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What you hear shapes how you think: Sound patterns change level of construal ☆

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HIGHLIGHTS

- Auditory cues related to distance and abstractness trigger abstract construal.
- Auditory cues related to proximity and concreteness trigger concrete construal.
- Distance/abstractness cues in sounds instigate the formation of broader categories.
- Distance/abstractness cues increase preference for global visual patterns.
- Also, these cues increase the weight placed on aggregate vs. single information.

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ABSTRACT

Psychological distance and abstractness primes have been shown to increase one's level of construal. We tested the idea that auditory cues which are related to distance and abstractness (vs. proximity and concreteness) trigger abstract (vs. concrete) construal. Participants listened to musical sounds that varied in reverberation, novelty of harmonic modulation, and metrical segmentation. In line with the hypothesis, distance/abstractness cues in the sounds instigated the formation of broader categories, increased the preference for global as compared to local aspects of visual patterns, and caused participants to put more weight on aggregated than on individualized product evaluations. The relative influence of distance/abstractness cues in sounds, as well as broader implications of the findings for basic research and applied settings, is discussed.

Introduction

Music has a huge impact on people's lives: It alters moods, energizes, chills or relaxes. A lot of research has demonstrated that music has the potential to change feelings and emotions (e.g., Blood & Zatorre, 2001; Egermann et al., 2011; Saarikallio, Nieminen, & Brattico, 2013; Sandstrom & Russo, 2013). In addition, music influences cognitions, such as recollections from episodic memory (e.g., Janata, 2009). So far, however, little research has investigated how musical sounds change *the way people think*. The present research aims to fill this gap. More specifically, building on the influence of psychological distance (Liberman & Trope, 2008; Trope & Liberman, 2000, 2003, 2010) and abstractness primes (Förster, 2011; Förster, Liberman, & Kuschel, 2008; Freitas, Gollwitzer, & Trope, 2004) on level of mental construal, we propose that musical sound parameters that are related to distance (vs. proximity) and abstractness (vs. concreteness) cause individuals to mentally construe their subjective world more abstractly (vs. concretely), with consequences for judgments and decision making.

Psychological distance and level of construal

Construal level theory (CLT, Trope & Liberman, 2003, 2010) proposes that psychological distance from objects (i.e., temporal, spatial, social, or probabilistic) enhances the tendency to build more high-level construals, whereas proximity enhances the tendency to build more low-level construals of objects. High-level construals are less diverse and include fewer details and less contextual information than low-level construals. High-level construals are abstract mental representations that extract the essential, core aspects of objects. Moving from a

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concrete representation of an object to a more abstract representation involves retaining central features and omitting features that may vary without significantly changing the meaning of the represented information.

Low-level, concrete construals, in contrast, consist of rich and specific details. They emphasize subordinate (vs. superordinate) features of an object, focusing on local (vs. global) perceptual elements, and processing information in a detailed-oriented (vs. holistic) manner (e.g., Shapira, Liberman, Trope, & Rim, 2012; Trope & Liberman, 2000).

By now, a huge body of evidence provides support for the relationship between psychological distance and high-level construal. For example, increased distance was found to facilitate perception of global, abstract visual patterns relative to local, concrete patterns (Liberman & Förster, 2009). It also led participants to include more objects in a category, indicating that participants thought about the objects in rather superordinate, abstract terms (Liberman, Sagristano, & Trope, 2002). Moreover, distance causes individuals to use generalized information when evaluating objects (Ledgerwood, Wakslak, & Wang, 2010). Taken together, these results indicate that psychological distance causes people "to see the forest instead of the trees."

Additionally, abstract versus concrete construal can be procedurally primed (Förster, 2011; Förster et al., 2008; Freitas et al., 2004; Fujita, Trope, Liberman, & Levin-Sagi, 2006; Hansen, Kutzner, & Wänke, 2013; Hansen & Wänke, 2010; Wakslak & Trope, 2009). For example, individuals who had focused on the whole gestalt of a state map demonstrated more global thinking in an unrelated task than individuals who had focused on a specific detail of the same map (Friedman, Fishbach, Förster, & Werth, 2003). In the present research, we tested whether distance-related and abstractness-related sound primes, as well, affect construal level across modalities.

If sound cues indeed have the potential to change the way individuals think, this will shed light on one powerful aspect of music that has been neglected so far: Rather simple auditory cues commonly encountered almost everyday in music could possibly influence higher-order cognitions. It would further shed light on the nature of abstraction: With very slight and simple stimuli, level of construal could be changed quite easily—even across modalities—demonstrating that level of construal is a very flexible tool of the human mind.

