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Is there an effect of subliminal messages in music on choice behavior?

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The present study examines the effects of subliminal text messages in music on choice behavior. Subliminal messages are assumed to function as auditory primers. The results of two experiments will be presented: In Experiment 1, the authors tried to manipulate choice behavior of adult students ($N = 66$; age: 19-30 years) using subliminally presented words in two pop music pieces. In two blinded, non-directed listening tasks, subjects had (a) to choose one word out of ten from a list of words (condition *wordlist*), and (b) to indicate which drink they would like by putting a plastic chip into a box standing in front of four labeled bottles of water (condition *choice of drink*). Musical examples without subliminal messages were used as a control condition. No significant differences were found between experimental and control conditions. In Experiment 2, children ($N = 82$; age: 7-11 years) served as subjects. Regardless of the task and age group, no effects of subliminal messages on choice behavior could be observed. The paper concludes with a general discussion about the lack of theories that could explain any observed effects of subliminal manipulation.

The influence of music on consumer behavior has been investigated in the last two decades (e.g., Milliman, 1982, 1986; North, 1996; North, Hargreaves & McKendrick, 2000). Studies have revealed that musical tempo and customers‘ music preferences are the best predictors for strength of influence. Slow music and appreciation for the respective musical style can, for example, affect the length of stay of supermarket shoppers or restaurant patrons. However, there are only a few studies on the effect of music on choice behavior. Groenland & Schoormans (1994) found that music can affect product evaluation and product choice in a two-fold way: First, music can create a short-lasting association between product and affective stimulus by mood induction; second, affective conditioning can create a longer-lasting connection between a product and an affective stimulus (e.g., music). In a field experiment, North et al. (1997; North, Hargreaves & McKendrick) showed that stereotypical folk music with strong national associations, such as German "Bierkeller" music or French accordion music, can activate related knowledge between the product (e.g., wine) and the respective country. The use of French music led to French wines outselling German ones, whereas playing German music led to the opposite effect on sales of French wine. Customers were unaware of these effects. This finding sheds an interesting light on the role of consciousness in advertisement, a topic which is currently under discussion in consumer research. Dijksterhuis et al. (2005) has argued that consumer choice is much more based on unconscious processes than previously assumed and is, for example, affected by environmental features. Following this approach, Chartrand (2005) has proposed building a more comprehensive model of nonconscious processes in consumer behavior. Our study is a contribution to the current discussion of the role of nonconscious perception.

In everyday life, it is a widespread belief that worded messages can be embedded and hidden in music with the intention of manipulating the listener's behavior. Many have claimed that subliminal techniques are used for advertising and propaganda purposes. For example, in the movie „Josie and the Pussycats" (Elfont & Kaplan, 2001), the breathtaking success of the band is based on subliminal advertising messages weaved into the songs by the band‘s producer. In the past, many studies on subliminal manipulation or perception have been undertaken (for a review see Merikle, 1988; Merikle, 2000; Ott, 1998; Theus, 1994). There is an ongoing interest in the field of subliminal stimulation, and a search for the term "subliminal" in the psychological database PsycINFO results in more than 600 hits.

Subliminal perception is characterized by perception without awareness. This characteristic is also emphasized in the definition of "subliminal message" by Merikle (2000, p. 497) who defined it as „any situation in which unnoticed stimuli are perceived." For example, such stimuli might be inaudible to the conscious mind but audible to the subconscious or deeper mind, or they may be images transmitted so briefly that they are perceived only subconsciously. Following Cheesman & Merikle (1985), we can distinguish between a "subjective" subliminal perception, which is characterized by subliminal stimulus presentation with answers above chance level, and "objective" subliminal perception, which is characterized by answers at chance level. Our study focuses on subjective subliminal perception, also described sometimes as "subception" (Lazarus & McCleary, 1951).

By looking at review studies related to the topic of subliminal stimulation, it becomes evident that there is a great interest in this subject. Scholars working on psychoanalytic theory are especially interested in this topic. For example, Balay & Shevrin (1988) reviewed studies by Silverman (e.g. 1975) who tried in numerous experiments to test his subliminal

psychodynamic activation (SPA) method. This method claims to activate subconscious conflicts using subliminal stimulation. However, Balay & Shevrin noted that Silverman's results suffered from methodological weakness. The review study by Fudin & Benjamin (1991) suggested that despite insufficient testing, auditory SPA seems to have several methodological advantages over visual SPA. After analyzing the effects of subliminal drive-related stimuli on behavior, Bornstein (1990) concluded that SPA has stronger effects than superliminal stimuli. In another study, Bornstein (1989) discussed the use of subliminal stimuli as a propaganda tool and concluded that exposure to subliminal stimuli can produce temporarily stable changes in attitudes and behavior. To summarize, numerous studies have claimed to provide evidence for an effect of subliminal perception and stimulation on behavior. However, a critical review of a selected number of studies on the effects of subliminal acoustical messages (SAM) and subliminal self-help tapes (SHT) raises the question as to whether or not there could be an effect that is beyond a placebo effect (see Table 1). As research on subliminal manipulation started with visual stimuli, we will first discuss some studies from this field which are relevant to our study.

Table 1. *Survey of the results of selected studies on effects of subliminal acoustical messages (SAM) and subliminal self-help tapes (SHT).*

Study	Study rationale	Effect
Henley, 1975	Influence of SAM on evaluation of pictures	no
Benes, Gutkin & Decker, 1990	Influence of SAM on associations	no
Greenwald et al., 1991	Effect of SHT (memory/self-conficence) in case of wrong labelling of tapes	no/placebo effect
Russell et al., 1991	Effect of SHT (academic achievement)	no
Merikle & Skanes, 1992	Effect of SHT (reducing of weight) in case of wrong labelling of tapes	no/placebo effect
Staum & Brotons, 1992	Effect of SHT (memory/self-conficence) in case of wrong labelling of tape	no
Walls et al., 1992	Influence of SAM on tempo perception	no
Benoit & Thomas, 1992	Imagination of non-existent SAM	placebo effect
Möller, Kotzé & Sieberhagen, 1993	Effect of SHT (self-confidence)	no
Mitchell, 1995	Influence of SAM on itching behavior	no
Moore, 1995	Identification of differrences between SHT	no
Harris et al., 1996	Realization of SAM below masking threshold	no
Froufe & Schwartz, 2001	Effect of SHT (self-confidence)	placebo effect

Visual subliminal stimulation

One of the most prominent studies related to visual subliminal stimulation might be the one undertaken by the consumer researcher James Vicary in 1957 (Moore, 1997; Schneider, 2004; Theus, 1994). At the same time, the book *The hidden persuaders* by Packard (1960) uncovered the highly specialized techniques of motivational manipulation in the advertising industry. This information supported the claims of Vicary's findings: This information supported the claims of Vicary's findings who had argued that he could raise sales of Coca-Cola and popcorn in a cinema through subliminal visual advertising (to be specific: the sales of popcorn by 58 % and the sales of Coca-Cola by 18 % over a period of six weeks). Vicary had allegedly tested this technique by altering movies so that messages urging viewers to "Eat popcorn!" and to "Drink Coke!" were displayed at regular intervals throughout the movie.

