

Background

Existing studies offer a weak and incomplete picture of the everyday-phenomenon known as "tunes in the head". This study is an attempt to provide a more precise description as a basis for further (also neuroscience-based) research. Based on the German notion of "earworm", two premises serve as a starting point:

(1) Obviously, music has to be memorized before it can occur as a "tune in the head". Since implicit memory is common for the domain of music, storing music in the mind can – but need not – be involuntary and unconscious.

(2) By working definition, the occurrence of "tunes in the head" or "earworms" needs to be involuntary. For the purpose of this study, conscious and active imagination of music is not understood as "tune in the head" or "earworm".

Theory

In a footnote to the "Interpretation of dreams", Freud mentions a female patient unwillingly "hallucinating songs or parts of them" (Freud [1900] 2000, p. 407). To Freud, the song's lyrics are a means for the unconscious articulation of wishes or biographical statements. However, this interpretation is limited to music linked to lyrics or to definite meanings, while the latter is a rare exception. In addition, hallucinations are nowadays considered to be pathological (or drug induced) and not quite an everyday-phenomenon.

Songwriting in the domain of popular music very often aims at creating 'hooks' – musical elements that can easily be remembered and thus have the potential to return as a "tune in the head". These elements include rhythm, melody, harmony, lyrics, instrumentation, tempo, dynamics, improvisation and accident, production elements, sound effects, editing, mix, channel balance and signal distortion (Burns, 1987).

Halpern provided fundamental investigations of musical imagery (Halpern, 1992), which have included neuroimaging for the past decade (e.g. Halpern & Zatorre, 1999). Results show that the brain regions active in imaging conditions are similar to those active in actual listening conditions (right auditory association cortex, together with right and left frontal cortices). However, these studies are based on active imaginations of well-known or previously memorized music. They are thus of limited use for the understanding of involuntarily occurring "tunes in the head".

Experiments carried out by Kraemer, Macrae, Green, & Kelley (2005) are based on rather short interruptions (2-5 sec.) of music examples which were individually selected for each subject. fMRI-based imaging shows an increased activity of the auditory association cortex for well-known titles which extends into the left primary auditory cortex when there are no lyrics. The effects are weaker for unknown music. Thus, Kraemer et al. did in fact observe involuntary "tunes in the head", but with very limited temporal extension.

Method

This is a primarily qualitative study! A CD with 20 "catchy" tunes covering 20 different genres (see table 1) was handed out to the subjects. They were simply asked to listen to the CD as often as possible. In addition, they rated their preferences for the titles and the according genres on accompanying questionnaire. An interview followed after a period of 1-6 weeks. All the questions mentioned on the right were addressed. Subjects were also asked to reproduce each of the "tunes" they had experienced and to provide a personal explanation of the phenomenon. Qualitative content analysis followed up the transcription of the interviews. Many of the statements could subsequently be quantified, which provided the ground for explorative calculations.

Subjects

59 subjects aged 11-67 could be addressed, mean age 28.6 yrs, SD= 13.4. 55.2 % females, 44.8 % males. Musical qualification mapped to a scale from 0 (laymen) to 10 (professional musician) showed an average of 3.93, SD= 3.56.

Table 2: Individual contexts of arising „tunes in the head“

Individual contexts of arising „tunes in the head“	#	%
"nothing special", background activities	15	27,8
Car or train ride, waiting	15	27,8
Housework, shower, bath	11	20,4
physical activity	9	16,7
stress condition	4	7,4

How much time elapses before tunes occur, and how long do they last?