Three factors that affect distance perception and construal level

The present research focuses on three sound factors that are related either to psychological distance (i.e., reverberation[1] and novelty) or to abstractness (i.e., segmentation).

Reverberation

People almost automatically use reverberation as a cue in auditory distance perception (Mershon & King, 1975). Unlike intensity of sound (which is considered a relative cue of distance perception), reverberation is an absolute cue for perceived distance because it provides the perceiver with information about distance from the source of a sound that can be translated into absolute values, such as feet or meters (Mershon & King, 1975). The effect of reverberation on judgments of spatial distance has been demonstrated even when the intensity and the frequency spectrum of the sound were held constant (von Békésy, 1960). In the present study, we varied reverberation as one sound factor affecting psychological distance.

Novelty

Novelty (vs. familiarity) is considered another cue of psychological distance (Liberman & Trope, 2008; Trope & Liberman, 2000, 2003, 2010). As direct experience with an object or events decreases, psychological distance increases. Accordingly, it has been demonstrated that asking participants to reflect about novel (vs. familiar) events increased abstract construal of actions, which led to more global perception (Förster, Liberman, & Shapira, 2009). A recent model on global versus local processing (the GLOMO^{sys}, Förster & Dannenberg, 2010) even considers novelty as one of the main factors that trigger global processing.

In the present research, we used harmonic modulation to manipulate novelty. That is, we presented combinations of musical keys that provide perceivers with either a very familiar sound pattern or a more unusual one. More specifically, participants listened to the two alternating chords C major and G major (i.e., a familiar combination), or to the two alternating chords C major and F# major (i.e., an unusual, novel combination). C major and G major are the tonic and dominant, respectively, of the C major key and thus share the same tonal material. C major and F# major, in contrast, do not share a common key signature. Thus, combining C major and F# major results in a feeling of unfamiliarity (Krumhansl, 1979) and therefore in a perception of more psychological distance.

Segmentation

Segmentation is directly related to level of construal. Compared to a low segmentation, a high segmentation psychologically translates into the perception of more and smaller units that correspond with a more fine-grained, concrete construal (Henderson, Fujita, Trope, & Liberman, 2006; Maglio & Trope, 2011). For instance, in one study, participants listened to a song and were asked to focus on either its "entirety or whole gestalt of composition and performance" or to "the details of the composition and performance" (Förster, 2011, Study 1). The detailed-oriented processing strategy triggered more concrete, local processing compared to the more holistic strategy.

We manipulated segmentation in the present research by varying the metrical fragmentation of the sound patterns. Some participants were presented with chords that were played only once in each measure. These participants should perceive the measure as one single unit. Other participants heard the chords four times per measure. These participants should perceptually divide the measure into fewer and smaller parts. We expected cross-modal effects: The more segmented presentation (the "auditory trees") should cause a lower level of construal than the more holistic presentation (the "auditory forest") in a different task.

The present research

Participants of the present study listened to one of five sound samples throughout the whole study. One sound was designed to trigger concrete construal: It included factors that are related to psychological proximity (i.e., no reverberation and C/G major chords), and it was metrically segmented. We refer to this sound as "concrete sound." Another sound was designed to induce comparably more abstract construal. This sound included reverberation, used C/F# major chords, and had no metric segmentation. We refer to this sound as "abstract sound." We hypothesized that this sound would induce the highest level of construal. Three further sounds varied only one of the cues. We hypothesized that, compared to the concrete sound, these sounds would also increase level of construal but to a lesser degree than the abstract sound.

Level of construal is a heterogeneous construct that can involve perceptual, conceptual, linguistic, goal-related, or attitude-related aspects of abstraction (Burgoon, Henderson, & Markman, 2013). This implies that level of construal cannot be measured directly; only its diverse facets can be assessed. Different measures of construal level refer to its different facets. In the present study, we used three different measures to investigate if sound parameters have an impact on construal level. Specifically, we assessed category breadth, preference for global (vs. local) visual patterns, and reliance on aggregated rather than individualized evaluations of objects in attitude judgments. Although

[1] For definitions of the technical terms used in this paper, see Appendix A.

related, these measures map onto different psychological functions and will therefore be discussed separately in this article.

Method

Participants and design

One hundred participants took part in a study that was introduced as being about sound and shopping. Participants were randomly assigned to one of five conditions (concrete sound, reverberation, C–F#, nonsegmentation, abstract sound). Five participants were excluded from the analyses because of problems with the technical equipment or because they reported hearing problems. The remaining sample consisted of 95 participants (69 females, 26 males). Age ranged between 17 and 48 years ($Mdn = 22$, $M = 22.47$, $SD = 4.09$).