These messages were presented so quickly (between 1/2000 and 1/3000 of a second) that no one was aware of them. Vicary became very popular with his study, and many people believe still today that his technique of advertising works. However, attempts to replicate his results were unsuccessful (Vokey, 2002). Finally, in 1962, Vicary conceded that he had faked his results; for him it was only a marketing trick. He never really found an effect of subliminal advertising. Neverthelss, other researchers claim to have observed similar effects. For example, Theus (1994) reported on a study that claimed to produce the sensation of thirst through subliminal presentation of the word "Coke." Another study claimed to invoke the feeling of hunger through subliminal presentation of the word "beef." Although Vicary's results were officially declared untrue, Wilson Key, the author of the 1973 book *Subliminal seduction*, still "popularized the myth of subliminal advertising" (Moore, 1997, p. 6). Key wrote a total of 4 books related to the alleged subliminal manipulation of consumers (Vokey, 2002).

Current research in the field of subliminal visual perception has provided empirical evidence of visual subliminal priming effects. Priming is defined as the process of activating a mental representation and its connections to memory in relation to a perceived stimulus. Through this activation, the connections will be more quickly accessible than they would be if they were not primed by the stimulus. For example, in the study by Naccache, Blandin & Dehaene (2002), subjects were required to decide whether a visually presented digit between the range of 1 and 9 is greater or smaller than the target number 5. Before the digits appeared, there was another digit which was presented subliminally. As a result, the decision speed was increased when the subliminally presented digit was congruent to the target stimuli by being greater or smaller than the digit 5. The authors concluded that subliminal priming can activate a particular connection in the memory and make responses faster. However, the priming effect disappears if the length of time between priming and target stimulus is greater than 100 ms. Another very recent priming study was carried out by Friedman et al. (2005), in which males who were subliminally primed with words related to alcohol rated women as more attractive than when they were primed with words not related to alcohol. Priming words were presented for a few milliseconds on the screen before the attractiveness of a woman had to be evaluated in a subsequent picture. Words related to alcohol were, for example, "wine" or "beer," whereas words such as "coffee" or "milk" were not related to alcohol. Still, the priming effect could be observed only in subjects who preferred alcohol to stimulate their libido.

Keeping these results in mind, it is obvious that in the visual modality, the existence of subliminal perception is very likely (Theus, 1994). However, these effects have only been observed under laboratory conditions and their external validity remains to be confirmed. Additionally, the reported studies only used very short examples; extended subliminal messages that might influence behavior could not be applied (Ott, 1998; Vokey, 2002). None of the presented studies concluded that a subliminal message could lead to a manipulation of choice behavior as claimed by Vicary.

Auditory subliminal stimulation

The present study focuses on auditory subliminal messages. There are five ways to embed worded messages in music: First, the target words or messages are placed in the music below the auditory threshold and are, thus, masked by the music; second, it is possible to use words with an inverted time-structure (so-called backward masked messages) and mix them

above the perceptual threshold (Walker, 1987); third, backward-masked messages can also be used subliminally; fourth, highpass-filtered worded messages (containing frequencies above 15 kHz) can be used (so-called "silent-subliminals"); finally, time-shrunk subliminal messages (played back twice as fast as recorded) can be hidden in the music.

Although there is no profound research with experimental evidence in the field of backward masking (Ott, 1998), the topic has often been of great public interest. For example, in 1990 the heavy metal band Judas Priest had to face trial for mixing backward-masked subliminal commands to commit suicide into their music (Moore, 1997; Schiller, 1990). The families of two fans who shot themselves accused the band of being responsible for those horrendous incidents. Although the court found the band not guilty, the topic of subliminal manipulation by backward messages has remained an issue nevertheless, despite Vokey & Read's (1985) convincing empirical evidence against any effects of stimulation by retrograde messages (for similar findings see also Begg, Needham & Bokkbinder, 1993; for similar findings see also Swart & Morgan, 1992). Their results showed that subjects were unable to understand the semantic content of the messages in either a conscious or subconscious way after listening to worded messages presented retrograde. In trying to affect subjects' spelling of homophones, the authors could find no effects of subliminal stimulation on behavior. The authors further noted that „the apparent presence of backward messages in popular music is a function more of active construction on the part of the perceiver than of the existence of the messages themselves" (Vokey & Read, 1985, p. 1231). The important role of expectation-guided perception of suggested backward messages could also be demonstrated in the study by Thorne & Himelstein (1984). Despite these negative results, there is an ongoing discussion about identifiable backward messages in rock music (for an overview see Walker, 1985). To summarize, effects of backward masked messages within music seem to be much more unlikely compared to subliminal (forward) masking only. Thus, in our study we decided to use subliminal messages only without backward masking or any other transformation.

Another interesting phenomenon of subliminal auditory messages is the use of subliminal self-help tapes that claim, for example, to strengthen self-esteem, memory or motivation. Rogers & Smith (1993) have amassed a market volume of about $50 million for self-help audio tapes in the United States. In a telephone survey, 45 % of those who participated believed that subliminal advertising would affect whether or not they would buy the product being advertised. There are only a few studies that have claimed positive effects of subliminal messages: Chakalis & Lowe (1992) found an improvement of the experimental group in a face-name-occupation memory test; Merikle & Daneman (1996) reviewed 44 studies on memory for events during anesthesia and found some evidence for unconscious cognition in their meta-analysis. Specific information was remembered following surgery, as long as testing was not delayed more than 36 hrs.

However, the majority of studies on the evaluation of self-help subliminal tapes as used, for example, for weight reduction, increase of academic achievement, or increase of self esteem, found only non-specific placebo effects of subliminal messages (e.g., Greenwald, Spangenberg, Pratkanis & Eskenazi, 1991; e.g., Merikle, 1988; Moore, 1995; Russell, Rowe & Smouse, 1991; Staum & Brotons, 1992). In a more recent study, Ott (1998) reviewed numerous studies dealing with subliminal auditory messages and concluded that the ability to control behavior through subconscious manipulation is very questionable.

