

Summary

Context:

- Recommender systems are essential tools for media providers such as **music streaming services**.
- In particular, on **Deezer**, a French service offering 90 million music tracks to 16 million users, the **Flow** feature helps users enjoy and discover music.
- Flow generates personalized and virtually infinite **radio-style playlists of songs** for each user.
- Nonetheless, despite promising performances over the past years, Flow used to ignore the **moods** of users.

In this paper:

- We introduce **Flow Moods**, an improved version of Flow that addresses this limitation.
- We explain how Flow Moods leverages collaborative filtering, audio data, and mood annotations to generate **personalized mood-specific playlists** at scale.
- We detail the motivations, the development, and the deployment of this system on Deezer.
- Since its release in October 2021, Flow Moods has been recommending music by moods to millions of users every day. Check it out! 🎵



I - Recommending Music with Flow

Flow: an exclusive feature launched on Deezer in 2014:

- A simple button on the homepage of Deezer users having 16+ favorite songs/artists.
- Launches playlists mixing the user's favorites along with new personalized recommendations.
- Based on collaborative filtering.
- Adaptive to user feedback: likes, skips, manual exclusions.

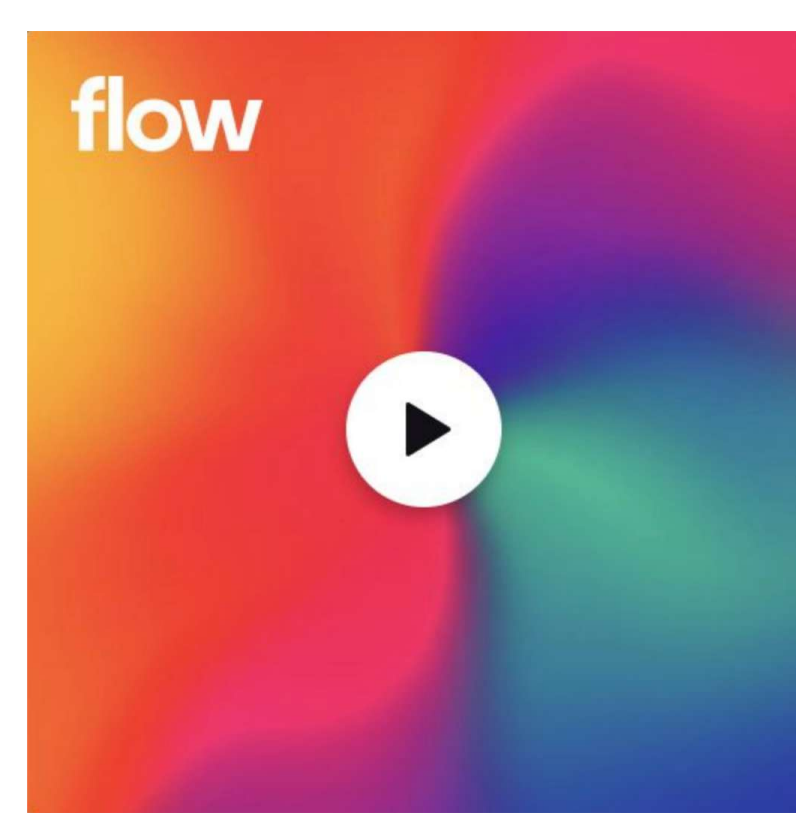


Figure 1: Flow button.

Problem: people listen to and perceive music differently depending on their emotions and activities. Flow used to overlook this aspect and launch songs “at the wrong time”.

