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Introduction
Machine learning has been used for prediction of energy expenditure (EE) from wrist-mounted accelerometers. However, it is unknown if models developed for an accelerometer on one wrist can accurately predict EE when applied to data collected from the opposite wrist.

Methods
Adults (n=44) wore GENEActiv accelerometers on the left and right wrists and a portable metabolic analyzer while participating in 90 minutes of simulated free-living activity. Participants performed 14 sedentary, lifestyle, exercise, and ambulatory activities for 3-10 minutes each and were allowed to choose activity order, duration, and intensity. Artificial neural networks (ANNs) were created to predict EE using a leave-one-out validation. Several feature sets were used in ANN development; additionally, preprocessing of raw data into non-negative values (e.g., absolute value) was performed for some ANNs. Accuracy of the ANNs was evaluated using correlations and root mean square error (RMSE), using metabolic analyzer data as the criterion for EE. Same-wrist accuracy (e.g., EE predicted from right-wrist ANNs using right-wrist accelerometer data) and opposite-wrist accuracy (e.g., EE predicted from right-wrist ANNs using left-wrist accelerometer data) were examined.

Results
ANNs yielded correlations of r=0.76-0.87 and RMSE=1.1-1.5 METs when predicting EE using same-wrist data. Accuracy fell for opposite-wrist prediction when ANNs were created using features from raw data (r=0.60-0.73, RMSE=1.6-2.2 METs); conversely, when raw data were preprocessed into absolute values before extracting features, ANN accuracy for predicting EE from opposite-wrist data (r=0.80-0.83, RMSE=1.2-1.4 METs) was similar to predictions for same-wrist data.

Discussion
Computing absolute values of raw acceleration data prior to ANN creation allowed for high EE prediction accuracy using ANNs developed from either wrist and provides a potential method for creation of wrist-independent models for EE prediction.

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Session 8

Thursday 11 June 14:00 – 15:00

CHARLES PARSONS LECTURE THEATRE

MEASURING AND OPTIMISING PHYSICAL BEHAVIOUR'S IN CLINICAL POPULATIONS 2

08.1 Further development of the instrumented Bath Ankylosing Spondylitis Functional Index (iBASFI) in axial spondyloarthritis: the added value of complex accelerometry-derived movement features for activity capacity assessment

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Introduction
Traditionally, performance-based measures of activity capacity rely only on movement duration (MD) captured with a stopwatch, complemented by self-reported outcome measures. Previously, the reliability and validity of automated algorithms to extract MD from accelerometer signals has been demonstrated in patients with axial spondyloarthritis (aSpA). This study aims to assess the explanatory power of more complex accelerometry-derived movement features to optimize activity capacity assessment.

Methods
Twenty-eight patients with aSpA (Mean(SD); Age:43.69(10.45); BMI:26.19(5.71); Sex:16M,12F) randomly completed seven performance-based tests derived from the Bath Ankylosing Spondylitis Functional Index (BASFI:3.41(2.19)) questionnaire. All patients wore a two-axial accelerometer (BodyMedia, USA) on the upper arm or the trunk sampling at 32 Hz. Various activity-related features, including MD, were extracted from filtered accelerometer signals using custom-written automated algorithms. Stepwise linear regression was used to model the BASFI score from an optimal set of features. A feature was included in the model if the R2 gain was at least 0.1. Features with less than 0.05 R2 gain were excluded. No co-linearity was detected (variance inflation factors <3).

Results
Full data including the final feature selection results were shown in Table I. For all performance-based tests, models with complex accelerometry-derived movement features were significant (p<0.013) and explained more variance (adjusted R2 value) than models including MD only. No generic explanatory feature was detected across tests.

Discussion & conclusion
In comparison to MD only, the addition of complex accelerometry-derived movement features to the iBASFI optimized activity capacity assessment in patients with aSpA. Technology-based activity capacity assessment merits further study in aSpA. *LB, TWS:equal contribution.

Test	Features	adjR² Complex*	adjR² MD only**
1: Sit-to-Stand 5x	Dominant frequency of jerk magnitude (stB -0.707)	0.481	0.376
2: Pick up a pen 5x	Minimum jerk magnitude (stB 0.429) Autocorrelation of longitudinal axis (stB -0.415)	0.471	0.209
3: Getting up	Norm. number of maxima of jerk angle (stB 0.463) Norm. spectral energy of jerk angle (stB -0.639)	0.728	0.209
4: Lying down	Norm. spectral energy of jerk angle (stB -0.719) Maximum absolute value of jerk angle (stB -0.444)	0.567	0.204
5: Reaching 5x	Maximum absolute value of angle (stB 0.606) Norm. skewness of angle (stB 0.617)	0.553	0.065
6: Putting on socks	Norm. complexity of magnitude (stB 0.572) Cross correlation between axes (stB 0.889)	0.509	0.078
7: Climbing stairs	10% spectral edge freq. of magnitude (stB -0.747)	0.541	0.356

Table 1: Final selection of complex accelerometry-derived movement features for each instrumented performance-based test resulting from stepwise regression modelling of the self-reported Bath Ankylosing Spondylitis Functional Index in patients with axial spondyloarthritis (n=28). Explanatory power was given as standardized beta values (stB) for each feature and as adjusted R^2 values ($adjR^2$) for complex* and movement duration (MD) only** models respectively. Norm.: normalized.

08.2 Treating gait impairments of patients with Parkinson's disease by means of real-time biofeedback in a daily life environment: The Cupid System

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Introduction
Gait difficulties are among the most disabling symptoms of Parkinson's disease (PD) with a strong impact on QoL. Audio-biofeedback techniques have the potential to improve gait performance. A newly developed home-based solution (CuPiD) based on two shoe-worn inertial sensors and a smartphone app, allow for stand-alone, unobtrusive and ecologically valid gait monitoring and closed-loop tutoring. Results of CuPiD usage are reported.

Methods
Twenty patients were provided with CuPiD for a period of six weeks. Patients' best performances were recorded under clinical supervision and stored as target into CuPiD at T0. Patients were then encouraged to walk 3x/week for sessions of 30 minutes while CuPiD monitored and tutored spatio-temporal