspects of mental state may have a confounding effect on the decoding of EFEs. As well, they did not measure disgust, an emotion for which there is evidence of impairment in PD and other disorders involving the basal ganglia.

Finally, there was no task involving identification or labelling, procedures which are commonly used in studies of EFE decoding. The procedures used were matching and discrimination which appear to be less difficult than labelling an emotion and are less representative of “real-life”, in which one must identify an emotion in order to determine how one is feeling. Therefore, the face validity may be limited.

Lastly, the systematic review conducted by Zjaljardic et al., (2003) contained various weaknesses. There was a lack of specific criteria for including the reviewed studies and the various designs of the studies were not indicated. As well, no scoring system was used to rank the quality of the studies; however, the major methodological issues were noted. Based on the findings of the systematic review, the authors concluded that half of all the included studies examining perception of EFEs showed deficits in the PD population in comparison to controls. However, no information regarding the nature of the deficits was provided (i.e., whether or not the impairments were emotion-specific, etc.) This information would be helpful when making overall conclusions about the evidence and when providing recommendations regarding the direction of future research.

#### *Recommendations for Future Research*

The present evidence suggests that individuals with PD may have difficulty recognizing EFEs, particularly disgust and anger. Furthermore, these findings propose the involvement of the basal ganglia in the recognition of emotion through facial expressions. However, since there appears to be a lack of consensus regarding the presence and nature of these difficulties, it is recommended that further research, including replication of previous studies, be conducted to confirm, clarify, and further the research that has already been completed. It is recommended that researchers take the following into consideration:

- a) Indicate whether or not patients are medicated. Patient performance (EFE recognition difficulties or a lack of) may

be influenced by the effects of medication. As well, in order to understand the role of the dopaminergic system in EFE recognition, the effects of medication should be taken into account. To facilitate the understanding of the role of dopamine, it is recommended that EFE recognition studies examine patients with PD on and off dopamine medication.

- b) Compare individuals in early stages of the disease to those in more advanced stages in order to evaluate whether EFE recognition worsens as the disease progresses.
- c) Utilize live-recordings of facial expressions so that the results are more representative of the “real-life” context for decoding facial expressions and thus more generalizable to every-day interactions.
- d) Use more refined assessment methods in which factors such as task-difficulty and ceiling effects are controlled and/or eliminated. For example, Suzuki et al. (2006) used a more refined method with morphed images and item response theory as well as a conventional method to assess EFE recognition. The refined method revealed impairments in EFE recognition in patients with PD compared to controls, whereas the conventional method failed to detect this impairment.
- e) Include detailed information regarding the method of subject selection. Many of the present studies either failed to state how the participants were selected or participants were recruited from defined geographical regions resulting in a potential selection bias.
- f) Provide details regarding blinding of participants and/or researchers to avoid biased results. All of the studies in this review failed to include information

about blinding, which reduces the strength of the findings.

- g) Examine the potential impact of these EFE decoding impairments on discourse comprehension, social interactions, and quality of life. It may be useful to understand how these decoding deficits affect the every-day lives of those suffering from PD.
- h) Develop reliable, valid, and efficient tools for assessment of EFE decoding deficits.

#### *Recommendations for Clinical Practice*

Clinicians should recognize the difficulty individuals with PD may have in decoding EFEs because it may be associated with problems in social interaction. As well, family members and caregivers may need to be informed about these potential impairments in PD. As a final note, clinicians should be aware of valid and reliable methods for the assessment of impairments in EFE decoding.

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