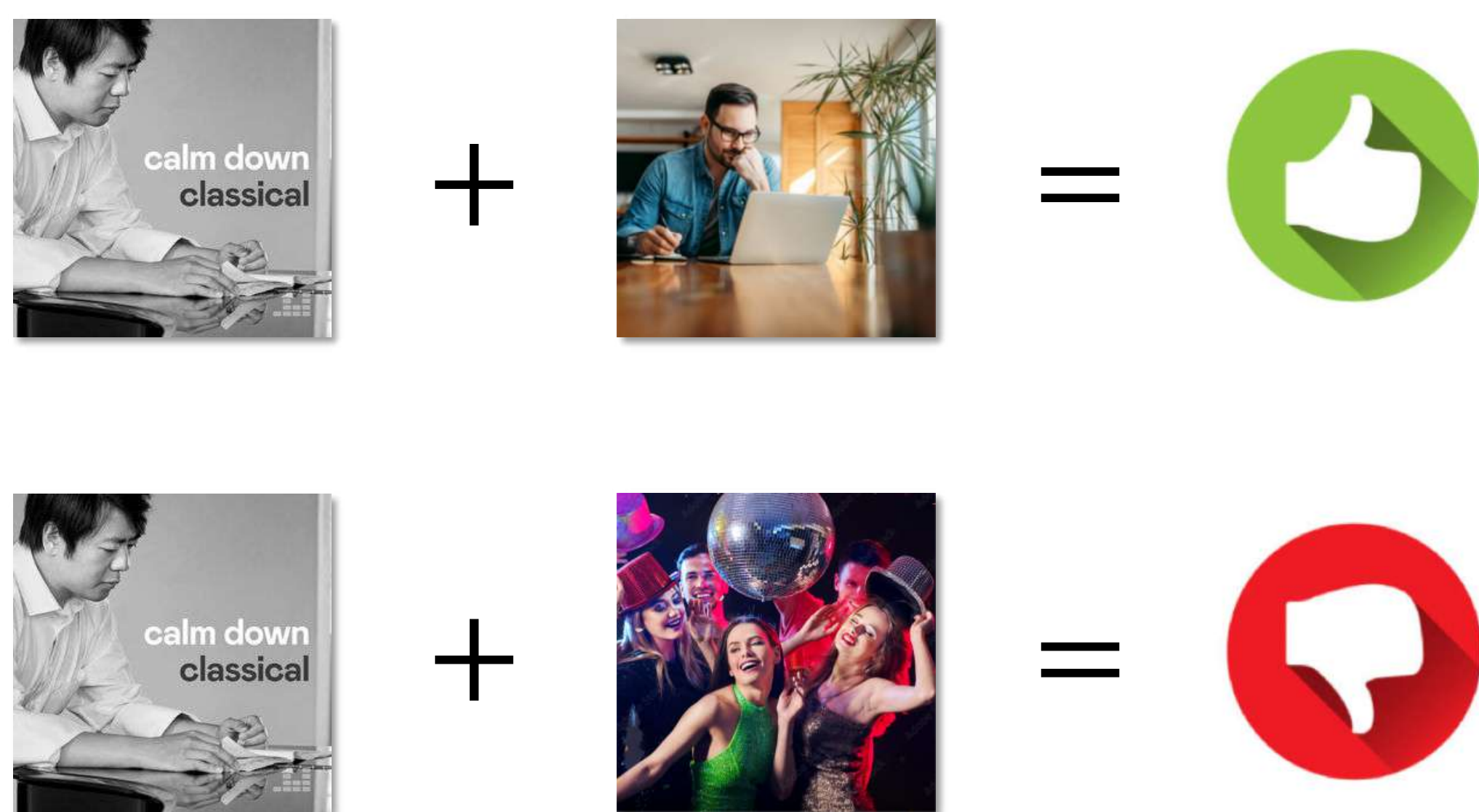


Figure 2: Some users reported that, while they enjoy listening to calming music when focusing at work or relaxing, they do not want such music to appear in their Flow when partying on a Friday night or doing sport.

Solution: encouraging users to provide mood-specific contextual information before recommending music.

