# Adapting Computational Music Similarity Models to Geographic User Groups

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## Music Similarity and User Data

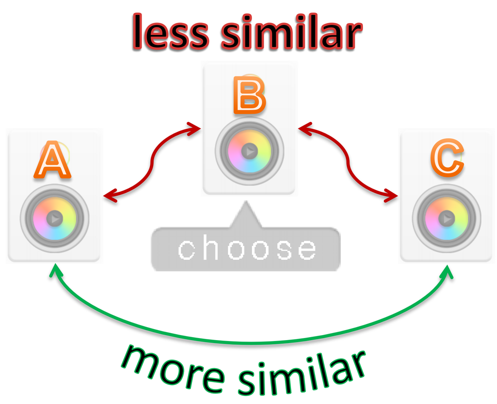
We present first results of experiments using music similarity ratings from human participants for group-specific similarity prediction. Music similarity is a key topic of research in music psychology and ethnomusicology. Perceived similarity is **specific to the individual user** and influenced by a number of factors such as **cultural background**, age and education.

Our goal is to adapt similarity models to similarity data of users sharing common attributes such as location. To this end we use information on the country where the data was provided. We finally compare the role of musical features in the specific and general models.

## Collected Data

Our Spot the Odd Song Out game **collects relative similarity judgments** of users on triplets of songs, where they are asked to **choose one song as the "odd song out"**.

- If song B is chosen, then:
  sim (A,C) > sim (B,C) AND
  sim (A,C) > sim (B,A)




Data is annotated with anonymised **user attributes**:

| | |
|---|---|
| Age group | Music education |
| Gender | Listening habits |
| Occupation (sector) | Favourite genres |
| Languages | Music activities |
| Current location (city) | Favourite media items |
| Birth location (city) | Religious affinities |
| Geoprofile of friends | Political affinities |

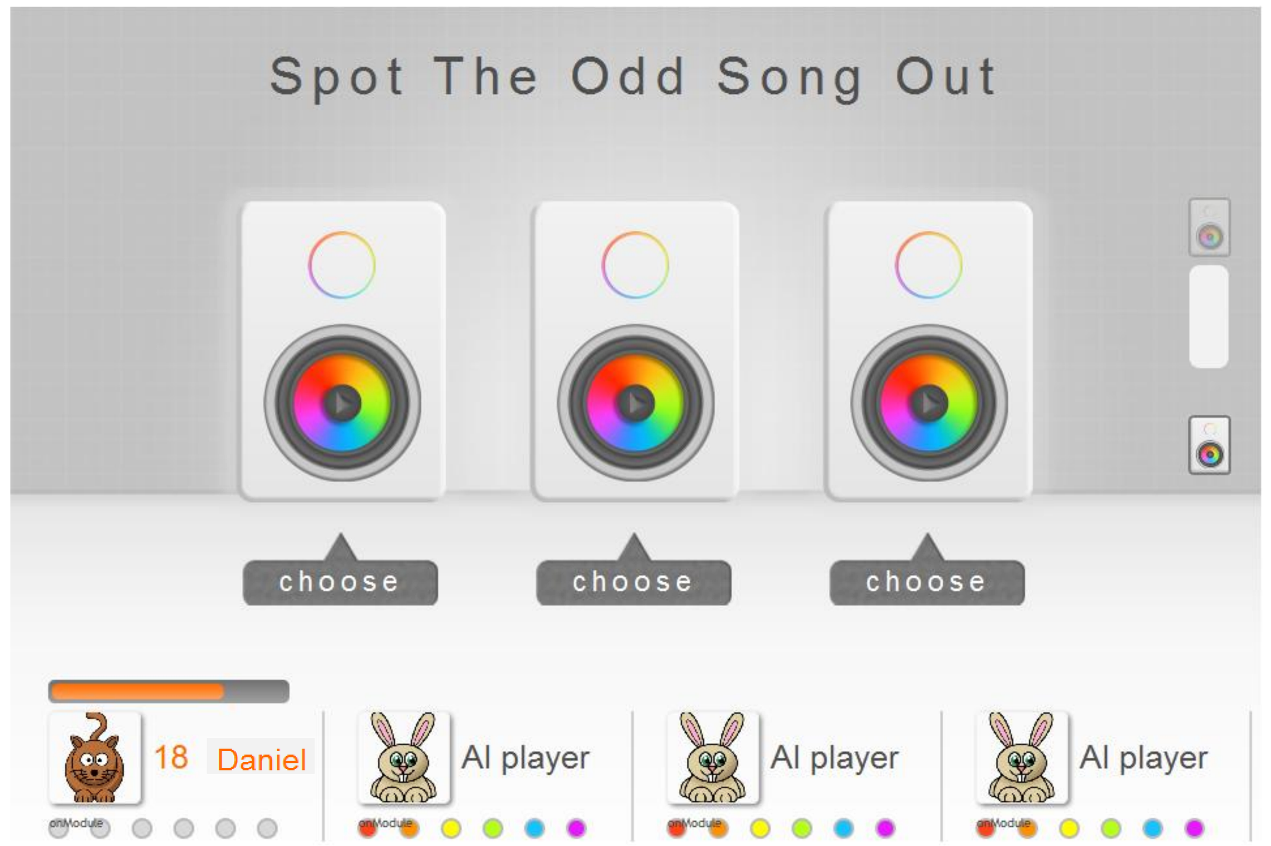
Users can login with their facebook account. Given prior permission, user attributes are extracted from their profile data.