Finally, the question remains as to how words in music can influence people if they cannot actually hear them. Two answers can be given to this question: First, from a

modern psychological perspective there is evidence that the mere belief in the existence of subliminal messages is sufficient to induce effects. Frequently, we can observe that subjects' behavior is influenced by their presumptions about subliminal messages and not by the information masked by the music (for experimental support see Greenwald et al., 1991; Merikle & Skanes, 1992; Pratkanis, 1992). Second, stimuli below the listening threshold can result in physiological reactions (e.g., change of heart rate, galvanic skin response, etc.). Even in the case of unconscious perception, information processing on a physiological level cannot be excluded. Experimental support can be found in the studies by Borgeat and co-workers (Borgeat, 1989; Borgeat & Goulet, 1983). Physiological reactions also depend on the content of messages: Compared to neutral target words, in the case of target words with sexual connotations, physiological reactions failed to appear (Borgeat, Elie, Chaloult & Chabot, 1985; Kotzé & Möller, 1990). Even messages perceived during anesthesia can have an effect on postoperative smoking behavior (Hughes, Sanders, Dunne, Tarpey & Vickers, 1994) or on memory for messages used in a postoperative sentence completion task (Merikle & Daneman, 1996). To summarize, we cannot rule out that subliminal messages can be perceived unconsciously and cause physiological reactions as indicators of subliminal information processing.

The influence of age

Up until now, it has remained questionable as to whether there could be an influence of age on sensitivity to subliminal stimulation. In 1963 Barber & Calverley (1963) found that children between the ages of 6 and 12 were more susceptible to hypnotic-like suggestions than were adults. A review of studies on suggestibility of children reveals that children seem to be more susceptible to suggestive questions in an interview situation (e.g., Bjorklund, Cassel, Bjorklund & Brown, 2000). The assumption of a greater suggestibility in children is also supported by consumer research: Oates, Blades & Gunter (2002) showed that an understanding of the persuasive character of television advertisements increased with age. They reported that even 10-year-olds do not fully understand the purpose of the presented advertisements. It therefore seems plausible to assume that children might be more vulnerable to subliminal manipulation than adults.

Rationale and hypotheses of the study

In our study we investigated whether choice behavior can really be influenced through subliminal messages in music, as is often claimed (Moore, 1997; Theus, 1994). We assumed that the effects of subliminal messages can best be predicted by an auditory priming effect and measured by choice behavior. Choice behavior was studied under two conditions: (a) the choice of a word from a list and (b) the choice of a drink. We drew up the following hypotheses:

Hypothesis 1: Differences in the choice of a word from a list would be found after the target word had been presented subliminally mixed within a piece of music.
Hypothesis 2: Differences in the choice of a drink would be found after the name of the target drink had been presented subliminally within a piece of music.
Hypothesis 3: Differences in choice behavior stimulated by subliminal messages would be found between adults and children.

The task referring to the first hypothesis will hereafter be called *wordlist* and the task referring to the second hypothesis *choice of drink*. To test whether children behave differently from adult subjects, we conducted two separate experiments; the first one with a group of adult students (Experiment 1) and the second one with a group of children from a primary school (Experiment 2).

Experiment 1
Method

Subjects

Music students (N = 66) from the Hanover University of Music and Drama served as subjects. The subjects were divided into two groups according to their affiliation with different courses. Group 1 (n = 34) consisted of 19 females and 15 males with a mean age of 21.3 years (range: 19-25 years). Group 2 (n = 32) consisted of 22 females and 10 males with a mean age of 21.9 years (range: 20-30 years). Both groups had to perform the wordlist and the choice of drink tasks.

Stimuli

Condition wordlist. The wordlist contained the following 10 German words: *Apfel* (apple), *Dämmstoff* (insulating material), *Käfer* (beetle) *Sonne* (sun), *Palme* (palm), *Lampe* (lamp), *Messer* (knife), *Auto* (car), *Wanne* (tub), Junge (boy). Words were randomly chosen from a German dictionary following the criterion of 2 vowels and 2 syllables. The target word *Sonne* (sun) was repeatedly spoken by a male voice, with a total number of 60 repetitions in 100 seconds, simultaneously with the music.

Condition choice of drink. This task was carried out with the following materials: Four different bottles containing water were placed on a table with a small box in front (see Figure 1). The position of the bottles was randomized between groups and sessions. To make sure that no existing trademark could influence the investigation, pseudo-names were invented for the drink labels. All names consisted of three vowels and three syllables. The target name, *Alora*, was repeatedly spoken by a male voice, with a total number of 108 repetitions in 176 seconds while the music played. The other three bottles were named *Plimona*, *Fontara*, and *Hubata*.

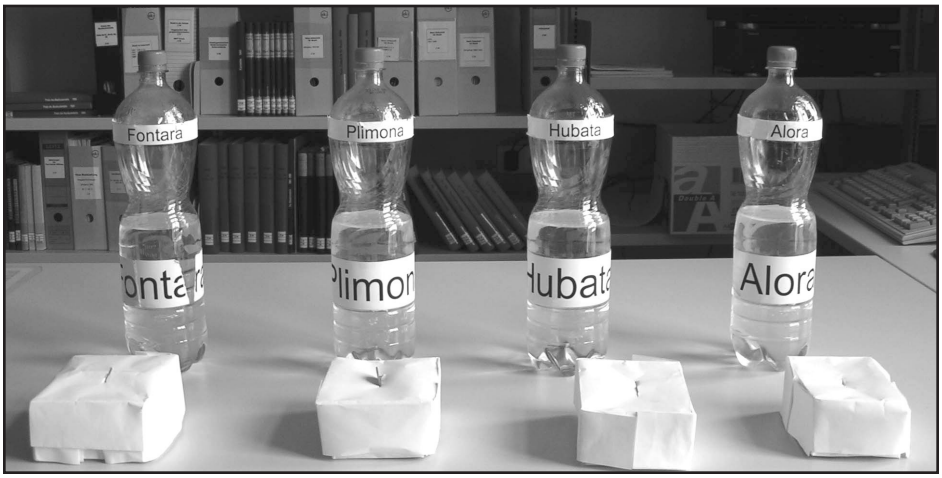


Figure 1. *Arrangement of the bottles for the choice of drink with chip boxes in front.*

Music. For each of the two tasks, one piece of music was composed. The two pieces were produced in a

home recording studio. The arrangements of both pieces were done according to the style of instrumental pop music using sampled and synthesized sounds. No vocals were added to make sure that they could not interfere with the subliminal worded messages. The piece for the condition wordlist lasted 1 minute and 42 seconds and for the condition choice of drink 2 minutes and 56 seconds. The intended messages (target words) were hidden within the music. The crucial point was the masking of the subliminal worded message through music. As there is no standardized method for the masking of subliminal messages through music (Ott, 1998), Zwicker & Fastl's (1999, p. 79) method of calculating the perceptual threshold for simultaneous masking was used initially. However, the model is based only on short tone bursts (< 1.000 ms) and continuous noise as a masker. For example, a 200 Hz tone burst with > 200 ms' duration and a sound pressure level of 60 dB is masked by noise if the sound pressure level of the noise is 80 dB. These results cannot be applied to the masking of language through music because music and language both have a frequency spectrum which changes over time.