II - Introducing Flow Moods, a Personalized Jukebox Playing Music by Moods

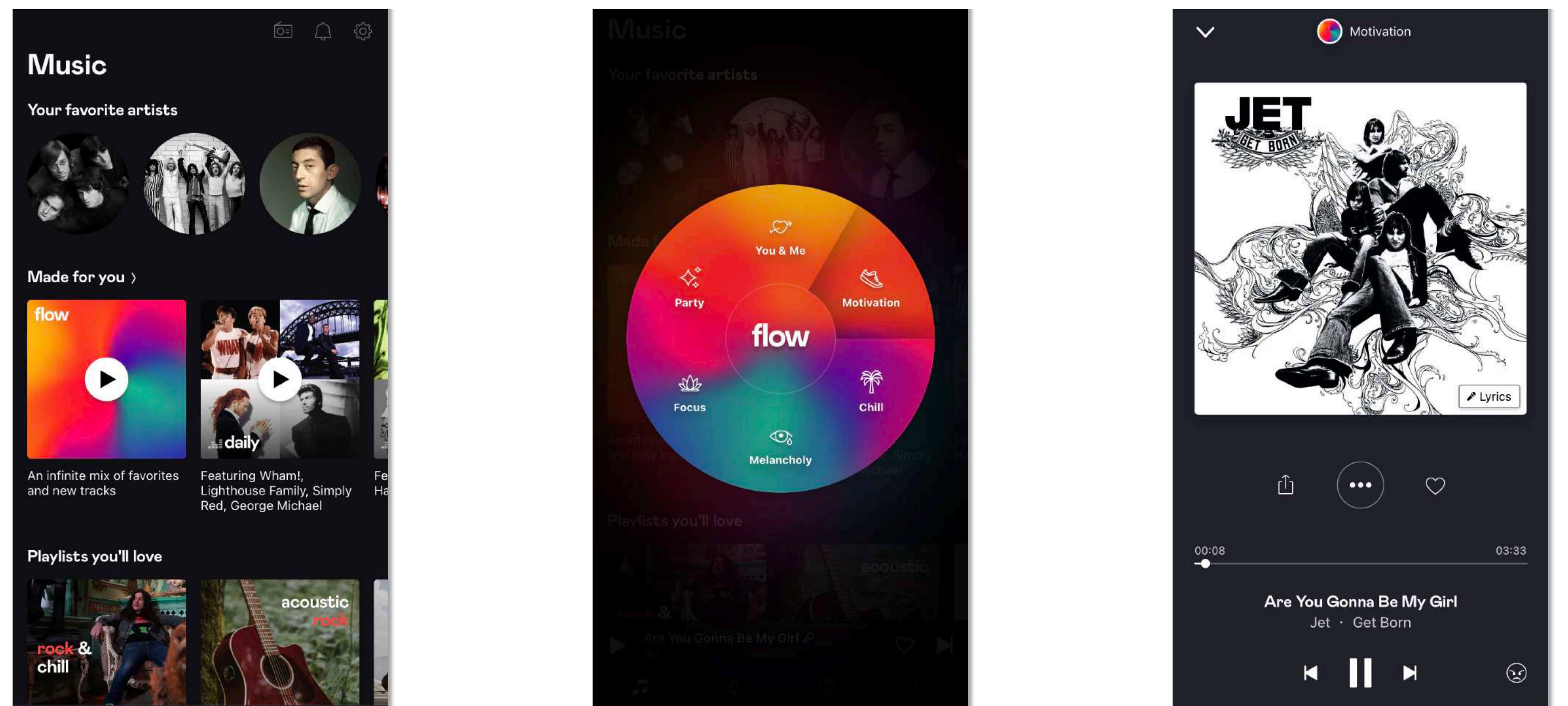


Figure 3: Interface of Flow Moods on the Deezer mobile app. After clicking on the Flow button on the homepage (left), the user can select a mood on an interactive wheel (middle). This generates a mood-specific personalized playlist of songs (right), as detailed in Section III. Note: a click at the center of the wheel would launch the “regular” Flow algorithm ignoring moods, presented in Section I.

III - Flow Moods: How Does It Work?

Mood Selection: with product teams, we pre-identified six moods:

- These moods particularly impact how users listen to music on Deezer.
- They are presented to users in the interactive wheel of Figure 3.

Mood Annotation: to identify the songs associated with each mood:

- We collaborated with professional music curators from Deezer.
- They annotated thousands of songs with “ground truth” mood labels.

Large-Scale Mood Classification: to annotate millions of other songs:

- We learned song embeddings from audio data, using a CNN for music tagging.
- We computed “mood scores” from these embeddings, using six Random Forest binary classifiers trained on manually annotated songs.

Flow Moods: incorporates mood scores in Flow (filtering + fallback) to generate personalized mood-specific playlists.

Table 1: Description of the six moods. In this work, the term “mood” encompasses emotions and activities associated with states of mind.

Mood	Description
Chill	Time to kick back? Relax with your favorite artists that help you unwind and let go.
Focus	No distractions, please! Let us help you stay in your zone with the right kind of music to help you achieve your goal.
Melancholy	We all get the blues now and then. If you are in the mood for a good cry or want to wallow in sorrow – let it all out here.
Motivation	Need a little nudge? Make workouts a joyful experience with a power mix to keep you moving.
Party	Whether it's a party of one or party of more, get in the spirit with an endless mix of crowd-pleasing music to get you dancing.
You & Me	Feeling a little frisky? Let us set the mood for romance with feel-good tracks that you and your partner will love.

