

RECOGNIZE THE TUNE? A STUDY ON RAPID RECOGNITION OF CLASSICAL MUSIC

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ABSTRACT

Background. Why are some compositions recognized by the first bar while the recognition of others, equally familiar ones requires much more time? Quickly recognized pieces may show catchy characteristics at their beginnings. Rapid recognition may also occur due to special contextual or personal knowledge of a piece (e.g., media effects). Field evidence from TV and radio game shows (such as “Ö3-Klang” in Austrian broadcasting) suggests that recognition times can be spectacularly short.

Aims. This study experimentally dealt with the following questions: (1) How quickly do subjects recognize classical pieces? (2) Why are some pieces recognized more quickly than others? (3) How do person factors (musical expertise, age, ...) influence recognition speed?

Method. Fifty subjects, all sufficiently familiar with classical music (listeners to orchestra professionals), were presented with the beginnings of 29 well-known pieces (from CD) and asked to stop each tune as soon as possible. To test whether identification was correct, subjects had to sing or whistle a few more bars in order to exclude verbal memory effects. We additionally asked why they had recognized the piece, and about how often they had listened to it (CD, radio, concert, TV, etc.) within the past 12 months.

Results. Medians of response times ranged from 1.1 to 10.4 s. The shortest individual response time was 0.1 s (*Thus spoke Zarathustra*). One participant recognized Gould’s recording of the *Goldberg Variations* merely by the first tone. Subjective accounts of rapid recognition included structural and melodic characteristics, instrumental timbres, and personal reasons (e.g., “daughter plays it on piano the whole day” – *For Elise*). Individual familiarity effects generally dominate both structural factors (e.g., triads, large intervals, pompous intros) and person factors.

Conclusions. Examples of extremely rapid recognition demonstrate that minimal sequences of music contain impressive amounts of (potentially discriminative) information. Future studies should more systematically vary, and also actively modify, structural components and comparatively extend the scope to other styles.

1. BACKGROUND

Being late, McClassic rushes into Queen Elizabeth Hall on the third bell ringing. Completely unaware of tonight’s musical program, he tries to find his seat as quickly as possible. He sits down just as Seiji Ozawa walks onto the stage. Silence. The orchestra starts with three quavers on the same pitch (McClassic – surprised, but almost sure...), the fourth tone is a major third below (... now grinning in absolute certainty): Beethoven’s 5th! At the same moment, numerous others in the audience have the same expression of recognition on their faces. How come so quickly?

Why are some pieces recognized so rapidly while the recognition of others, equally familiar ones requires much more time? Quickly recognized pieces may show catchy characteristics at their beginnings. Rapid recognition may also occur due to special contextual or personal knowledge of a piece (e.g., media effects). Field evidence from TV and radio game shows suggests that recognition times can be stupendously short: “Ö3-Klang” in Austrian broadcasting, for instance, presents three sequences of just some seconds taken from different pop songs in a row, and requires the candidate to identify all three in order to win the price.

Many experiments in cognitive psychology report on unexpectedly fast recognition speeds and on the ability to recognize enormous amounts of information. Shepard (1967) asked participants to scan through a list of 540 words. After reading the list just once, 88% of the words were subsequently recognized correctly. In another experiment by Shepard, participants had to look through a series of 612 never-before-seen colored photographs. When recognition memory was tested immediately afterwards with pairs of pictures (one of each presented before and one completely new), participants were able to identify 96% of the previously shown pictures on average. Standing (1973; as cited in Goldstein & Gigerenzer, 1999) raised the amount of photographs to 1.000 and limited the presentation time to five seconds. 48 hours later, people still recognized 885 of the previously presented pictures (770 after a correction for guessing). After repeating the experiment with 10.000 pairs of pictures (still finding an identification rate of 83%), Standing stepped back from repeating the experiment with even greater amounts of material. He estimated, though, that 731.400 previously shown items would be identified correctly if 1 million items were presented.

Can similar results be expected in music psychology? Few experiments deal with similar questions in the music domain. However, the published studies concerned with the recognition of musical pieces, the recognition of composers or the recognition of transformed music typically show effects of strong and quick recognition.