We therefore decided to adjust loudness differences between the subliminal worded message and the music track by repeated evaluation and stepwise approximation so that the worded message was slightly below the masking threshold, and no message could be heard while listening to the embedded stimuli. In a pre-test, the final version of each mixed song was evaluated by a group of music students to exclude perceptibility of spoken messages under normal listening conditions (playback through loudspeakers).

Differences in loudness between target stimulus and music were monitored for separate tracks and adjusted using the software dB Sonic (2002). Measurement of sound pressure levels (SPL) differences between the mean level of the music and the peak level of the spoken message was used as a guideline. SPLs for the final version of the message and the music track are shown in Table 2.

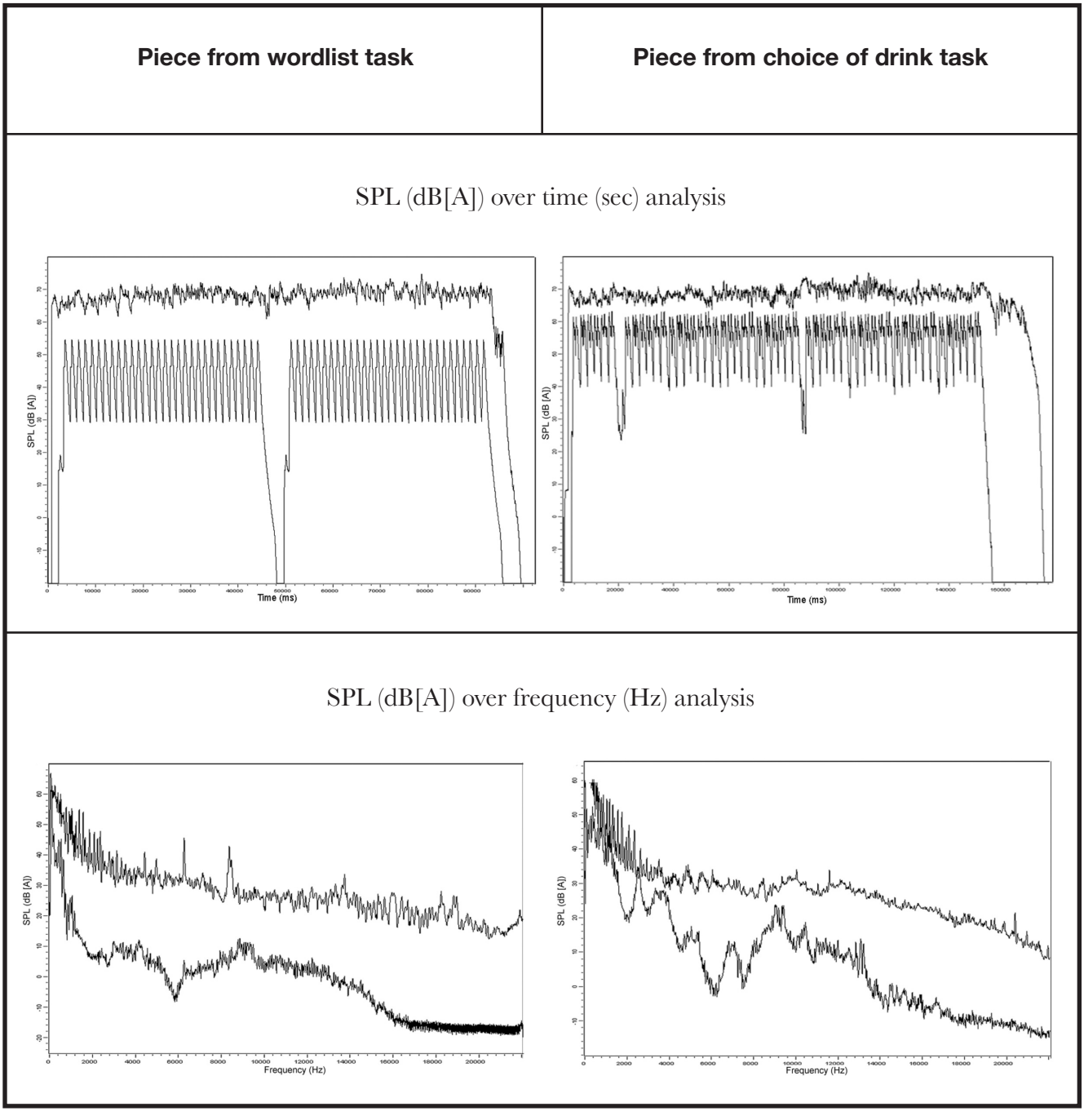
Table 2. *Mean and peak sound pressure levels (SPL) in db(A) for both subliminal stimuli and music pieces.*

	Condition	
	Wordlist	**Choice of drink**
Mean SPL music	68.5	68.6
Mean SPL message	47.2	56.7
Peak SPL music	74.8	75.7
Peak SPL message	54.7	63.3
Difference between means of music/message	21.3	11.9
Difference between peak SPL music/peak SPL message	20.1	12.4
Difference between mean SPL music/peak SPL message	13.8	5.3

As Table 2 shows, the SPL difference between the mean SPL of the music and the peak SPL for the message was 13.8 db(A) for the wordlist condition and 5.3 dB(A) for the choice of drink condition. Figure 2 shows the results of the analysis of sound pressure level over time and of the frequency components of the two tracks (message and music) for the two pieces. As Figure 2 shows, in both conditions the maximum SPL of the message signal is lower than the SPL of the music signal; the message signal is always completely masked by the music. All acoustical analyses were

realized using the psychoacoustic analysis software dB Sonic (2002). Each of the two pieces was produced with and without the subliminal messages so that four different versions were ultimately used in the experimental and control conditions.