Sound materials

Simple sound stimuli were created that each consisted of two chords. To control for differences in the frequency spectrum, we used only neutral sine tones. The two chords represented two different harmonies that alternated repeatedly. That is, the first chord was played for one measure, followed by the second chord played for one measure, followed by the first chord again played for one measure, and so on. We used a 4/4 measure with a tempo of 100 beats per minute. Each chord was present for one whole measure. This means that one harmony was present for 2.4 s (25 times in 2 min). The sounds were presented over headphones with an intensity of 70 dB during the whole study.

The concrete sound stimulus consisted of the two harmonies C major and G major; each chord was presented in a metrically segmented format (i.e., repeated on each of the four beats in a 4/4 measure); and the sounds were played without reverberation. The abstract sound consisted of the two harmonies C major and F# major; each chord was presented on only the first beat of a 4/4 measure (i.e., nonsegmented); and reverberation was added to the sounds (200 ms release time, 1 ms predelay). In the three remaining conditions, only one of the three factors was manipulated (see Table 1 for the musical scores). Please note that the speed of harmonic alterations was held constant across all conditions.

Procedure

Upon arrival in the lab, participants were welcomed and seated in separate cubicles where they found a questionnaire package that they were asked to fill in. A research assistant who was blind to condition asked participants to put on headphones before starting with the questionnaire. The sounds were presented continuously over the headphones.

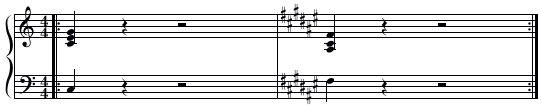
To support the shopping cover story, on the first page of the questionnaire it was explained that the study was about different shopping situations. Participants were first asked to put themselves in a shopping situation and to indicate on 7-point scales how hungry they were (1: *not at all*, 7: *very hungry*) and how often they do grocery shopping (1: *very rarely*, 7: *very often*). The five conditions did not differ on these two filler items, $F < 1$ and $F(4, 89) = 1.15$, $p = .34$. On the second page of the questionnaire, participants were instructed to imagine doing grocery shopping and to create a shopping list. They were asked to write down all products that came to mind and that they wanted to include on their list. This filler task took about 3 min and helped participants to get used to the sounds that were played during the experiment.

Next, the three measures of construal level were administered: (1) category breadth, (2) preference for visual patterns, and (3) reliance on aggregated rather than individualized evaluations in attitude judgments. All three measures were given in paper-and-pencil format in the same order as presented below. No further measures of construal level were included in the experiment. The three measures are described together with the findings in detail below.

To control for the possibility that the sounds could change participants' mood, which in turn would affect level of construal (Gasper & Clore, 2002), we also assessed mood by two items. Participants indicated on 7-point scales how they felt at the moment (1: *very bad*, 7: *very good*) and how their mood was at the moment (1: *happy*, 7: *sad*). The ratings on the two mood items did not differ between conditions, Fs < 1, and will not be discussed further.

Additionally, as a manipulation check for the musical parameters that were supposed to induce distance, participants were asked to indicate on 7-point scales how spatially far away (1: *very near*, 7: *very far*) and how temporally distant (1: *very near*, 7: *very distant*) they experienced the sound samples to be. At the end, participants provided some demographical data and were thanked and debriefed.

Table 1
Experimental conditions with the composition of parameters per condition.

Sound conditions	Parameters			Musical notation
	Reverberation	Harmonic modulation	Metrical segmentation	
Concrete sound	No	C–G	Each beat	
Reverberation	Yes	C–G	Each beat	
C–F#	No	C–F#	Each beat	
Nonsegmentation	No	C–G	First beat only	
Abstract sound	Yes	C–F#	First beat only	

Note. 1-minute versions of the five sounds can be downloaded from http://dx.doi.org/10.1016/j.jesp.2014.05.022 (see Appendix B).

Manipulation check

The two distance measures correlated with each other, $r(N = 95) = .41$, $p < .001$, and thus were averaged into one distance index. The groups differed on the distance index, $F(4, 90) = 11.15$, $p < .001$, $\eta_p^2 = .33$. This effect was mainly due to the abstract sound ($M = 3.84$, $SD = 1.17$) and the nonsegmentation ($M = 3.67$, $SD = 0.99$) conditions, which both differed from the concrete sound ($M = 2.65$, $SD = 1.03$), the C–F# ($M = 2.10$, $SD = 0.85$), and the reverberation ($M = 2.39$, $SD = 1.01$) conditions, Bonferroni adjusted $ps < .02$ for the pairwise comparisons, all other differences: Bonferroni adjusted $ps > .87$. It seemed that a subjective experience of distance created by the sounds was due solely to the segmentation factor but not to the two factors related to distance (reverberation and novelty). We will discuss this surprising finding below.

