Narrowing wide-field optic flow affects treadmill gait in left-sided Parkinson's disease

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Narrowing wide-field optic flow affects treadmill gait in left-sided Parkinson's disease.

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LETTER TO THE EDITOR

Radially expanding optic flow is a visual consequence of forward locomotion and supports walking, also in patients with Parkinson's disease (PD) (1). When presented on a display, it evokes the illusion of forward self-motion. This implies that manipulation of optic flow while walking on a treadmill enables testing the effect of this basic stimulus pattern on gait progression, independent from actual walking. As movements in PD patients are more vulnerable to external stimuli, which may lead to e.g. freezing of gait (FOG), we expected a stronger effect of manipulating optic flow in these patients than in healthy control (HC) (2).

Fifteen PD patients (8 right-sided symptom dominance (PD.R), 7 left-sided (PD.L)) and 10 matched HC (mean age 66.3 yrs, SD 7.8) were tested. Patients (aged 64.9 yrs, SD 7.7) were mildly affected (Hohn & Yahr 2.3; UPDRS III 24.3 (SD 7.6)) and did not suffer from FOG. At steady-speed walking on the treadmill, narrowing the optic flow field was expected to evoke slowing of gait with backward displacement, mimicking the effect of approaching a narrow corridor. The latter was quantified by centre of mass calculation (3). Optic flow was presented by white dots in the lower half of a black screen (171x128cm). A gradual 1.8s transition from a wide to narrow flow field occurred by expanding dark grey surfaces from the horizon in both upward and downward directions (condition Fw-to-Ftn), which provided the natural illusion of moving into the changing environment (4). Control conditions for non-specific visual effects were the abrupt transition from wide flow to stationary dots (Fw-to-Sw) and gradual transition from a wide to narrow stationary field (Sw-to-Stn), respectively. Given right-hemisphere dominance in visuospatial processing, stronger effects were expected in PD.L (5). The WAIS block design test was used as general indicator of right hemisphere function.

The transition of narrowing the wide optic flow field evoked clear gait obstruction in particularly PD.L (figure 1). This suggested a relation with right hemisphere dysfunction, which was supported by the correlation between stronger gait obstruction and lower scores on the WAIS block design in the entire PD group ($p_{one\text{-}tailed}$=0.016, r=-0.552).

Although patient numbers were rather small after splitting into PD.L and PD.R groups, the novel paradigm of manipulating optic flow during treadmill gait appears to provide a promising strategy to study the effects of basic visual stimulus features on gait control. The effect in particularly PD.L is consistent with right-hemisphere dominance concerning visuomotor transformations, also in gait (5-6). Enhanced stimulus effects on movements in PD may be a consequence of reduced output from basal-ganglia-thalamic circuitry to the lateral premotor cortex leaving an overruling effect of parietally transferred visual information. As the output of basal-ganglia-thalamic circuitry to medial frontal regions may be even more affected (7), interference of gait by external stimuli is complemented by a failure to keep this movement pattern going by internal drives (8). This medial-lateral distinction is supported by our recent functional MRI study in healthy subjects showing a shift from lateral to medial premotor cortices when wide-field optic flow transited into a narrow flow field (4).

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AUTHORS' ROLES

A. van der Hoorn: Conception, organization and execution of the research project; Design and execution of statistical analysis; Writing of the first draft of the manuscript. A.L. Hof: Conception of the research project; Design of statistical analysis; Review and critique of manuscript. K.L. Leenders: Conception of the research project; Review and critique of manuscript. B.M. de Jong: Conception and organization of the research project; Review and critique of statistical analysis; Review and critique of manuscript.