Figure 2. *Acoustical analyses of the two pieces: The upper panel shows sound pressure level (SPL) over time and the lower panel SPL over frequency. The upper curve always represents the music signal (masker), the lower curve represents the masked message (left column: target word Sonne for wordlist task; right column: target word Alora for choice of drink task).*



Experiment design

The experiment design is shown in Table 3. Each group listened to one piece with a subliminal message (experimental condition) and to the other piece without a subliminal message (control condition). Group 1 listened to the first piece of music without the subliminal message while performing the wordlist task and to the second piece of music with the subliminal message while performing the choice of drink task. Group 2 listened to the first piece with the subliminal message while performing the wordlist task and to the second piece without the subliminal message while performing the choice of drink task.

Table 3. *Experiment design of Experiment 1 and 2*

Condition	Listening to music without subliminal message	Listening to music with subliminal message
Wordlist	Group 1	Group 2
Choice of drink	Group 2	Group 1

Procedure

The procedure was the same for both groups: The experiment was conducted in two different sessions for both groups. Thus, half of the subjects of each group was seated in a classroom and first given a short verbal instruction. In order to ensure a blind-study, we used a non-directed listening paradigm (as used in music perception, for example, in Wolpert, 2000), meaning that subjects were not informed about the possibility of subliminal messages and the intention of the experiment. The following instructions were given to the subjects on a questionnaire:

> *You will now listen to a short piece of music. While listening, you will be given a sign to turn the sheet over. After turning over, mark a word of your choice from the list. After a short break you will listen to a second piece of music. Now your task is different: Please come individually to the back of the classroom. There you will find a collection of bottles. Please choose a drink by inserting your chip into the box on the desk. We ask you to remain quiet during the entire length of the experiment.*

At this point the subjects received a plastic chip and the questionnaire. After one minute of listening, they were allowed to turn the questionnaire over and choose one of the words from the wordlist on the backside of the paper and mark it with a pencil. No specification was given on how to decide which word to take. The playback SPL of both pieces was at a comfortable level of about 74.5 dB(A), at a distance of four meters from the stereo speakers to the subjects. The experiment took about 20 minutes for each group.

Results

Figure 3 shows the distribution of choices for the experimental and the control condition in the wordlist task. The subliminally presented word *Sonne* (Sun) was not chosen any more frequently than other words on the list. The distribution of word choices seems to be random. Additionally, the control condition (no message heard) shows that word choices seem to be influenced more by associations to particular words (e.g., *Auto/Car*) than by an auditory priming effect. Frequency distribution of word choice in both conditions (message/no message) showed no significant influence on choice behavior (Fisher's Exact Test, $p = .49$).

Figure 3. *Frequency of word choices in the wordlist task (adult group). Subliminal target word is highlighted in bold.*

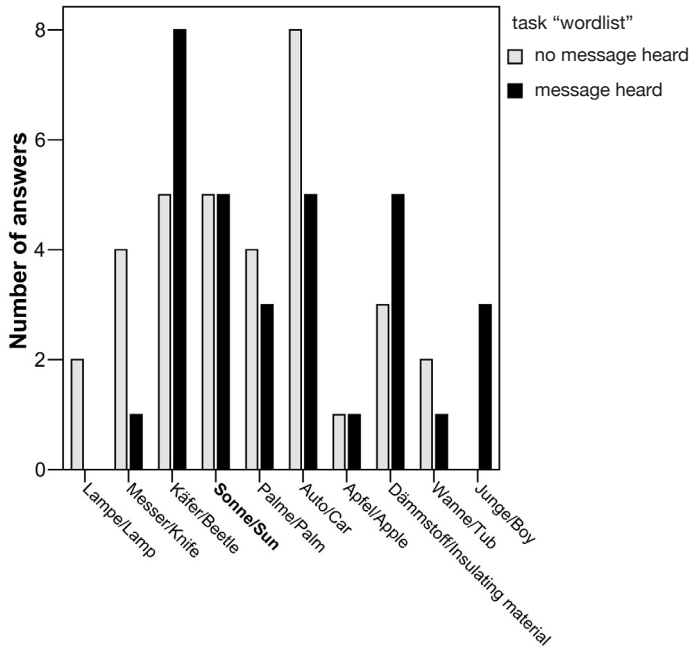
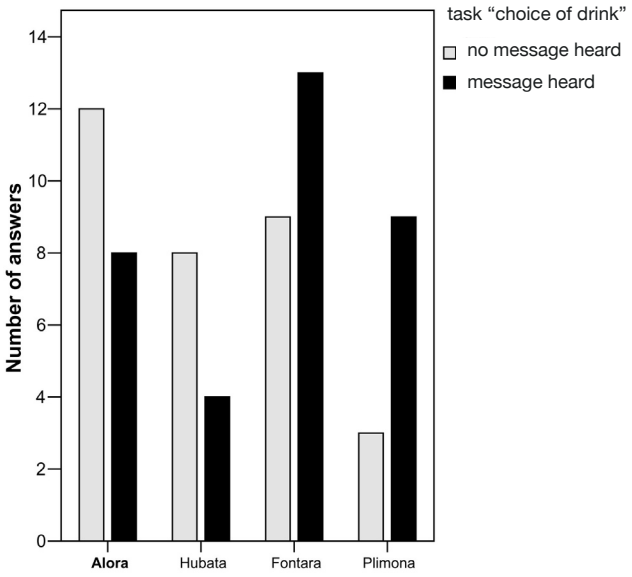


Figure 4. *Frequency of choices in the choice of drink task (adult group). Subliminal drink name is highlighted in bold.*



Frequency analysis from the choice of drink task shows a similar result: As can be seen in Figure 4, the drink *Alora* was not chosen more often while listening to the subliminal message than while listening to the music only (Fisher's Exact Test, $p = .13$).

Experiment 2

In our second experiment, we tested the effect of subliminal messages in music on children. The same stimuli and procedure were used.

Method

Subjects

Pupils ($N = 82$) from a primary school in Hanover served as subjects and were divided into two groups. Group 1 ($n = 36$) consisted of 15 females and 21 males aged between 8 and 11 years ($M = 9.3$). Group 2 ($n = 46$) was comprised of 23 females and 23 males, aged between 7 and 11 years ($M = 8.9$).

Stimuli, experiment design and procedure

In Experiment 2, the use of stimuli, the experiment design and the procedure were the same as in Experiment 1.

Results

As Figure 5 shows, the subliminal message showed no influence on choice behavior in the wordlist task. As in Experiment 1, listening to the subliminally presented word *Sonne/Sun* did not result in this word being more frequently chosen than any other word from the list (Fisher's Exact Test, $p = .88$).

