A Psychological Approach to Musical Form: The Habituation–Fluency Theory of Repetition

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With the possible exception of dance and meditation, there appears to be nothing else in common human experience that is comparable to music in its repetitiveness (Kivy 1993; Ockelford 2005; Margulis 2013). Narrative artifacts like movies, novels, cartoon strips, stories, and speeches have much less internal repetition. Even poetry is less repetitive than music. Occasionally, architecture can approach music in repeating some elements, but only sometimes. There appears to be no visual analog to the sort of trance–inducing music that can engage listeners for hours. Although dance and meditation may be more repetitive than music, dance is rarely performed in the absence of music, and meditation tellingly relies on imagining a repeated sound or mantra (Huron 2006: 267).

Repetition can be observed in music from all over the world (Nettl 2005). In much music, a simple "strophic" pattern is evident in which a single phrase or passage is repeated over and over. When sung, it is common for successive repetitions to employ different words, as in the case of strophic verses. However, it is also common to hear the same words used with each repetition.

In the Western art–music tradition, internal patterns of repetition are commonly discussed under the rubric of *form*. Writing in *The Oxford Companion to Music*, Percy Scholes characterized musical form as "a series of strategies designed to find a successful mean between the opposite extremes of unrelieved repetition and unrelieved alteration" (1977: 289). Scholes's characterization notwithstanding, musical form entails much more than simply the pattern of repetition. Discussions of form also commonly specify certain kinds of passages or rhetorical treatments, such as distinguishing expository, developmental, transitional, or closing passages (see, e.g., Brown 1970; Caplin 1998; Dahlhaus 1978; Hepokoski and Darcy 2006; Kielian–Gilbert 1990; Koch 1793; McCredie 1983; Nattiez 1975, 1987; Root 1986; Sisman 1993). In addition, much music involves the concatenation of common patterns, such as *partimenti*, scripts, clichés, or licks (e.g., Gjerdingen 2007; Pressing 1988; Sanguinetti 2012; Sawyer 1998). Forms also frequently involve broad harmonic patterns, especially key– or modulation–related patterns (e.g., Salzer 1952; Schenker 1906; Schoenberg 1954). In the Western art–music tradition, examples of conventional forms include strophic songs,

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binary, rounded binary, and ternary forms, theme–and–variations, canons, chaconnes, passacaglias, fugues, rondos, medleys, overtures, suites, and sonata–allegro form.

In Western music, the concept of form is historically and culturally situated. Although discussions of musical form can be found throughout the history of Western music, the concept rose to prominence in the nineteenth century and has remained a central topic in art–music scholarship. Form is often distinguished from the concept of genre, but the two concepts are intertwined (Greene 1992). For the purposes of this article, we will sidestep the conceptual issues. Although the title of this article includes the word "form," the focus here will be exclusively on patterns of exact or inexact repetition. That is, our sole concern will be with that aspect of musical form that has to do with the structure of repetitions.

In considering musical forms, one might suppose that many repetition structures arise solely due to cultural convention. Theoretically, any arbitrary pattern might become established as a cultural norm that is replicated by successive generations of musicians. At the same time, one wonders if there exist deeper underlying principles. Over the centuries, various music scholars have proposed different theoretical accounts based on philosophical, metaphysical, or other premises. In this paper, we focus on empirically established psychological phenomena that might plausibly influence the patterning of musical repetitions.

Specifically, we will focus on two psychological phenomena that relate directly to repetition. We begin by reviewing research on a venerable topic in psychology—*habituation*. This is followed by a discussion of the phenomenon of *processing fluency* (and two precursor concepts—the *mere exposure effect* and *perceptual fluency*). On the one hand, repetition induces habituation in which familiar stimuli lead to a reduction in responsiveness. On the other hand, processing fluency induces positive feelings toward familiar stimuli. The two processes appear to contradict each other. However, we will see that by attending to the details of both processes, it is possible to organize patterns of repetition so as to maximize processing fluency while circumventing the problems due to habituation. Using the psychological concepts as premises, we will derive a series of repetition strategies that, from a theoretical perspective, successively improve the overall *hedonic effect*. Two studies are then reviewed—one correlational and one experimental—that test two conjectures arising from the theory. We will see that two commonplace patterns of repetition are notably consistent with the theory: a "variation strategy" (in which a passage is repeated with persistent slight modifications), and a "rondo strategy" (in which sequences of repetition grow shorter over the course of the work and new material is introduced sparingly). In short, our study will endeavor to account for at least two "strategies" that Percy Scholes would have regarded as achieving a balance between "unrelieved repetition and unrelieved alteration." Along the way, we will see that the theory also provides a parsimonious account of the trance experience.