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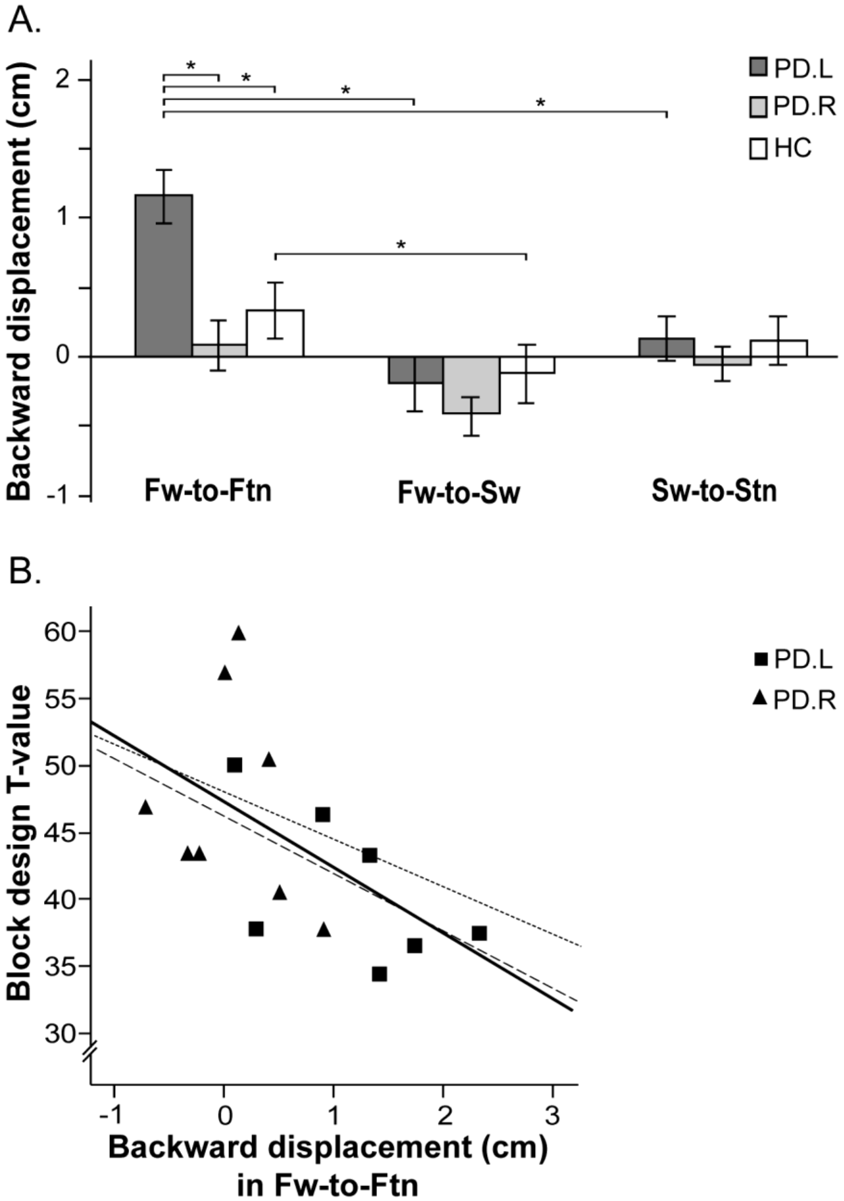
FIGURE 1.



Effect of narrowing optic flow on treadmill position and correlation with block design test.

A. Mean backward displacement on the treadmill (with standard error) is expressed by positive values (in cm), comparing the mean position in the 1.8s frame after- and 1.8s before transition onset in the visual display (* $p<0.05$).

B. Right-hemisphere involvement in backward displacement of Parkinson patients during treadmill gait is expressed by the correlation between the block design test and the effect of the transition from a wide to narrow forward optic flow field (Fw-to-Ftn). The thick line shows the overall regression, R^2 = 0.305. The separate regression lines for PD.L and PD.R patients are constituted by thin dashes and dots, respectively.

Abbreviations: PD.L = Parkinson's disease with left-sided symptom dominance; PD.R = PD with right-sided symptom dominance; HC = Healthy controls; Fw-to-Ftn = transition from wide flow-field to narrow flow; Fw-to-Sw = control transition of wide flow to stationary wide field; Sw-to-Stn = control transition of stationary wide field to stationary narrow field; cm = centimeter.