## Music Database

- More than 11000 clips in total, each min. 30 seconds long
- Datasets:
  - **1.Million Song Dataset Subset**
    - Mostly Pop/Rock music, streamed by 7digital
  - **2.MagnaTagATune**
    - Only "classic" genre subset used.

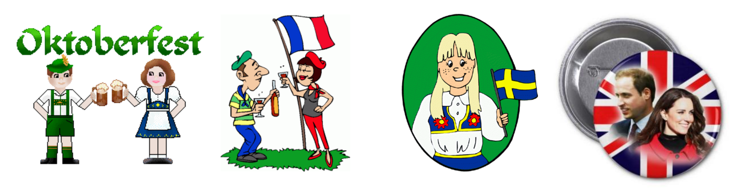
## The Game Interface

- HTML5 web application runs on many devices w. browser
- **Odd One Out** scenario
- 45 seconds **time limit**
- **Decision and timings** are logged
- **Game** look and feel
- **Multiplayer**
- Motivation through rewarding of agreement
- **Hop-on – hop off**: enter or leave anytime




## Single Country Datasets

- For first experiments with user groups we use the most frequently annotated attribute: Input location
- Select datasets from the 4 European countries with most data
- Only minor differences expected due to the macroculture character of pop music, but regional microcultures exist.

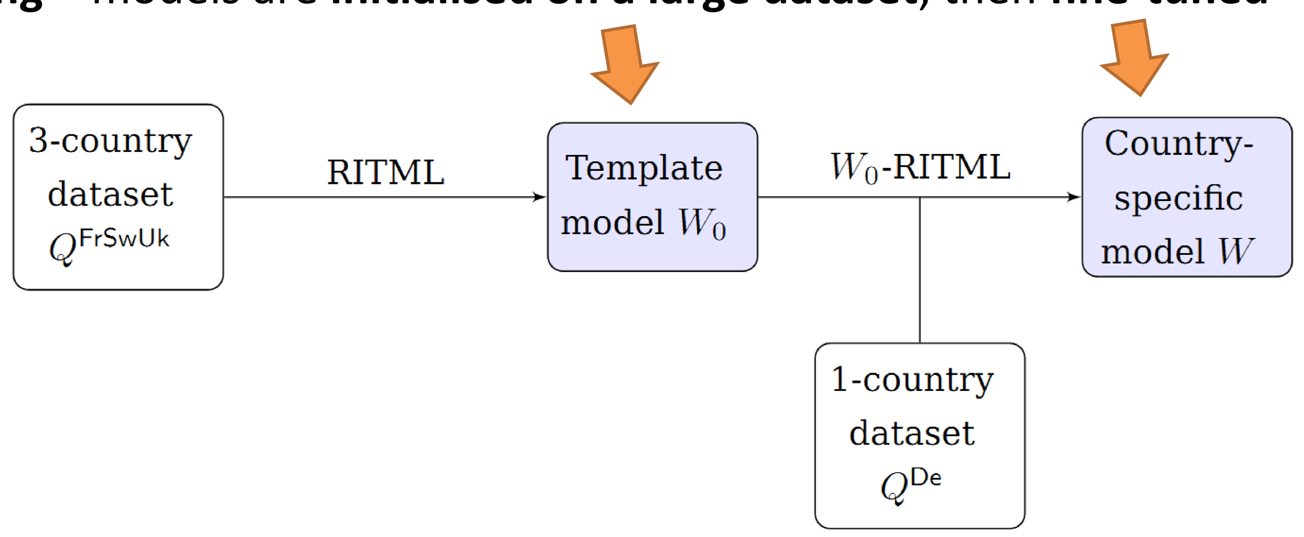



| | DE | FR | SE | UK |
|---|---|---|---|---|
| # unique constraints | 459 | 463 | 309 | 411 |
| # clips | 151 | 151 | 123 | 151 |