A similar result can be observed in the choice of drink task: Although the children chose the subliminally "advertised" drink *Alora* more frequently than any other drink, this difference was merely chance (Fisher's Exact Test, $p = .33$). Furthermore, *Alora* was also most frequently preferred in the group to which the name had been not presented (‚no message' condition).

General discussion

To summarize the results of the two experiments, we conclude that subliminal worded messages in music have no effect on choice behavior in a non-directed listening situation. Neither the children nor the adults showed a modification of behavior through subliminal stimulation in the wordlist task or in the choice of drink task. All observed differences between the experimental and the control condition (no message) in both tasks can be attributed to chance. Therefore, all three hypotheses have been rejected, and the claim of a potential manipulation of choice behavior (e.g., Theus, 1994) cannot be corroborated.

Figure 5. *Frequency of word choices in the wordlist task (children group). Subliminal target word is highlighted in bold.*

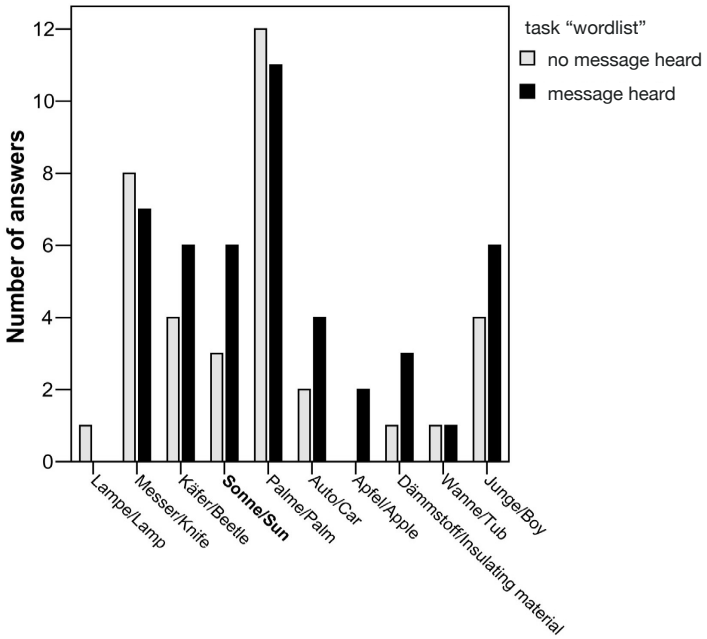
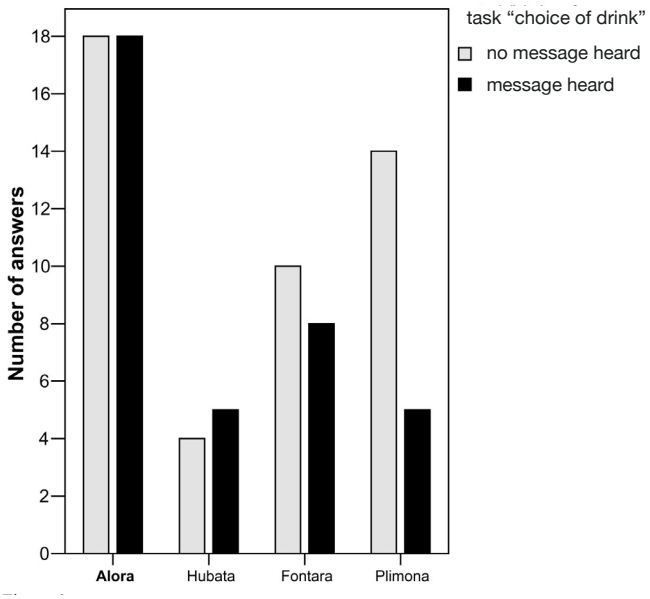


Figure 6. *Frequency of choices in the choice of drink task (children group). Subliminal target word is highlighted in bold.*



However, a general effect of subliminal worded messages cannot be ruled out by our investigation. It might still be possible that the effect in question could be observed under different conditions. The crucial point -- and most challenging task for research on auditory subliminal manipulation in music -- is the question of how to produce the stimuli. There is no standardization for the composition and arrangement of the music pieces. As Ott (1998) has shown in his review of subliminal studies, it depends on the producer's intuitive decision as to how a subliminal message is inserted into music. In our study, we tried to use guidelines from psychoacoustic research, such as Zwicker & Fastl's (Zwicker & Fastl, 1999) measurement of impulse masking through noise. However, it is clear that language cannot be treated as a tone impulse just as music cannot be considered continuous noise. Moreover, in music numerous other acoustical qualities (e.g., tempo, key, style, instrumentation, etc.) might have an influence on masking. Using a different stimulus could therefore lead to different results.

If an effect of auditory subliminal messages had been observed, it would have been difficult to explain the underlying mechanisms, and the following two questions would have to be answered: First, how could a subliminally perceived word influence behavior? With the knowledge of the cochlea's biomechanical response, there is no explanation of how a signal below the masking threshold could excite the basilar membrane (Yost, 2000, p. 95). An audio signal that is masked by another louder signal is nearly cut off from the information flow to the brain. Due to the cochlea‘s organization into 24 critical bands, each band starts to resonate if a frequency lies within its limits. If two sounds with a similar frequency occur at the same time and stimulate the same critical band, only the louder sound will be perceived. This might lead to the assumption that a subliminally presented word does not exist at all in the nerve signal of the hearing nerve. However, the question remains open as to whether or not there are two thresholds for audio perception as there are for visual perception: one for the conscious perception and one for the subconscious perception of very short stimuli (Naccache et al., 2002; Theus, 1994). In other words, how can one explain an effect of something that does not exist at the neurological level? Second, how do super- and subliminal stimulation differ? If it is hard to find evidence even for the influence of superliminal stimulation (above masking threshold) on choice behavior, such as in advertising, it is even more diffucult to explain the subliminal stimulation. These questions illustrate one crucial problem: There is no real theory that would be able to explain effects of subliminal manipulation (Vokey, 2002). However, it is worth discussing if superliminal presentation of repeated messages could have an effect, for example, on the probability that these items will lead listeners to choose them. On the one hand, we can form the opinion that a mere repetition of messages, such as „I am a nice person," are boring and ineffective in promoting self-esteem (Vokey, 2002, p. 246). On the other hand, our method of repeated words or phrases is used in numerous studies on subliminal messages (e.g., Walls, Taylor & Falzone, 1992) and result in similar findings as do studies that use a permanent variation of words for the same message.