1. Habituation

When experiencing the world, it is important not simply to pay attention to certain stimuli, but also to ignore certain stimuli. Brains have limited bandwidth, which precludes attending to everything around us (Cherry 1957). Minds need filters—mental mechanisms that block low–priority stimuli from commanding conscious awareness. When something is novel, it makes sense that an organism should direct its attention towards it. However, most of the sounds encountered in daily life do not warrant much mental effort. One of the most important mental mechanisms organisms have for ignoring stimuli is *habituation*—the brain's version of "been there, done that."

Habituation is regarded as the simplest form of learning. Formally, habituation is defined as a decrease in responsiveness resulting from the repeated presentation of an eliciting stimulus. With successive repetitions of the same sound or sound–pattern, a listener becomes progressively less responsive to the stimulus. In neurological terms, habituation is considered a central process rather than a peripheral process. That is, habituation happens in the brain, not in the ear or the eye. Habituation should not be confused with sensory fatigue or sensory adaptation. It is not that certain neurons in the cochlea, for example, reduce their rate of firing because of repeated stimulation (see, e.g., Worden and Marsh 1963). Habituation is an attentional process; it is the brain simply ignoring particular sensory inputs.

Habituation is commonplace in human listening; however, the most detailed research regarding habituation has been carried out with non–human animals. In animal research, it is common to demonstrate habituation using the *startle response*. Playing a loud tone to a mouse will result in a momentary frozen posture. After a minute or so, repeating the loud tone will again result in a startle response. If the process is continued, the mouse will become progressively less and less responsive until the startle response is extinguished. The animal will go about its business without showing any sensitivity to the tone.

The speed of habituation depends on several factors. One factor is how frequently the stimulus occurs (e.g., Harris 1943). If the stimulus is repeated every 10 seconds, habituation will occur sooner than if the stimulus is repeated once per minute. For example, a mouse might habituate to a tone after only eight presentations—if the tones are presented in relatively quick succession. However, it might take twelve presentations for habituation to arise if the sounds are more widely spaced in time.

Another factor that contributes to habituation is the predictability of the stimulus. By way of illustration, compare the following two scenarios: If a stimulus is presented every 10 seconds, then an animal might habituate after just six presentations. By contrast, the same stimulus might be presented at random times: the tone might still be presented six times over the course of a minute, but they now occur at random moments and so are less predictable. Typically, it will take more presentations before the animal habituates to the sound.

Suppose that an animal habituates to a sound after nine presentations. The animal is then left alone for some period of time—perhaps an hour, or an entire day. After the elapsed time, the experiment is then repeated. Typically, the animal will have regained its responsiveness to the sound. For example, a mouse might again be startled by a loud sound to which it had habituated the previous day. This regaining of responsiveness is referred to as *spontaneous recovery*. Spontaneous recovery might be formally defined as the re–sensitizing of an animal to a previously habituated stimulus due to the passage of time.

It is possible to have many cycles of habituation and spontaneous recovery. However, these recurring cycles leave a mental legacy. Following each spontaneous recovery, researchers observe that it takes fewer repetitions of the stimulus before the onset of habituation (Harris 1943). On Monday, it might take nine sound presentations before a mouse habituates. On Tuesday, it might take only seven sound presentations. On Wednesday, it might take just four presentations. This phenomenon is referred to as the *potentiation of habituation*. In formal terms, *potentiation of habituation* may be defined as the facilitating effect on habituation due to a past history of habituation. In short, habituation becomes easier when we have habituated to something in the past.