Measure 1: category breadth

When events are represented abstractly, people build fewer and broader categories when asked to classify diverse objects into as many categories as they deem appropriate (Liberman et al., 2002). Accordingly, we assumed that participants who listened to the distant sound would build larger and fewer categories of objects than participants who listened to the proximal sound, with the other conditions ranging in between. Participants were presented with a list of 32 products (e.g., noodles, tomatoes, cheese, grapes, and salt). Participants were asked to place the items that belonged together into groups by writing them on the right of the list and circling them. They were instructed to classify every item into nonoverlapping groups.

Results and discussion

The number of categories was used as the dependent variable with fewer categories reflecting more abstract construal. An F test for independent samples (Sound Priming: concrete sound, reverberation, C–F#, nonsegmentation, abstract sound) revealed a main effect, $F(4, 90) = 2.50$, $p = .05$, $\eta_p^2 = .10$. Consistent with our prediction, people used significantly fewer categories to classify the objects when they listened to the abstract sound ($M = 6.63$, $SD = 0.96$) than when they listened to the concrete sound ($M = 7.9$, $SD = 1.52$), with the other conditions ranging in between, $t(90) = 2.73$, $p = .008$ for the $+1, 0, 0, 0, -1$ contrast (see Fig. 1). The finding that participants classified items into fewer and broader categories when hearing a sound that included reverberation, used unusual harmonies, and was presented in a holistic, nonsegmented way, compared to when hearing a sound that did not include reverberation, used familiar harmonies, and was presented in a segmented way is consistent with our hypothesis that distance/abstractness cues in sounds facilitate high-level mental construal.

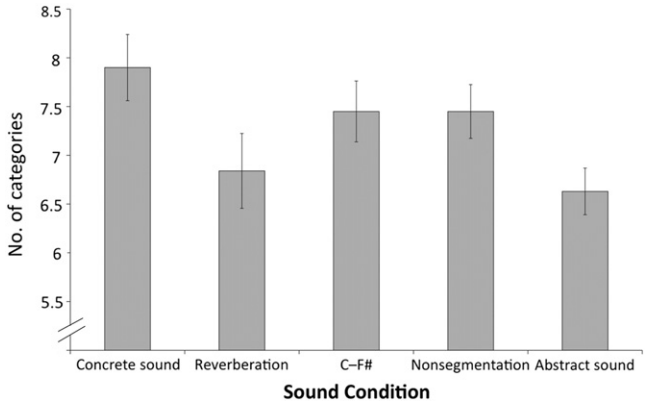


Fig. 1. Mean number of categories as a function of Sound Priming (±1 *SE*).

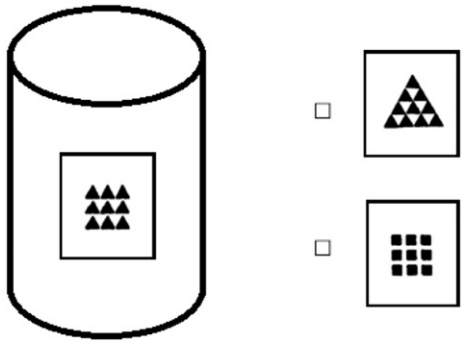


Fig. 2. Sample item of the adapted Kimchi–Palmer figure task.

Measure 2: local versus global processing

As a second measure of level of construal, we administered a perceptual task. When thinking more abstractly (vs. concretely), people focus more on global perceptual shapes instead of local perceptual shapes. To measure local versus global processing, participants received a modified version of the Kimchi–Palmer figure task (Förster, 2011; Gasper & Clore, 2002; Kimchi & Palmer, 1982). In this modified version, the task was introduced to participants as a brand logo matching task. Participants were presented with eight compound geometrical figures (e.g., a square) made of different-shaped smaller geometrical figures (e.g., triangles). These target figures were pictured as a logo on a drawn can to bolster the cover story on brand logos (see Fig. 2). Next to each item, two alternative "logos" were presented, one matching the target figure locally, the other matching the target figure globally. Participants were asked to decide which of the two samples better matched the target figure on the can. To give an example, if participants chose the upper sample in Fig. 2, this would reflect attention to the local details, whereas if they chose the lower sample, this would reflect global attention. The dependent measure for global processing was the number of global choices participants made (cf. Förster, 2011).