IV - Releasing Flow Moods on Deezer

Deployment: Flow Moods is designed for large-scale production use (see paper for technical details) and was released globally in October 2021, which improved our KPIs such as the penetration rate of the Flow feature.

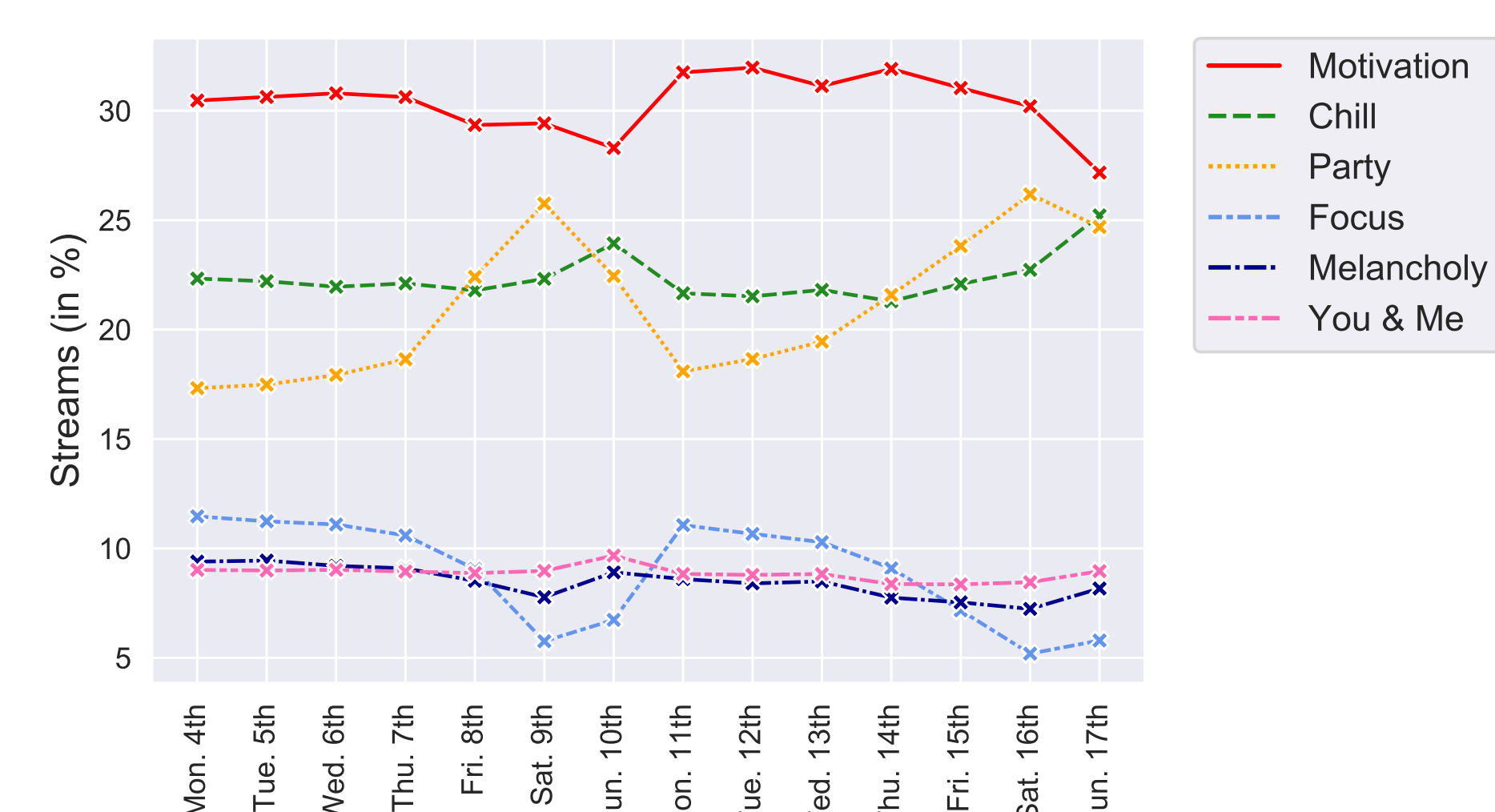


Figure 4: Daily distribution of streams by moods (April 2022), helping us understand how users listen to music over time. In this figure, “Party” increases on Fridays/weekends, while users tend to “Focus” more on weekdays, and to “Chill” more on Sundays.