Abei-Struth (1982) reports a high percentage of correct judgments when five to seven year olds had to recognize musical pieces immediately and after one week. Recognition was even higher in the case of more complex pieces (including distinctive features more likely to be retained in memory). Immediate recognition performance declined only slightly over the one-week interval.

A similar experiment with college and high school students reports on higher recognition skills in music majors than in other groups of students (Duerksen, 1968). High recognition performance was related to listening experience and expressed interest for classical music, but not necessarily to studying music theory or music history.

Well-known musical pieces are assumed to be recognized even when slightly modified. Werner (1925; as cited in Deutsch, 1999) reported that melodies were recognized when the octave was replaced by a different interval (e.g.; fifth or two octaves). A replication study by Vicario (1983; as cited in Deutsch, 1999) showed that, although participants were basically able to recognize the transformed pieces, distortions did well impair melody recognition to some extent.

Another topic similar to the recognition of musical pieces deals with the identification of composers' styles. Simonton (1997) presumed that aficionados of classical music would be able to identify a composer after listening to only a few bars of a never-before heard musical piece as long as they were familiar with the composer's style. He quotes a study conducted by Paisley (1964), who successfully programmed a computer to identify the distinctive style of major classical composers from just the first four notes of the melody alone. Simonton (1984) conducted an extended historiometric replication based on a sample of 15.618 classical pieces and again demonstrated that most composers are highly recognizable already from a theme's characteristic beginning.

This small set of studies shows that well-known musical pieces and composers' styles are quite reliably recognized, even if the music material is slightly transformed. But how quickly can well-known pieces be recognized?

2. AIMS

This study experimentally dealt with the following questions:

1. How fast do subjects recognize classical pieces? Can "rapid recognition" results from other domains be generalized to music perception?
2. Why are some pieces recognized more quickly than others? Do certain kinds of beginnings show characteristics that lead to especially fast recognition ("earwig factor")?
3. How do person factors influence recognition speed? Do listener attributes such as age or musical expertise play a significant role?

3. METHOD

Fifty subjects, all sufficiently familiar with classical music (from mere listeners to orchestra professionals), were presented with the beginnings of 29 well-known pieces from CD, ranging from Bach's *Goldberg Variations* to Wagner's *Ride of the Valkyries*. Participants had no prior information about which pieces the set actually contained. They were asked to interrupt each piece as quickly as possible by saying "stop" or lifting a hand as soon as they had merely recognized it. The music was then immediately switched off by the instructor, and the recognition speed (measured by a stop-watch with tenths of a second resolution) was protocolled. To test whether identification was correct, participants had to sing or whistle a few more bars of the piece instead of naming it, in order to exclude verbal memory effects. We additionally recorded

- why participants had recognized the piece (subjective reason for recognition),
- how often they had listened to each piece during the past 12 months (CD, radio, concert, TV, etc.),
- age and gender,
- and musical expertise. Each participant belonged to either of the four expertise groups "listeners", "(listeners as well as) singing in a choir", "playing an instrument for fun" or "orchestra professionals".

4. RESULTS

Medians of response times ranged from 1.1 to 10.4 seconds. The shortest individual response time was 0.1 s (*Thus spoke Zarathustra*). Most quickly recognized pieces were Beethoven's *5th symphony* (median 1.1 s), Tchaikovsky's *Nutcracker Suite* (1.3 s) and Vivaldi's *Four Seasons* (1.3 s). An overview across all 29 pieces is given in Table 1 (last page).

Subjective accounts of rapid recognition included structural and melodic characteristics, instrumental timbres, and personal reasons (e.g., "daughter plays it on piano the whole day" – *For Elise*). Individual familiarity effects generally dominated both structural factors (e.g., characteristic triads, large intervals, pompous intros) and person factors. There was no correlation found between recognition speed and how often participants had recently listened to individual pieces. However, some pieces were associated with specific events, like the *Blue Danube Waltz* to which Austrians use to dance on New Year's Eve.