Results and discussion

We hypothesized that participants who listened to the abstract sound would choose more global samples than participants who listened to the concrete sound, with the other conditions ranging in between. An F test for independent samples (Sound Priming) revealed a main effect, $F(4, 90) = 2.44$, $p = .052$, $\eta_p^2 = .10$. As expected, participants who listened to the abstract sound ($M = 7.69$, $SD = 1.01$) chose more global figures than participants who listened to the concrete sound ($M = 6.25$, $SD = 1.86$), with the other conditions ranging in

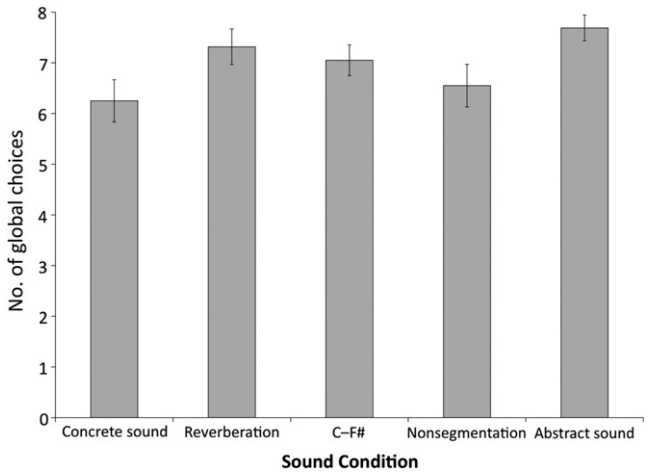


Fig. 3. Mean number of global choices as a function of Sound Priming (±1 *SE*).

between, $t(90) = -2.71$, $p = .008$ for the +1, 0, 0, 0, −1 contrast (see Fig. 3). This finding indicates that sound parameters that are related to distance/abstractness influence global versus local information processing.

Measure 3: weighting of average versus single evaluative information

Research has shown that psychological distance and abstract thinking influence the type of information on which participants base their judgments and decisions. That is, when thinking abstractly, people shift their attention from individualized to average information (Bruchmann & Evans, 2013; Ledgerwood et al., 2010). For instance, abstract representations enhance the relative influence of broad, aggregated product reviews compared to single evaluations of products (Ledgerwood et al., 2010). We tested if our abstract sound—compared to the concrete sound—would cause participants to put increased weight on broad, decontextualized information that is averaged across multiple individuals and instances at the expense of information that is more closely tied to a single experience within a specific context when they evaluated a product.

For this task, participants were randomly assigned to a 5 (Sound Priming: concrete sound, reverberation, C–F#, nonsegmentation, abstract sound) × 2 (Information Type: favored by average information, favored by individualized information) mixed design with the second factor varied within participants. Participants were asked to imagine they needed to buy a toaster and had decided to do so via Amazon.com (cf. Ledgerwood et al., 2010). They were presented with the pictures of two toasters (Toasters A and B). Beneath each toaster participants found an aggregated evaluation and a single review. One of the toasters was favored by the aggregated information: It had an average rating of 4.5 out of 5 stars across 204 customer reviews, although the single review stated that the "toaster does not work very well and is not recommended" (below, we refer to this stimulus as the 4.5-star toaster). The other toaster was favored by individualized information: It had an average rating of only 2.5 of 5 stars across 204 customer reviews, but the single review said the "toaster works as advertised and is a wonderful addition to the kitchen" (below, we refer to this stimulus as the 2.5-star toaster). The order of the pictures and the assignment of the information to the pictures were counter-balanced across all conditions. Next, participants rated how interested, likely, confident, and happy they would be about buying each toaster and how they generally felt about each toaster from 1 (*not at all/very unlikely/very negative*) to 7 (*extremely/very likely/very positive*). Responses of these five items were averaged for each toaster to form evaluation scores for the toaster favored by the aggregated (Cronbach's α = .94) and the toaster favored by the individualized (Cronbach's α = .94) information. Participants also indicated how much they would be willing to pay for each toaster. Finally, they chose which toaster they would buy, assuming they were equally priced.

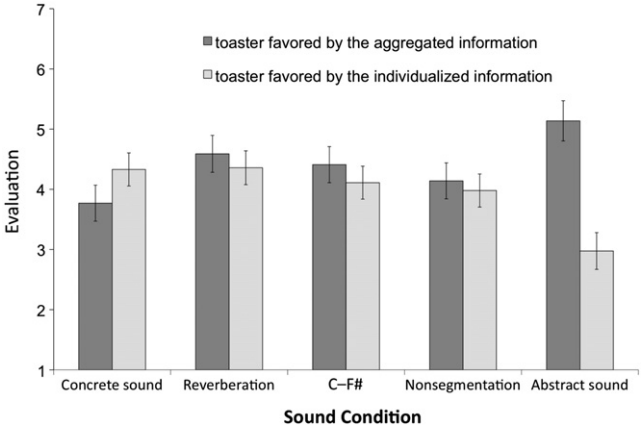


Fig. 4. Mean evaluation of the toasters as a function of sound and type of information (±1 *SE*). The mean evaluation score ranged from 1 to 7; higher values indicate more positive evaluation.