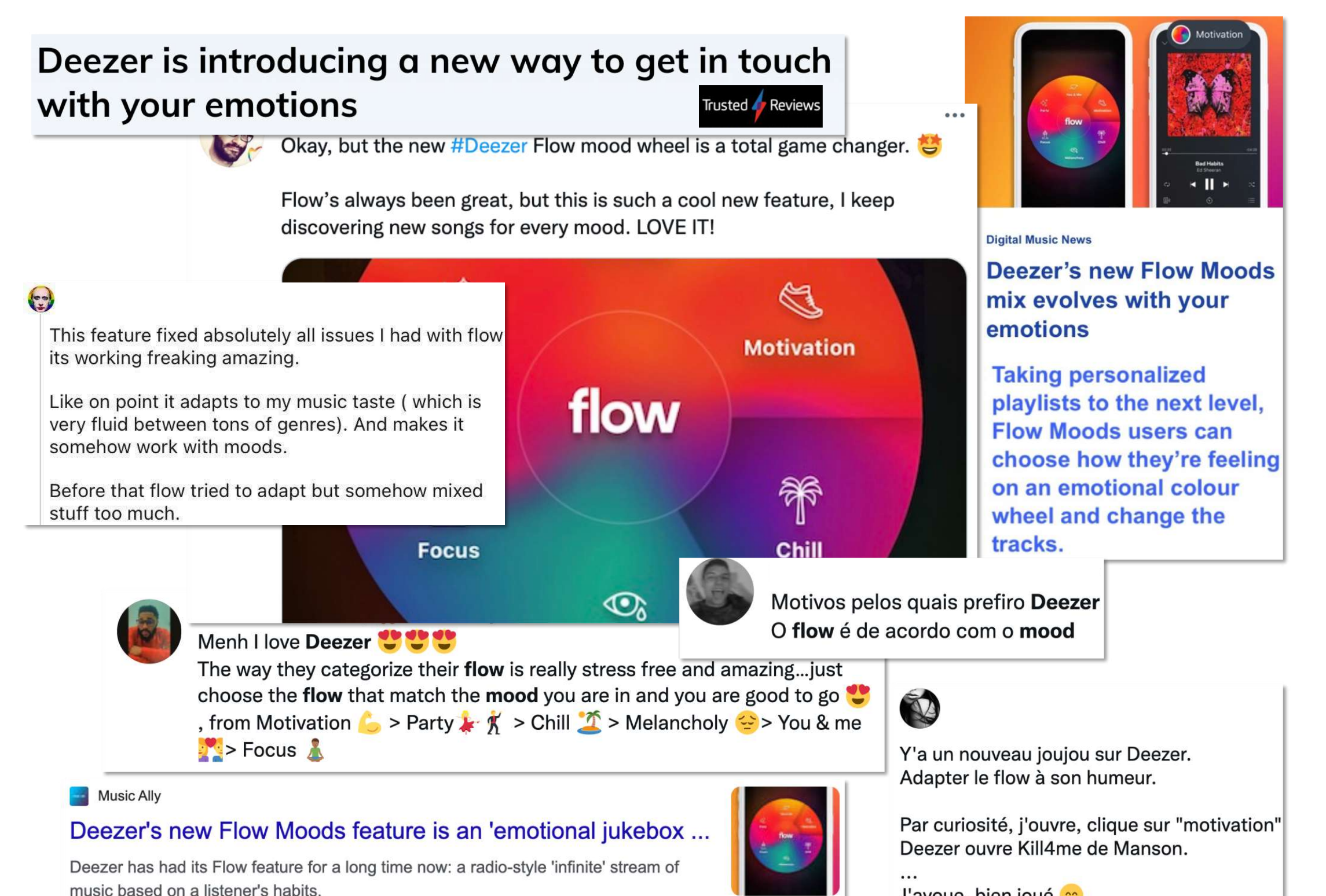


Figure 5: The Flow Moods release has generated numerous reactions.