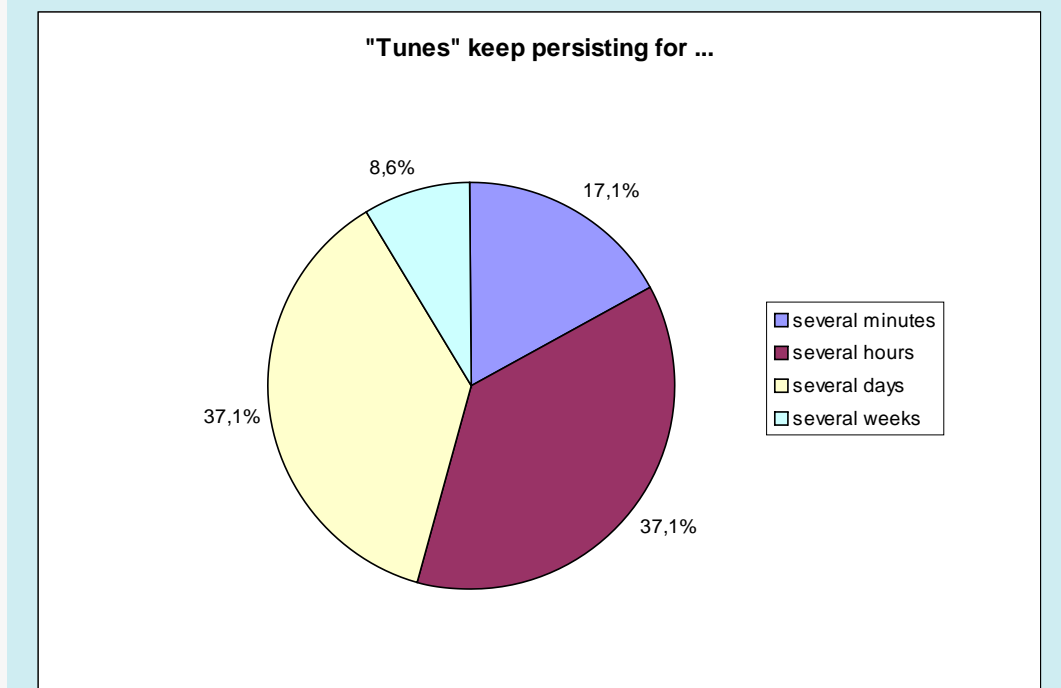
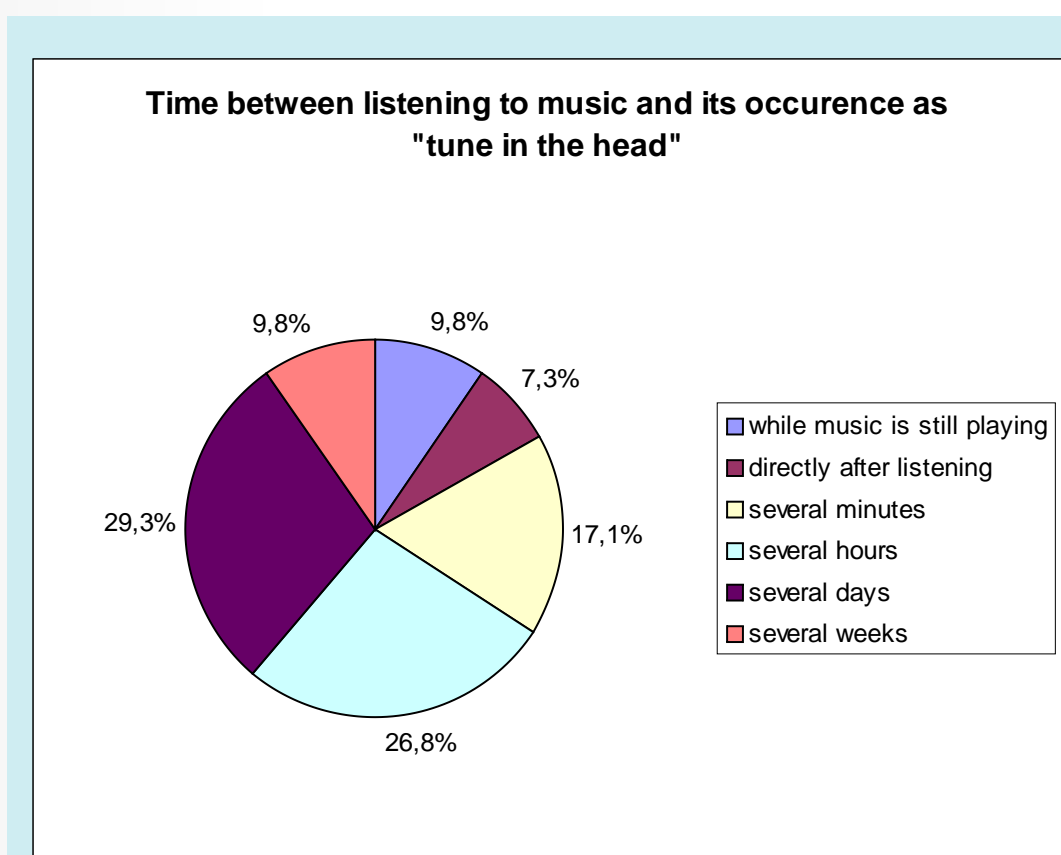