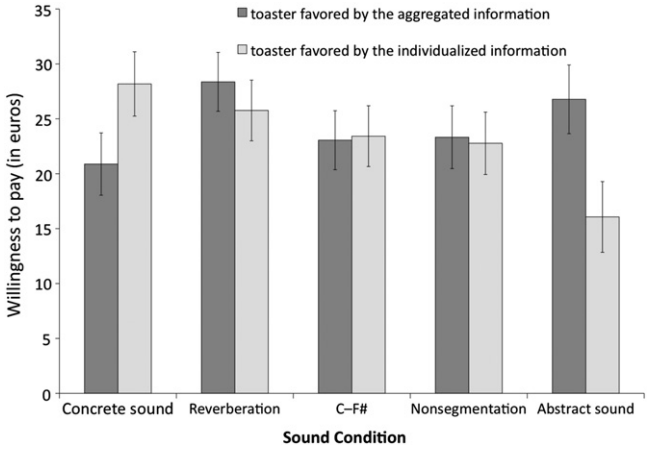


Fig. 5. Mean willingness to pay for the toasters as a function of sound and type of information (±1 *SE*).

Results and discussion

A 5 (Sound Priming) × 2 (Information Type) mixed-design analysis of variance (ANOVA) on the evaluation revealed a main effect of type of information, $F(1, 90) = 3.93$, $p = .05$, $\eta_p^2 = .04$, indicating that participants preferred the toaster with the positive aggregated information over the toaster with the positive individualized information. Importantly, we found the predicted interaction, $F(4, 90) = 3.47$, $p = .01$, $\eta_p^2 = .13$. Participants who listened to the abstract sound strongly favored the toaster with the positive aggregated information (the 4.5-star toaster, $M = 5.14$, $SD = 0.72$) over the toaster with the positive individualized information (the 2.5-star toaster, $M = 2.98$, $SD = 0.79$), $p < .001$. Participants who listened to the concrete sound, in contrast, slightly favored the 2.5-star toaster ($M_{4.5\text{-star}} = 3.77$, $SD = 1.36$; $M_{2.5\text{-star}} = 4.33$, $SD = 1.41$), although the contrast was not significant, $p = .27$. Participants who listened to sounds in which only one distance/abstractness factor was manipulated evaluated both toasters equally, $ps > .55$ (see Fig. 4). To compare the five conditions with each other, we subtracted the evaluation of the 2.5-star toaster from the evaluation of the 4.5-star toaster. The simple comparisons of this difference score revealed that the participants who listened to the abstract sound differed from participants in all other condition, $ps < .02$. The difference between the two toaster evaluations in the other four groups did not differ from each other, $ps > .31$.

A 5 (Sound Priming) × 2 (Information Type) mixed-design ANOVA on the willingness to pay judgments revealed a similar two-way interaction, $F(4, 82) = 2.68$, $p = .04$, $\eta_p^2 = .12$, confirming that the effect of Sound Priming extends to perceived value. Participants who listened to the abstract sound were willing to pay an average of €10.71 more for the toaster favored by the customer aggregated (vs. the single review). In contrast, participants who listened to the concrete sound were willing to pay more (i.e., €7.29) for the toaster favored by the single review (see Fig. 5).

To assess if the Sound Priming increased the likelihood of choosing the toaster that was favored by the aggregated (vs. individualized) information, a chi-square test was conducted. As predicted, participants who listened to the abstract sound (93.8%) were more likely to choose the toaster that was favored by the aggregated information than participants who listened to the concrete sound (40.0%), with participants who listened to sounds in which only one distance/abstractness cue was manipulated ranging in between (52.6%; 55.0%, and 70.0%, respectively), $\chi(4) = 12.47$, $p < .02$.

These findings provide support for the hypothesis that sound features related to distance and abstractness (vs. proximity and concreteness) are capable of affecting attitude judgments and choices. They influenced on which type of information (i.e., aggregated vs. individualized) participants based their judgments.

General discussion

The present experiment demonstrated that sound parameters can affect level of construal. Sounds that included cues to distance (such as reverberation and novel harmonic combinations) and cues to abstraction (such as low segmentation) triggered more abstract construals on three measures, whereas sounds that included relatively more cues to proximity (such as no reverberation and familiar harmonic combinations) and cues to concreteness (such as high segmentation) triggered more concrete construals. Compared to concrete sounds, abstract sounds caused participants to build broader categories, to focus more on global shapes, and to weight aggregated information more strongly than individualized information when evaluating a product.