*Combined dataset: 861 unique constraints, 176 clips*
*Unique constraints: Independent of the number of votes*

## Modelling Strategy: Transfer Learning

- We model music similarity using the a **generalisation of the Euclidean distance**: The **Mahalanobis distance**. This allows for training **a weighting and combination** of **music features** that correspond to the collected similarity data.
- Training of model achieved with new RITML algorithm, adapted from ITML [Davis et al. 2007]
- **Challenge**: single country **datasets are very small** – direct training (RITML) becomes difficult
- **Solution**: Use **transfer learning** – models are **initialised on a large dataset**, then **fine-tuned** to single country data.
- Idea: Train general model, then adapt to specific group




Process (for DE dataset)

1. Use data from 3 countries (FR + SW + UK) for training a general model "$W_0$"
2. Adapt model to single country (DE) data with $W_0$-RITML method.

## Results

| | DE | FR | SE | UK | AVERAGE |
|---|---|---|---|---|---|
| $W_0$-RITML | **69.28%** | 64.34% | **64.40%** | 70.36% | 67.09% |
| JOINT | 67.80% | **67.39%** | 64.05% | **70.46%** | **67.43%** |
| RITML | 64.35% | 62.71% | 61.75% | 63.78% | 63.15% |
| Euclidean | 60.79% | 62.09% | 58.11% | 62.65% | 60.91% |

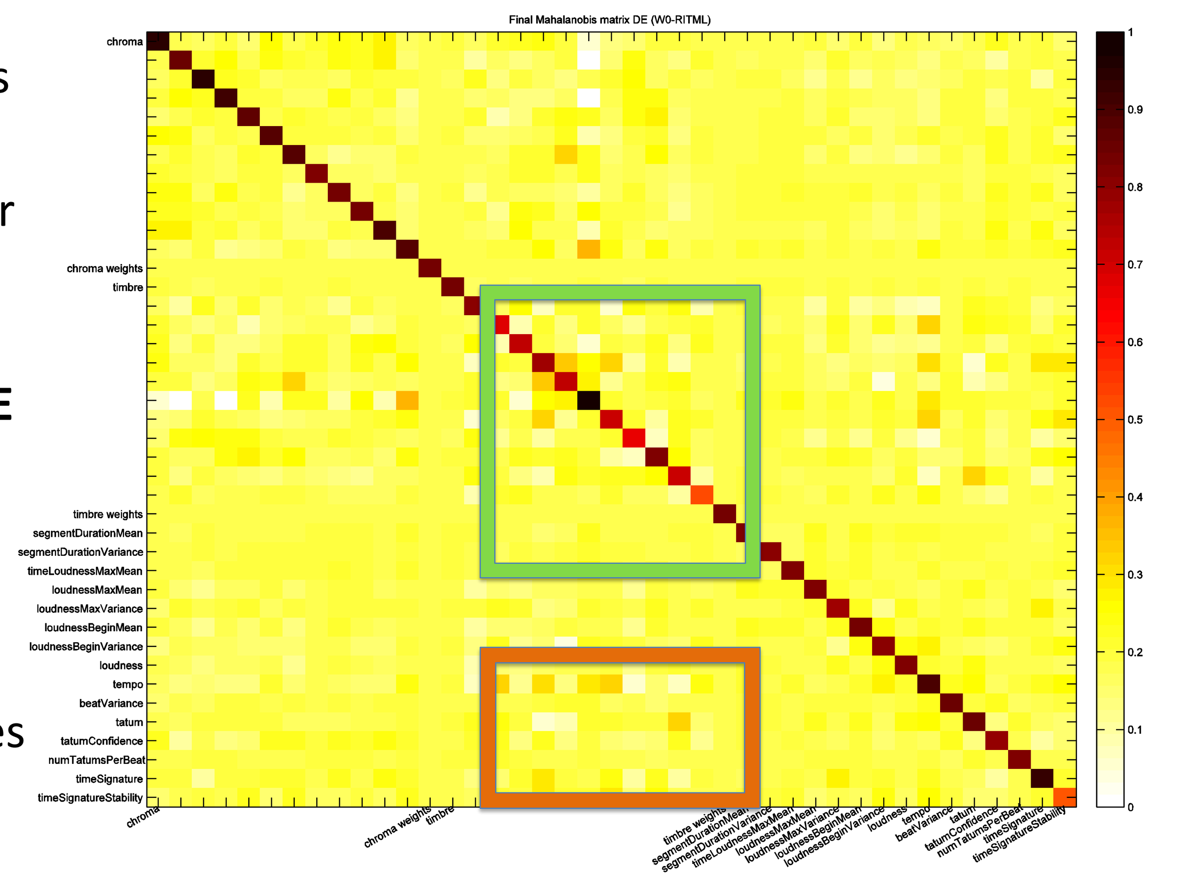
*Generalisation performance in percentage of similarity ratings fulfilled by the models on the single-country datasets (10-old cross-validation). We compare: No training (Euclidean), direct training (RITML), transfer learning (W0-RITML) and training with all countries' data (JOINT)*