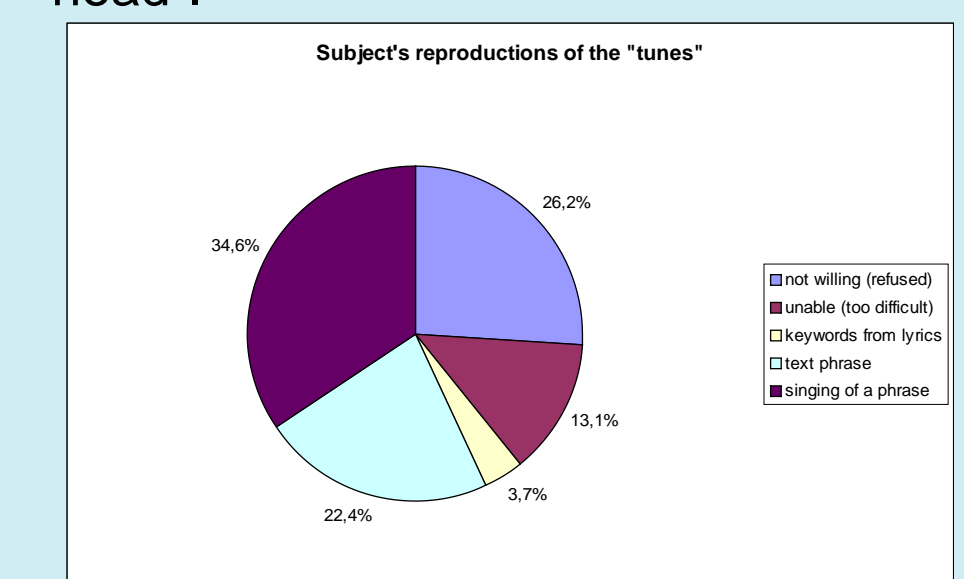