Interestingly, on two of the three measures, reverberation alone was sufficient to increase construal level: When only reverberation was manipulated (with harmonies and segmentation held constant), participants built fewer (and broader) categories and chose more global figures in the modified Kimchi–Palmer task, compared to participants who listened to a sound without reverberation (i.e., the concrete sound). Although highly speculative, it might be possible that construal level measures which (partly) involve "physical" properties—such as physical space on a sheet of paper in the category breadth task or perception of physical size of figures in the global (vs. local) preference task—are more likely affected by distance cues which refer to spatial distance (i.e., reverberation) compared to measures that do not involve such properties. Additionally, the finding may indicate that reverberation can be regarded as one of the main cues of auditory distance affecting construal level. However, the other two factors (novelty and segmentation) nevertheless added to the manipulation of abstraction, as evident in the third measure and the descriptive differences in the means between the distance and the reverberation condition.

Possible mechanisms

We propose that auditory cues influenced level of construal because they are associated with psychological distance and abstraction. Segmentation is directly related with a low level of construal and may have elicited concrete construal quite directly. Reverberation and novel harmonic modulations may increase a feeling of psychological distance, which in turn may have affected level of construal.

Alternatively, as the effective tempo in the segmentation condition is four times faster than in the nonsegmented condition, it may have increased arousal in our participants. However, arousal does not explain any effect of reverberation and harmonic modulation but only effects of segmentation. Additionally, in spite of the possibility that segmentation increases arousal, the condition in which segmentation was eliminated (i.e. the nonsegmentation condition) did not significantly differ from the concrete sound condition in all measures, which renders an arousal account for our effects less compelling.

Perceived distance of auditory cues

When we asked participants directly about the perceived distance from the sounds (i.e., our manipulation check), surprisingly, segmentation seemed to be the crucial factor instead of reverberation and novelty. How can this inconsistency be explained? Although we have no data in support for this interpretation, as reverberation is a very obvious cue to distance, participants perhaps corrected for this cue when asked to indicate how spatially and temporally distant the sound appeared. Further, novelty is a cue that is more indirectly related to distance. Therefore it may not have influenced distance on a conscious level. However, harmonic modulation still contributed to the change in construal level. Low segmentation, on the other hand, seems to be a subtle distance cue that affects both conscious experience of distance and level of construal. Future research could investigate whether subtle, indirect, and obvious distance cues are effective in changing distance perception as well as construal level.

It may be worthwhile to explore whether other cues to distance, not included in the present study, affect level of construal. Acoustic color (or timbre) is a promising candidate. The human voice, for instance, is a relatively proximal cue that may trigger more concrete construal than, for instance, a didgeridoo sound that is relatively related to distance. Interestingly, even within the human voice, sounds affect construal level: Recent research on speech sound demonstrated that back vowels (such as *oo* in "fool") trigger more abstract construal than front vowels (such as *ee* in "feel"; Maglio, Rabaglia, Feder, Krehm, & Trope, 2014), providing further evidence for the idea that sounds influence thinking. Other musical cues that were not varied in the current study—such as tone pitch, melodic features, the main key of a musical piece, or variations of major versus minor key (which also affect emotions)—could be associated with abstract versus concrete construal, as well. Moreover, it is possible that certain features of music influence more than one aspect of distance and construal. Rhythmic segmentation (such as dividing each measure into four random time intervals), for instance, may affect both novelty and segmentation in parallel.

Construal level theory (Trope & Liberman, 2003, 2010) proposes four dimensions of psychological distance: temporal, spatial, social, and probabilistic distance. In our study, only spatial and probabilistic distance was varied (by reverberation and novelty, respectively). However, temporal distance between different sounds can vary as well. For instance, a symphony of Mozart played by an orchestra may seem more temporally distant than the same symphony played by a cell phone. Likewise, musical preferences of outgroups versus ingroups may cause more or less felt social distance when listening to the particular music. Such temporal and social distance cues in sounds may affect level of construal just as spatial and probabilistic distance cues.

Apart from music, sounds can trigger distance in other contexts, too. Certain sound features in the human voice, for instance, may trigger social distance via construal level. Variations in the voice of a person with respect to rhythmic segmentation or familiarity/novelty of the sounding may affect how abstractly this person is construed. Construal level, in turn, affects social distance. This may have implications for communicative contexts. Could it be, for instance, that people who carry more distance cues in their voice are addressed more politely (Stephan, Liberman, & Trope, 2010)?