4.1 Recognition speed by pieces

In order to provide a picture of both the commonalities and idiosyncrasies of the subjective accounts given for recognition, details are reported here for the most quickly recognized musical pieces. (If not further specified, the beginning, first movement, first part, or overture of the respective oeuvre was presented. Those instances where the piece was not recognized at all are not dealt with in this paper.)

- Johann Strauß (1825-1899), *The Blue Danube Waltz*: Most participants (41 out of 50) stopped the waltz after 3.5 to 6.5 s, which is immediately after the ascending triad in the first bar. Thirty-six participants actually said they had recognized the waltz on the ascending triad, and most people associated it with New Years Eve.
- Richard Strauss (1864-1949), *Rosenkavalier*: The overture was mainly recognized on the ascending figure between the first and the fourth second. Seven participants said they had recognized the piece on the first three intervals. Twenty-one referred to the whole theme at the beginning (first three bars), and four times the theme was identified as the signation of a former ORF TV program (culture news).
- Richard Wagner (1813-1883), *The Ride of the Valkyries*: Twenty-one participants recognized the piece within the first two seconds, which is during or after the second glissando. Most participants also mentioned the first one or two glissandi as a reason for recognition.
- Ludwig van Beethoven (1770-1827), *5th Symphony*: Most participants stopped the piece during the first 1.1 s, which equals the first two bars on the sheet. Fifteen persons said they had recognized the symphony on the first three tones and the rest (35) needed the descending interval to be sure.
- Ludwig van Beethoven, *For Elise*: Half of the participants recognized *For Elise* during the first seven notes (0.8 to 1.3 s). No specific tone or interval was mentioned as the reason for recognition. Five participants had played the piece on the piano themselves, and almost everyone said they knew it from listening to children playing it on the piano.
- Antonio Vivaldi (1678-1741), *The Four Seasons*: The piece was mostly recognized within the first 1.5 s, which equals the first six tones. Only three participants stopped after the first three tones. Twenty-nine participants mentioned the first ascending interval in combination with the following two notes as being the decisive factor for recognition, and the “rhythm” of the first two bars was mentioned 13 times. Most people said the *Four Seasons* was a piece played “on the street” or in the media relatively often.
- Ludwig van Beethoven, *Sonata “Moonlight”*: The sonata was mainly recognized during the first two decomposed triads of the first bar or shortly afterwards. Participants said they had recognized the sonata due to the triads.
- Richard Strauss, *Thus spoke Zarathustra*: This piece was only stopped on the first note of the fifth bar, which is at the beginning of the theme (first ascending interval). Only one participant was able to identify *Thus spoke Zarathustra* from the underlying string background (“Streichernebel”). Subjectively, various parts of the beginning (first or second ascending interval, first descending interval) or the wind instruments’ timbre led to recognition. The piece was associated with a TV commercial two times without remembering which one exactly, and one participant mentioned Stanley Kubrick’s *2001: A Space Odyssey* (1968).
- Peter I. Tchaikovsky (1840-1893), *First Piano Concerto*: The piano concerto was mostly recognized within the first three seconds, which was during the first three descending intervals. These were also mentioned by most participants, apart from the association with a TV commercial (“Inzersdorfer” – preserved food).
- Peter I. Tchaikovsky, *The Nutcracker Suite* (“March”): The piece was mostly recognized after 0.8 and 1.3 s, which equals the fifth and sixth note of the first bar. The first four (one plus three) tones of the same pitch alone were therefore not sufficient to recognize the piece. Only two persons stopped the piece on the first four tones. Seventeen participants said they had recognized the piece due to the first four notes, and 17 mentioned the rhythm of the beginning bar as being of prime importance. Five mentioned the trumpets, and two associated the beginning with a fanfare.
- Carl Orff (1895-1982), *Carmina Burana* (“O Fortuna”): Three participants stopped the piece on the first tone (!) and most others on the choir’s entry in the first bar. Ten participants said they had recognized it on the first and second drum beat, one mentioned the harmony and one the piece’s tragedy.
- Robert Schumann (1810-1856), *Scenes from Childhood* (“Von fremden Ländern und Menschen”): The piece was mostly stopped within the first two bars. Most participants said they had recognized the *Scenes from Childhood* on the first ascending interval. Apart from that, the first five tones, the character of the melody, and the peaceful atmosphere were mentioned. Moreover, the piece was well-known as the signation of the radio-program “Menschenbilder” broadcasted by an Austrian radio station every Sunday. *Scenes from Childhood* was therefore the only frequently perceived piece (once a week) in our set.
- Johann Sebastian Bach (1685-1750), *Goldberg Variations*: Although the average recognition speed of this piece was 6.9 s, it is still interesting to mention that one participant recognized Glenn Gould’s (1981) recording merely by the first tone, and could even distinguish between the 1955 and the 1981 recording. Six more participants reacted shortly after the first two tones. Subjective reasons reach from the first one or two tones to “melody” and to the right hand trill. One person mentioned that one could hear Glenn Gould’s singing to the piece.