Our study was based on a total of 148 subjects. This might give a persuasive amount of evidence that the effects on choice behavior as described by Theus (1994) can hardly be caused by subliminal stimulation. In visual modality, subliminal priming effects were shown under restrictive laboratory conditions (Friedman et al., 2005; Naccache et al., 2002). However, effects of subliminal visual priming could be observed only when the delay between the subliminal message and the superliminal target word was very short (< 1 s). Is it possible that an effect of auditory subliminal messages could not be found due to a too long

delay between item presentation and test? We think this is very unlikely, because Borgeat et al. (1989) could show that long term effects of subliminal stimuli can still be observed on a physiological level 15 minutes after subliminal presentation. Chakalis & Lowe (1992) found an increase of memory performance by subliminal messages 15 minutes after stimulus presentation.

Finally, there are some research perspectives for the future: First, our stimuli could be re-mixed to test the effects of superliminal messages on choice behavior. This could be done in a non-directed listening as well as in a directed listening task. Although non-directed listening is typical for the use of music in everyday life (Sloboda, O'Neill & Ivaldi, 2001), there is some literature on the effects of directed listening of subliminal messages (Harris, Salus, Rerecich & Larsen, 1996; Merikle, 1988; Moore, 1995; Staum & Brotons, 1992). However, in no case could a difference between the conditions of directed and non-directed listening be found. Second, the question remains whether the measurement of choice behavior as a dependent variable is the best method, or if other responses from the subject could also be used to evaluate the influence of subliminal messages. Third, a greater variety of musical stimuli could also lead to different results. However, with the current state of research, we cannot find convincing evidence for an effect of auditory subliminal stimulation on choice behavior. Finally, the documentation of misheard (superliminal) lyrics in music[1] shows that perception is strongly based on reconstruction processes, which, of course, can be misleading in some cases. Thus, we assume that the discussion about backward and subliminal messages will be ongoing in the future.

1 A collection can be found in the Archive of Misheard Lyrics (http://www.kissthisguy.com)

Author note

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References

Balay, J. & Shevrin, H. (1988). The subliminal psychodynamic activation method: a critical review. *American Psychologist, 43*(3), 161-174.

Barber, T. X. & Calverley, D. S. (1963). „Hypnotic-like" suggestibility in children and adults. *Journal of Abnormal & Social Psychology, 66*(6), 589-597.

Begg, I. M., Needham, D. R. & Bokkbinder, M. (1993). Do backward messages unconsciously affect listeners? No. *Canadian Journal of Experimental Psychology, 47*(1), 1-14.

Benes, K. M., Gutkin, T. B. & Decker, T. N. (1990). The effects of mellow and frenetic music on reported cognitions resulting from auditory subliminal messages. *Journal of General Psychology, 117*(1), 83-89.

Benoit, S. C. & Thomas, R. L. (1992). The influence of expectancy in subliminal perception experiments. *Journal of General Psychology, 119*(4), 335-341.

Bjorklund, D. F., Cassel, W. S., Bjorklund, B. R. & Brown, R. D. (2000). Social demand characteristics in children's and adults' eyewitness memory and suggestibility: the effect of different interviewers on free recall and recognition. *Applied Cognitive Psychology, 14*(5), 421-433.

Borgeat, F. (1989). Psychophysiological responses to subliminal auditory suggestions for activation. *Perceptual & Motor Skills, 69*(3, Pt 1), 947-953.

Borgeat, F., Elie, R., Chaloult, L. & Chabot, R. (1985). Psychophysiological responses to masked auditory stimuli. *Canadian Journal of Psychiatry, 30*(1), 22-27.

Borgeat, F. & Goulet, J. (1983). Psychophysiological changes following auditory subliminal suggestions for activation and deactivation. *Perceptual & Motor Skills, 56*(3), 759-766.

Bornstein, R. F. (1989). Subliminal techniques as propaganda tools: review and critique. *Journal of Mind & Behavior, 10*(3), 231-262.

Bornstein, R. F. (1990). Critical importance of stimulus unawareness for the production of subliminal psychodynamic activation effects: a meta-analytic review. *Journal of Clinical Psychology, 46*(2), 201-210.

Chakalis, E. & Lowe, G. (1992). Positive effects of subliminal stimulation of memory. *Perceptual & Motor Skills, 74*(3, Pt 1), 956-958.

Chartrand, T. L. (2005). The Role of Conscious Awareness in Consumer Behavior. *Journal of Consumer Psychology, 15*(3), 203-210.

Cheesman, J. & Merikle, P. M. (1985). Word recognition and consciousness. In D. Besner & T. G. Weller & G. E. MacKinnon (Eds.), *Reading research: advances in theory and practice* (Vol. 5, pp. 311-352). New York: Academic Press.

dBSONIC. (2002). (Version 3.12) [Computersoftware for psychoacoustic analysis. For description see http: //www.cortex-instruments.de]. Regensburg: Neutrik Cortex Instruments GmbH.

Dijksterhuis, A., Smith, P. K., van Baaren, R. B. & Wigboldus, D. H. J. (2005). The unconscious consumer: effects of environment on consumer behavior. *Journal of Consumer Psychology, 15*(3), 193-202.

Elfont, H. & Kaplan, D. (2001). Josie and the pussycats (Director, Director). USA: Metro Goldwyn Mayer.

Friedman, R. S., McCarthy, D. M., Förster, J. & Denzler, M. (2005). Automatic effects of alcohol cues on sexual attraction. *Addiction, 100*(5), 672-681.

Froufe & Schwartz, A. B. (2001). Subliminal messages for increasing self-esteem: placebo effect. *Spanish Journal of Psychology, 4*(1), 19-25.

Fudin, R. & Benjamin, C. (1991). Review of auditory subliminal psychodynamic activation experiments. *Perceptual & Motor Skills, 73*(3, Pt 2), 1115-1136.

Greenwald, A. G., Spangenberg, E. R., Pratkanis, A. R. & Eskenazi, J. (1991). Double-blind tests of subliminal self-help audiotapes. *Psychological Science, 2*(2), 119-122.

Groenland, E., A.G. & Schoormans, J. P. L. (1994). Comparing mood-induction and affective conditioning as mechanisms influencing product evaluation and product choice. *Psychology & Marketing, 11*(2), 183-197.

Harris, J. L., Salus, D., Rerecich, R. & Larsen, D. (1996). Distinguishing detection from identification in subliminal auditory perception: A review and critique of Merikle's study. *Journal of General Psychology, 123*(1), 41-50.

Henley, S. (1975). Cross-modal effects of subliminal verbal stimuli. *Scandinavian Journal of Psychology, 16*(1), 30-36.