Table 1: Stimulus material in descending order based on the number of occurrences as "tune in the head". Letters in the first column indicate G= German lyrics; F= Foreign language lyrics; I= instrumental title

Composer	Title	Genre	Rating of genre	Rating of title	# of occurrences as "tune in the head"	approx. # of internal repeats of "catchy" passage
G	Wise Guys	Ohrwurm	A capella	2,32	2,25	20
G	Mike Krüger	Der Nippel	Comedy	2,67	2,67	14
F	Dusty Springfield	Son of a preacher man	Soul music	2,51	1,78	14
G	Fettes Brot	Emanuela	German Hip Hop	3,22	2,60	13
F	Beach Boys	Barbara Ann	Oldies	1,67	1,98	12
F	Europe	The final countdown	Rock	1,82	2,30	10
G	Ernst Krenek	Malborough zieht in den Krieg	Folk tune	4,07	3,24	6
G	Andrea Berg	Du hast mich tausendmal belogen	German Schlager	m.v.	3,87	6
I	Michael Gajare	Loverstrich	Kids music / kids films	m.v.	2,18	6
I	John Williams	Indiana Jones, Main Themes	Film soundtrack	2,12	2,51	5
F	Buena Vista Social Club	Chan Chan	Latin	2,32	2,00	4
F	Andrew Lloyd Webber	Cats - Memory	Musical	2,46	2,38	3
F	Frank Sinatra	A Night & Day	Jazz (vocal)	2,59	2,64	2
F	G.F. Hendel	Halleluja (from Messiah)	Classical vocal music	3,07	2,89	2
F	Silken Soul	Wait and bleed	Metal	3,71	3,42	1
I	Kali Tracid	Life Is Too Short	Techno	4,14	3,62	1
I	Edvard Grieg	Hill of the mountain king (from Peer Gynt)	Classical instrumental music	2,48	2,37	1
I	Bill Evans	Waltz for Debby	Jazz (instrumental)	3,12	3,19	0
I	Carl Albert Hermann Telke	Alle Kameraden	(military) marches	3,84	3,82	0

The first eight tracks in the chart on the left contain lyrics, half in (native) German, half in foreign language. Thus, lyrics appear to be important. While it remains problematic to determine the number of internal repeats within a title, this value does not correlate with the number of times the title occurred as a "tune in the head".



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Do tunes occur more frequently with preferred music?

Yes. The average rating of a title (Table 1) significantly correlates to its occurrence as "tune in the head" ($r=0,50$, $p=0,026$). However, the opposite case of "tunes" with much disliked tracks also exists.

Are tunes usually considered to be pleasant or unpleasant?

Once they are there, 53.4 % of the subjects consider the "tunes" to be pleasant, only 27.4% say they're unpleasant. 19.2 % provide ambivalent statements - sometimes paired with a time perspective: "I liked it in the beginning, but now I hope it goes away"

Do musicians experience more or less "tunes in the head" than non-musicians?

They don't. While some evidence was found that "tunes" occur with idle or unused cognitive capacities, none of the items listed in the table correlate with the individual number of "tunes".

Table 3: Non-significant correlations between the individual number of "tunes" and ...

Item	r	p
The amount of daily music listening	-0,14	0,23
The frequency of attending concerts	0,09	0,38
Individual musical skill level	0,1	0,44

Why does even much disliked music sometimes cause a "tune in the head"?

If music "matters", in a positive or negative way, it is remembered.

What can I do to get rid of an unwanted "tune"?