Further implications

The present findings have implications for theorizing, research, and applied settings. First, on a theoretical level, the findings suggest that level of construal is a very flexible tool that can be influenced by very subtle cues. Additionally, they show that a simple auditory manipulation can have effects across modalities: It influenced three different aspects of level of construal—category breadth, global (vs. local) preferences, and weighting of aggregated (vs. individualized) information. Interestingly, these three measures did not significantly correlate with each other (see Table 2), which indicates that three different facets of level of construal were measured and influenced by sounds. This finding additionally testifies to the generality of the phenomenon. The fact that the three measures did not correlate with each other additionally calls for more research on the heterogeneity of construal level and the interrelations between its subcomponents.

It would be interesting to see if simple sounds cause differences in other measures than categorization, preference, attitude, and choice that are related to construal, as well. Research has shown, for instance, that psychological distance and abstract construal increase self-control

Table 2
Intercorrelations between the three construal level measures.

Measure	1	2	3
Measure 1			
Category breadth (no. of categories)	–		
Measure 2			
Visual preferences (no. of global choices)	−.14 ($p = .18$)	–	
Measure 3			
Weighting of aggregate versus individual evaluations in attitude judgment, WTP, and choice[a]	−.10 ($p = .36$)	.18 ($p = .08$)	–

Note. WTP = willingness to pay. $N = 95$.
[a] The weighting-of-aggregate-information measure was calculated as follows: The difference of evaluation (4.5-star minus 2.5-star toaster), difference of willingness to pay (4.5-star minus 2.5-star toaster), and choice of toaster favored by the aggregated information were z-standardized each and then averaged.

(Fujita et al., 2006), trigger a focus on causes (vs. consequences) of events (Hansen, Rim, & Fiedler, 2013; Rim, Hansen, & Trope, 2013), and influence the experience of time flow (Hansen & Trope, 2013), truth judgments (Hansen & Wänke, 2010), and attributional processes (Henderson et al., 2006), just to name a few variables. Possibly, more abstract sounds would have comparable effects (compared to more concrete sounds).

Second, with simple sound stimuli, it seems possible to very easily manipulate construal level in future research. This is an advantage because the sound stimuli can be present during a whole experimental session and thus prime distance continuously, which is not possible with a mindset or distance prime that is administered prior to the main tasks. With continuously played sounds, distance and abstract construal could possibly be primed for a longer time, making it possible to test effects of distance and abstraction on dependent variables that take more time. Additionally, priming with sounds eliminates the need for verbal instructions. This is an advantage for studies investigating construal-level effects with populations of participants who cannot understand complex instructions, such as small children or mentally deficient participants.

Third, sound primes are an effective way to alter processing and weighting of information. This opens possibilities for applied settings. For instance, sound cues in advertisements or in shops could cause consumers to focus relatively more on individualized or aggregated product information, depending on the proportion of proximity/concreteness and distance/abstractness cues in the sounds. In health settings, sounds could be used to induce a concrete versus abstract mindset. For instance, there is evidence that construal level causally influences symptoms and processes involved in psychological disorders, such as emotional response, repetitive thought, impulsivity, and procrastination (Watkins, 2011). Distance/abstractness cues in sounds could possibly be used to functionally support therapies of such disorders.

In conclusion, the present study is the first to show that musical sound parameters can affect construal level. Although certainly more research is needed to investigate additional effects of distance/abstractness versus proximity/concreteness cues in sounds, the present findings nicely illustrate that sounds can modify the way people think, with consequences for judgments and decision making.

Appendix A

Definitions of technical terms

Chord Harmonic set of at least two notes that are played simultaneously.
Didgeridoo Traditional Australian wind instrument.
Dominant Fifth degree of a diatonic scale.
Harmony Use of chords that move in progression according to principles that govern both their construction and connection.
Key Scale around which a piece of music revolves. It refers to the tonic note/chord, which is the center of the scale.
Key signature Defines the key and shows the number of sharps (♯) or flats (♭) in its scale.
Major scale Diatonic scale that consists of a series of whole tone steps except for semitone steps between the third and fourth as well as the seventh and eighth degree.
Measure (or *bar*) Segment of time defined by a given number of beats.
Minor scale Diatonic scale that consists of a series of whole tone steps except for semitone steps between the second and third as well as the sixth and seventh degree.
Pre-delay Lengths of time between the direct sound impulse and its earliest reflections.
Reverberation Persistence of a sound after the original sound is produced, caused by multiple reflections of the sound within a particular (closed) space.
Sine tone Tone with a single frequency whose waveform is that of a sine wave.
Tonic Tonal center and first degree of a diatonic scale.

Appendix B. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jesp.2014.05.002.

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