Questioning the definition of Tourette syndrome – evidence from machine learning

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Background

The clinical diagnosis of Tourette syndrome (TS) is not always clear and straightforward because motor and vocal tics in TS are often difficult to discern from single spontaneous movements or vocalizations in healthy people.

Objective

To identify aspects of TS phenomenology that are most useful in diagnosing an individual with TS using machine learning to independent video ratings of motor and vocal tics.

Methods

A standardized video of patients with TS and healthy controls was taken using the Modified Rush Videotape Rating Scale (MRVRS). 1 Five categories (number of body areas, frequency of motor and vocal tics, severity of motor and vocal tics) were scored (from 0-4) yielding a total score ranging from 0-20. In addition, motor tic count per minute was computed.

Spontaneous movements that could not reliably be distinguished from tics were counted as tics.

N= 101 patients with TS and n= 109 healthy controls were included in a support vector machine (SVM) based analysis to examine the impact of each category of the MRVRS, the motor tic count per minute, as well as age and gender for the classification of individuals into the groups „TS“ and „no TS“. 2

Results

Demographical data, MRVRS variables, and motor tic count per minute for the patient and control group are given in Figure 1 and Table 1. The results of the SVM analysis (Figure 2) show that only a single feature, the severity of motor tics is sufficient to identify an individual as having TS with an accuracy of 91.4%. Adding more features to the analysis does not significantly improve predictability.

Conclusion

The results of the SVM analysis presented here are of great relevance for the conceptualization of TS because it questions the validity of current diagnostic criteria for TS requiring the presence of both motor and vocal tics. 3 This has implications for medical practice because current recommendations for TS would then also apply to the group of chronic motor tic disorders. 4

Table 1: Variables of the Modified Rush Videotape Rating Scale and motor tic count per minute separately for the patients with Tourette syndrome (TS) and healthy controls. Mean values and standard deviations are given.

|                      | Patients with TS | Healthy controls |
|----------------------|------------------|-----------------|
| Number of body areas | 3.11 ± 1.01      | 0.84 ± 0.88     |
| Motor tics frequency | 2.31 ± 1.13      | 0.71 ± 0.70     |
| Vocal tics frequency | 0.81 ± 0.84      | 0.02 ± 0.12     |
| Motor tics severity  | 3.08 ± 0.92      | 0.76 ± 0.92     |
| Vocal tics severity  | 1.14 ± 1.22      | 0.02 ± 0.12     |
| Total score          | 10.45 ± 4.14     | 2.34 ± 2.39     |
| Motor tic count per minute | 39.20 ± 29.25 | 7.35 ± 12.12 |

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Sources

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Image

Figure 1: Demographic data for the patients with Tourette syndrome (TS) and healthy controls.

Figure 2: Results of the SVM analysis. The first bar shows the prediction accuracy of the feature contributing most to SVM classification performance (the motor tic severity of the MRVRS). The other bars indicate if and how much the cumulated classification accuracy increased compared to the best feature. Blue indicates a positive change, orange a negative change and black no change in classification accuracy. The 99% confidence intervals are displayed as black error bars.