

ABSTRACT

BACKGROUND: Micrographia is a common, often presenting feature of Parkinson's disease.

METHODS: We assessed a simple writing paradigm in 40 PD patients "off" medications, 35 different PD patients "on" medications, and 57 age matched controls. Patients wrote "Today is a nice day" with both eyes open and eyes closed to assess the effects of visual withdrawal (eye closure). The order (eyes open vs. eyes closed) was alternated. If "eyes open" was second, the first sample was covered, so subjects could not cue off of it. **RESULTS:** In the "off" medicine group, eye closure increased the writing length by 14.0±10.1% (p<0.05) from a mean of 69.1 mm to 77.7 mm [range -14% to +73%]. The percentage increase was larger in the 20 subjects with the smallest baseline writing size (worse micrographia), compared to the 20 with relatively larger writing (19.5% vs. 7.9%, p<0.05). In the "on" medicine group, there was no overall change in writing size, 75.1 mm to 75.9 mm [range: -24% - +34%]. The control group also did not change. **CONCLUSION:** Simple eye closure significantly increased writing size in "off" PD patients to a similar or greater amount as levodopa. This data suggests that micrographia is not a pure motor hypokinetic feature but is affected by PD similar to other super-learned tasks such as walking. Furthermore, some patients have adapted this simple eye closing strategy when writing, especially signatures.

INTRODUCTION

Micrographia is a common, often presenting feature of Parkinson's disease. Although presumed to be secondary to hypokinesia and bradykinesia, the sign correlates only modestly with these features. Micrographia can partially improve with levodopa and sub-thalamic nucleus deep brain stimulation or pallidotomy, although writing speed improves more than size.¹⁻³ Some have suggested that micrographia results from increased processing demands⁴ although this has not been well demonstrated.⁵ Others have correlate it with poor attention.⁶ Past research suggests that micrographia can improve with fixed visual cueing, such as lines to write between, but data on verbal cueing is mixed.^{6,7}

PD patients have variable abnormal writing responses to altered proprioceptive feedback induced from prisms and computer generated magnification^{8,9}, but surprising little data exists concerning the complete withdrawal of visual feedback.

METHODS

The protocol received a waiver from the Baylor College of Medicine IRB. PD patients were segregated into those who were: 1. the "off medication" group, not taking any PD medications or were practically defined "off" (>12 hours off levodopa) and 2. the "on medication" group, those who were currently taking dopaminergics and were clinically "on".

Controls were collected from spouses and friends accompanying patients at our clinic. Subjects were asked to write "Today is a nice day" in their "normal" handwriting with both their eyes open and with their eyes closed. This was done by a single investigator (W.O.) using a standard size piece of paper and diameter of pen. We alternated the order (eyes open first vs. eyes closed first).

METHODS cont'd.

If the eyes open was second, we covered the original writing so that they could not see it. We then measured the length of the writing sample and added this, along with patient demographic data into a database for analysis. Statistical analysis consisted of student t-tests comparing eyes open vs. eyes closed in the different groups.

RESULTS

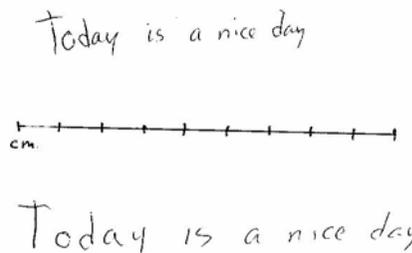
We assessed writing in 75 PD patients (29 female, current age 65.0±10.8 years, duration of PD 8.4± 5.4 years). The PD subjects were divided into those "off" medication group (N=40) and the "on" medication group (N=35). [Table 1] We also collected data on 57 age matched controls.

In the "off" group, 20 subjects wrote with eyes open first and 20 with eyes closed first. The order did not affect the writing size. Eye closure increased the writing length by 14.0±10.1% (p<0.05) from a mean of 69.1 mm to 77.7 mm [range: -14% to +73%]. The percentage increase was larger in the 20 subjects with the smallest baseline writing size (worse micrographia), compared to the 20 with relatively larger writing (19.5% vs. 7.9%, p<0.05) In the "off" subjects, eye closure increased writing size in 32, decreased it in 4, and did not alter it in 2. Sex did not affect change in writing size with eyes closed (10.1% female increase vs. 15.9% male increase, NS)

In the "on" group, 19 wrote with eyes open first and 16 eyes closed first. Order did not affect writing size. There was no overall change in writing size, 75.1 mm to 75.9 mm [range: -24% - +34%]. Eye closure increased writing size in 17 and decreased it in 18.

In the control group, 28 wrote eyes open first and 29 eyes closed first. The eyes open first group tended to have larger regular (open eye) writing (99.1 mm vs. 89.6 mm, p=0.07). There was no significant change in writing size with eye closure (89.6 mm to 95.8 mm, NS). The modest trend was powered by several outliers. Eye closure increased writing size in 29 and decreased it in 28. Overall, the "off" PD group eyes open handwriting was 23% smaller than that of age matched controls.

FIGURE 1: Example of Writing: Eyes Open (top) and Eyes Closed (bottom)



RESULTS cont'd

Table 1: Demographic Data and Writing Size

	PD "Off" (N=40)	PD "On" (N=35)	Controls (N=57)
Age (year)	62.7± 10.7	67.7± 10.4	66.1± 7.1
Sex	17 female (42.5%)	12 female (34.3%)	30 female (52.6%)
Duration (year)	8.9± 5.9	7.9± 4.7	-----
Eyes Open (mm)	69.1± 16.9	75.1± 15.1	89.6± 20.1
Eyes Closed (mm)	77.7± 18.4	75.9± 16.4	95.8± 21.7
% Increase	14.0± 18.1%	1.7± 15.0	7.1 ± 14.6

DISCUSSION

Simple eye closure significantly increased writing size in "off" PD patients. It did not increase writing size in "on" PD patients or controls. We did not compare intra-subject "on"/eyes open vs. "off"/eyes closed, however the later group tended to have larger writing suggesting that closing eyes is as effective as dopaminergics for micrographia. This was more pronounced in subjects with worse micrographia.

This data suggests that micrographia is not a pure motor hypokinetic feature but is affected by PD similar to other super-learned tasks such as walking. We feel this is analogous to gait freezing, which can also improve with eye closure. Although eye closure is an impractical treatment for walking, some patients have adapted this simple eye closing strategy when writing, especially signatures.

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