Figure 1 (next page) shows a characteristic response time distribution for a piece with high recognition speed, the *March* from P. I. Tchaikovsky’s *Nutcracker Suite*.

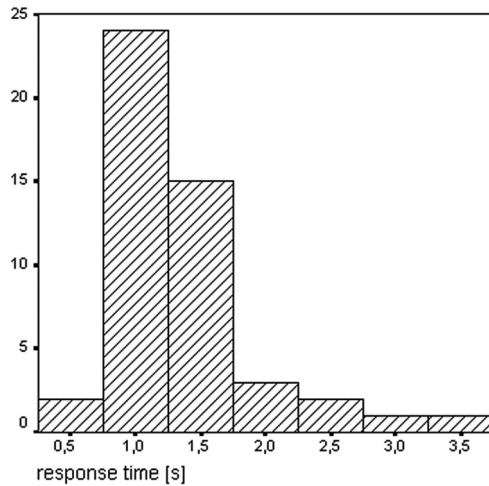


Figure 1: Typical response time distribution (grouped histogram): The *March* from Tchaikovsky's *Nutcracker Suite*.

Piece of music	Minimum rec. speed [s]	Median of rec. speed [s]
1. The Blue Danube Waltz	0.5	4.9
2. Rosenkavalier	0.9	3.1
3. Mahler / 5 th Symphony	1.5	9.0
4. The Trout	1.9	3.5
5. Lohengrin	1.8	7.4
6. A Midsummer Night's Dream	1.5	5.1
7. Pictures at an Exhibition	1.5	3.2
8. From the New World	1.6	10.4
9. Ases' Death	1.2	7.5
10. Beethoven / 7 th Symphony	1.1	9.9
11. Ride of the Valkyries	0.6	8.3
12. Beethoven / 5 th Symphony	0.5	1.1
13. For Elise	0.6	1.4
14. Dance of the Swans (Swan Lake)	1.1	4.4
15. The Four Seasons	0.7	1.3
16. Brahms / 4 th Symphony	1.1	5.5
17. Mahler / 8 th Symphony	1.2	4.2
18. Moments Musicaux	1.7	10.3
19. Sonata "Moonlight"	0.9	4.3
20. Bruckner / Te Deum	1.1	5.7
21. Mahler / Adagietto	1.9	8.7
22. Sonata "Waldstein"	1.5	5.3
23. Thus spoke Zarathustra	0.1	4.2
24. Tchaikovsky / First piano concerto	0.7	1.9
25. Nutcracker Suite (March)	0.6	1.3
26. Carmina Burana	0.7	4.6
27. Schumann / Scenes from Childhood	0.9	2.1
28. Schumann / Träumerei	1.6	5.2
29. Goldberg Variations	1.3	6.9

Table 1: Minima and medians of recognition speed.

Table 1 shows both individual minima and sample medians of recognition speeds across all 29 pieces. Minima *below* one second and median values *above* seven seconds are printed in boldface.

5. CONCLUSIONS

Examples of extremely rapid recognition demonstrate that minimal sequences of music contain impressive amounts of potentially discriminative information. Future studies should more systematically vary, and also actively modify, structural components and comparatively extend the scope to other styles.

6. REFERENCES

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