- **Training improves performance**, but general models provide better results than specific ones

→ Used **datasets too variable / small** to train robust models per country and to analyse model differences

- **Fine-tuning** only effective on **DE** dataset
- **Resulting model** for DE as example for country-specific adaptation
- Diagonal => most of the features are assigned an equal weight
- Larger weights for **timbre**, **timbre&tempo, timbre&tatum**

Final Model for DE dataset



## Analysis of Specificities

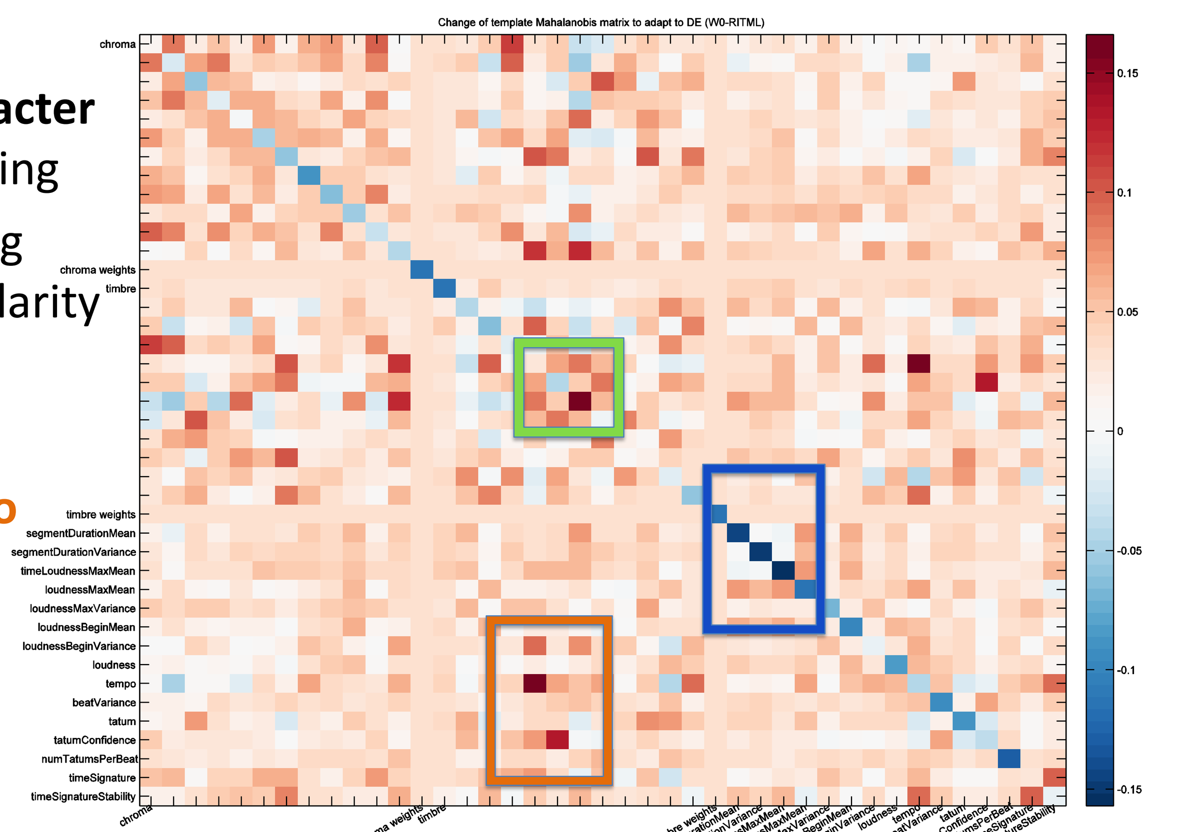
- Analyse the difference of fine-tuned model to general model
- For **DE dataset, exemplary character** as more data needed for modelling
- **Red entries** for specifically strong correlation of features with similarity data, **blue** for lesser importance

→ Specific importance of **timbre**

→ Heightened correlation of **tempo** **and tatum confidence with timbre**

→ Less correlation to **Segment duration, #TatumsPerBeat** and **loudness factors**

Differences DE – general Model



**Conclusion: Method allows analysis of features' influence on similarity, can be extended to ethnomusicology with different user groups.**

**Future work: Collection of more data with user attributes.**