Hughes, J. A., Sanders, L. D., Dunne, J. A., Tarpey, J. & Vickers, M. D. (1994). Reducing smoking. The effect of suggestion during general anaesthesia on postoperative smoking habits. *Anaesthesia, 49*(2), 126-128.

Kotzé, H. F. & Möller, A. T. (1990). Effect of auditory subliminal stimulation on GSR. *Psychological Reports, 67*(3, Pt 1), 931-934.

Lazarus, R. S. & McCleary, R. A. (1951). Autonomic discrimination without awareness: a study of subception. *Psychological Review, 58*, 113-122.

Merikle, P. M. (1988). Subliminal auditory messages: an evaluation. *Psychology & Marketing, 5*(4), 355-372.

Merikle, P. M. (2000). Subliminal perception. In A. E. Kazdin (Ed.), *Encyclopedia of psychology* (Vol. 7, pp. 497-499). Oxford: Oxford University Press.

Merikle, P. M. & Daneman, M. (1996). Memory for unconsciously perceived events: evidence from anesthetized patients. *Consciousness & Cognition: An International Journal, 5*(4), 525-541.

Merikle, P. M. & Skanes, H. E. (1992). Subliminal self-help audiotapes: A search for placebo effects. *Journal of Applied Psychology, 77*(5), 772-776.

Milliman, R. E. (1982). Using background music to affect the behavior of supermarket shoppers. *Journal of Marketing, 46*(3), 86-91.

Milliman, R. E. (1986). The influence of background music on the behavior of restaurant patrons. *Journal of Consumer Research, 13*(2), 286-289.

Mitchell. (1995). Effects of subliminally presented auditory suggestions of itching on scratching behavior. *Perceptual and Motor Skills, 80*(1), 87-96.

Moore, T. E. (1995). Subliminal self-help auditory tapes: an empirical test of perceptual consequences. *Canadian Journal of Behavioural Science, 27*(1), 9-20.

Moore, T. E. (1997). Scientific consensus & expert testimony: lessons form the Judas Priest trial. *American Psychology Law Society News, 17*(1), 3-14.

Möller, A. T., Kotzé, H. F. & Sieberhagen, K. J. (1993). Comparison of the effects of auditory subliminal stimulation and rational-emotive therapy, separately and combined, on self-concept. *Psychological Reports, 72*(1), 131-145.

Naccache, L., Blandin, E. & Dehaene, S. (2002). Unconscious masked priming depends on temporal attention. *Psychological Science, 13*(5), 416-424.

North, A. C. (1996). The effects of music on responses to a dining area. *Journal of Environmental Psychology, 16*(1), 55-64.

North, A. C., Hargreaves, D. J. & McKendrick, J. (1997). In-store music affects product choice. *Nature, 390*(6656), 132.

North, A. C., Hargreaves, D. J. & McKendrick, J. (1999). The influence of in-store music on wine selections. *Journal of Applied Psychology, 84*, 271-276.

North, A. C., Hargreaves, D. J. & McKendrick, J. (2000). The effects of music on atmosphere in a bank and a bar. *Journal of Applied Social Psychology, 30*(7), 1504-1522.

Oates, C., Blades, M. & Gunter, B. (2002). Children and television advertising: when do they understand persuasive intent? *Journal of Consumer Behaviour, 1*(3), 238-245.

Ott, R. (1998). Subliminale akustische Beeinflussung - Fakten und Fiktionen [Subliminal auditory influences: facts and fictions]. *Hypnose und Kognition, 15*(1-2), 57-78.

Packard, V. (1960). *The hidden persuaders*. Harmondsworth: Penguin (original work published 1957).

Pratkanis, A. R. (1992). The cargo-cult science of subliminal persuasion. *The Skeptical Inquirer, 16*(3), 260-272.

Rogers, M. & Smith, K. H. (1993). Public perceptions of subliminal advertising: why practitioners shouldn't ignore this. *Journal of Advertising Research, 33*(2), 10-18.

Russell, T. G., Rowe, W. & Smouse, A. D. (1991). Subliminal self-help tapes and academic achievement: an evaluation. *Journal of Counseling & Development, 69*(4), 359-362.

Schiller, U. (1990, 10 August). Man hört, was man hört [You hear, what you hear]. *Die Zeit*, pp. 50.

Schneider, R. U. (2004). *Das Buch der verrückten Experimente [The book of crazy experiments]*. München: Bertelsmann.
Silverman, L. H. (1975). A clinical application of subliminal psychodynamic activation. *Journal of Nervous & Mental Disease, 161*(6), 379-392.
Sloboda, J. A., O'Neill, S. & Ivaldi, A. (2001). Functions of music in everyday life: an exploratory study using the Experience Sampling Method. *Musicae Scientiae, 5*(1), 9-32.
Staum, M. J. & Brotons, M. (1992). The influence of auditory subliminals on behavior: a series of investigations. *Journal of Music Therapy, 29*(3), 130-185.
Swart, L. C. & Morgan, C. L. (1992). Effects of subliminal backward-recorded messages on attitudes. *Perceptual & Motor Skills, 75*(3, Pt 2), 1107-1113.
Theus, K. T. (1994). Subliminal advertising and the psychology of processing unconscious stimuli: a review of research. *Psychology & Marketing, 11*(3), 271-290.
Thorne, S. B. & Himelstein, P. (1984). The role of suggestion in the perception of satanic messages in rock-and-roll recordings. *The Journal of Psychology, 116*(2), 245-248.
Vokey, J. R. (2002). Subliminal messages. In J. Vokey, R. & S. W. Allen (Eds.), *Psychological sketches* (6th ed., pp. 223-246). Lethbridge, Alberta: Psyence Ink.
Vokey, J. R. & Read, J. D. (1985). Subliminal messages: between the devil and the media. *American Psychologist, 40*(11), 1231-1239.
Walker, M. W. (1985). Backward messages in commercially available recordings. *Popular Music and Society, 10*(1), 2-13.
Walker, M. W. (1987). How to produce forward/backward recordings (without supernatural guidance). *Popular Music and Society, 11*(2), 1-3.
Walls, K. C., Taylor, J. A. & Falzone, J. (1992). The effects of subliminal suggestions and music experience on the perception of tempo in music. *Journal of Music Therapy, 29*(3), 186-197.
Wolpert, R. S. (2000). Attention to key in a nondirected music listening task. *Music Perception, 18*(2), 225-230.
Yost, W. A. (2000). *Fundamentals of hearing: an introduction* (4th ed.). San Diego: Academic Press.
Zwicker, E. & Fastl, H. (1999). *Psychoacoustics. Facts and models* (2nd ed.). Berlin: Springer.

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