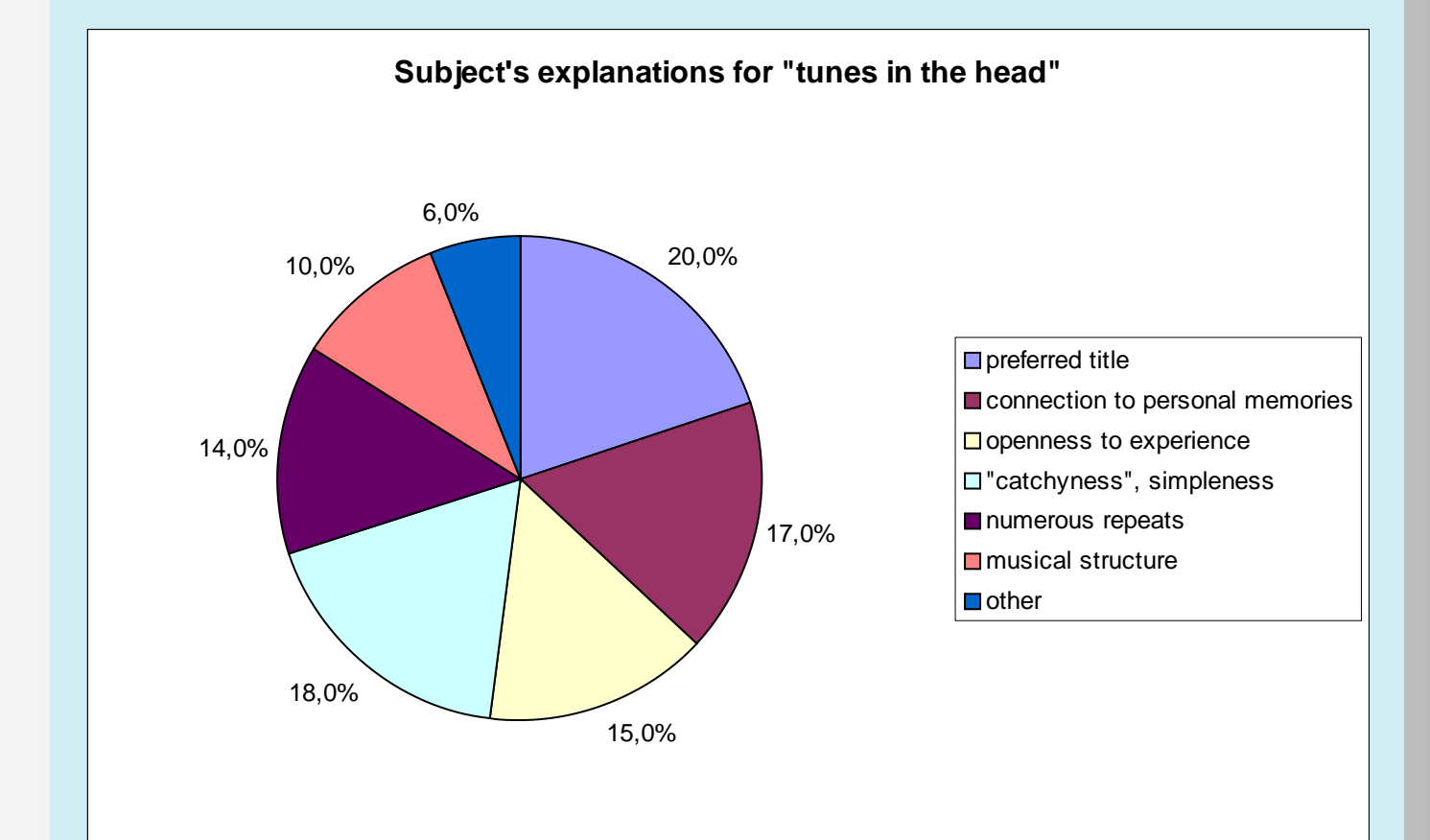
It seems that memorization of music is dependent to the (either positive or negative) affective loading of the musical experience.

Strategies described include listening to or imagining other music as well as turning to concentrated work.

"Tunes in the head" - a provisional definition

"Tunes in the head" are unintentional recollections of music previously memorized by listening. They manifest themselves through involuntarily occurring, vivid auditory imagery which frequently results in the subject's practice to sing, hum, whistle along or tap the according rhythm. Moments of mental relaxation, sometimes paired with increased physical activity, seem to be in favour of involuntary occurrences of "tunes in the head". Although the opposite case also exists, "tunes in the head" predominantly arise among personally preferred musical titles. Lyrics serve as an important basis of the remembrance. In addition, "tunes" are frequently connected to past events or situations in personal biographies. They may commence while the music is still playing or even several weeks after listening. Also, they may last from a few minutes to several weeks. They are mostly considered to be pleasant: listening to or imagining other music as well as turning to concentrated work can serve as counter strategies if needed. Structural characteristics of the music causing "tunes" are hard to identify. On the whole, the phenomenon of 'tunes in the head' should be regarded as a compound effect of objective (musical) characteristics and subjective dispositions.

To a large extend, the findings match the subject's everyday notions of "tunes in the head" as displayed in the following chart.



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