THE INFLUENCE OF MUSIC ON KINEMATIC AND DYNAMIC GAIT PATTERNS

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INTRODUCTION

For the optimization of therapeutic processes different learning strategies have been suggested. From a neurophysiological point of view cognitve processes such as learning and memory are affected by emotions [1]. Beside psychological interventions music can lead to emotional responses [2]. The aim of this study was to investigate the influences of music on everyday movement with extremely individual characteristics [3].

METHODS

Kinematic and dynamic gait patterns were recorded from 16 subjects within three conditions: Stimulating (s), comfort (c), and no (n) music. In all trials headphones were worn. In each condition subjects had to pass in a randomly assigned order three times a 5m zone within which one double step was video recorded (25 Hz). Gait velocity was self determined (0.86-1.49m/s) and measured by means of two pairs of light bars. Subjects were recorded three dimensionally with 2 video cameras (JVC), one in front, and one on the right side of the subject. Angles and angular velocities of the main joints (ankle, knee, hip, shoulder, elbow, trunk) were determined via DLT within SIMI-Motion-Software. Ground reaction forces were measured via Kistler force platform (1000Hz). The time courses of all variables and groups of variables during three right ground contact phases were classified by means of hierarchical cluster analysis. The groups of variables were a) all angles and angular velocities, b) all angles, c) all angular velocities, d) all variables of the lower extremities, e) the ankle angle, and f) ground reaction forces. Assessment rates were determined by $AR = \dfrac{1}{n}\sum_{i=1}^{n}\dfrac{m_i}{r_i}100\%$,

with n = number of subjects, m = number of trials clustered in the largest cluster, and r = number of trials per subject. All subjects had to answer a questionnaire about the personal music preferences.

RESULTS AND DISCUSSION

The cluster analysis on the basis of all trial and all variables reveals an AR of 90%, which increases up to 93% when only the angular variables are included. Both ARs with respect to the number of subjects and trials provide strong evidence for the individuality of gait patterns according to [3]. On the background of the ground reaction forces the AR decreases to 70%. Obviously, the angular variables, as the most differentiated type of data, lead to the highest AR. The cluster analyses within single subjects show a strong influence of music in the gait pattern of only two subjects. Most intriguingly some subjects who stated to have no musical or rhythmical sense in the questionnaire displayed fairly good ARs for each type of music. Two subjects achieved a 100% separation by the type of music which they were listening to
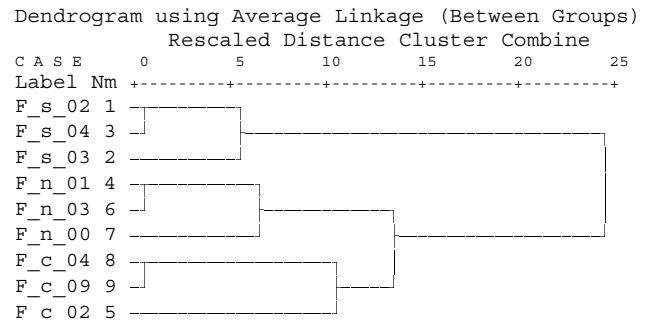

Figure 1: Dendrogram of a single subject (F) based on all kinematic variables with a disjunct separation of gait patterns by type of music (s, n. c).

during gait (figure 1). Very often the single- subject- cluster-analysis leads to a separation of the gait pattern with stimulating or with calming music. When the stimulating music mode was separated the calming and no music mode was merged. When the calming music condition was separated the stimulating and no music condition was clustered together. Whether this provides insight into fundamental personal moods or into situational personal music preferences demands further research.

CONCLUSIONS

Although the applied linear pattern recognition approach is not considered as the most differentiated one[4] , the results verify relevant consequences. This study shows a twofold support for emphasizing research, particularly in clinical applications, on individuals rather than on groups. Firstly, a strong individuality of gait patterns was diagnosed. Secondly, evidence for individual motor reaction when listening to music was shown. However, the presented approach provides a supplementary and sensitive tool for interdisciplinary problems towards more complex or holistic questions.

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