Dishabituation: There is another way in which an organism can become re–sensitized apart from spontaneous recovery. Spontaneous recovery arises simply through the passage of time. However, re–sensitization can also occur in response to a novel stimulus (Pavlov 1927). After habituating to a sequence of identical stimuli, the introduction of a single novel stimulus—expressed schematically as A A A A A A A B—will tend to cause the listener to re–orient to the stimulus stream. Moreover, the presence of the novel stimulus may cause a listener to lose his/her habituation to the first stimulus. Consequently, an ensuing return to the initial stimulus will tend to cause the listener to respond as though he/she had not habituated to it. This phenomenon is known as *dishabituation*, and the novel stimulus is referred to as a *dishabituating stimulus*. Formally, dishabituation can be defined as the recovery of responsiveness due to an intervening novel stimulus. It is appropriate to note that a dishabituating stimulus will tend to lose its effectiveness with time. In effect, there is a kind of “habituation of dishabituation.” In practice, this limits the number of times a given stimulus can be used in a dishabituating role (see Lehner 1941 and Thompson 2009).

In summary, there are two processes by which an organism might regain its responsiveness to a stimulus after habituation. The first is spontaneous recovery, which arises simply through the passage of time. The second is dishabituation, which arises due to the introduction of a dishabituating stimulus.

Stimulus Generalization: To this point, our discussion has presumed that a given stimulus is identical on each presentation. In practice, there is room for variation. For example, a mouse might habituate to a loud 1,000 Hz tone with a duration of 0.5 seconds and a 50 millisecond onset envelope. That same mouse might similarly exhibit habituation to a 1,050 Hz tone, whose duration is reduced by half, and whose onset duration has been tripled.

In practice, researchers find that there is a range over which the animal will deem the stimulus to be sufficiently similar that it will respond (or not respond) accordingly (Sharpless and Jasper 1956). Moreover, if a little bit of variety is introduced during the initial training or exposure period, it is especially likely that the animal will treat modified stimuli in the same way. Consequently, rather than regarding a stimulus as a single item, it is more appropriate to view it as a class or range of stimuli that will all evoke similar responses. This phenomenon is referred to as *stimulus generalization*. Formally, stimulus generalization can be defined as the class of stimuli that an animal treats as similar or equivalent.

Resistance: The phenomenon of habituation applies to all types of stimuli. However, research shows that certain types of stimuli are less prone to habituation. In general, high–intensity or high–energy stimuli are more resistant to habituation than low–intensity stimuli (e.g., Harris 1943). Bright lights, intense smells, forceful contact, extreme temperatures, and loud sounds require more exposures to induce habituation than dim lights, dilute smells, light contact, moderate temperatures, and quiet sounds.

Moreover, there exists a class of stimuli to which animals (including humans) do not habituate. The most important of these is *pain*. In fact, pain can sometimes lead to the opposite experience where repeated stimuli produce an increase in the elicited response rather than a decrease. This is referred to as *sensitization*. Sensitization is not common, and when it occurs it is usually short–lived. A novel stimulus might evoke pain, and that makes the animal more sensitive the next time it encounters the stimulus. However, this usually just happens once or twice. Then the response returns to normal. In other words, sensitization is ephemeral. Formally, sensitization can be defined as the (rare and normally short–lived) process by which a repeated stimulus produces an increase in the elicited response rather than a decrease.

Whether or not a person experiences sensitization, the important point is that we do not habituate to pain. For many medical conditions, this failure to habituate represents a grave tragedy. It means that people who suffer from chronic pain have great difficulty adapting to their situation.

Another class of stimuli that resists habituation is *fear*. Although fear is quite resistant to habituation, unlike pain, it is possible to habituate to fear–inducing stimuli. It is not uncommon for people to suffer from various anxiety disorders or pathological fears—such as excessive fear of spiders or open spaces. The typical approach to treating these conditions is "exposure therapy," where a person is exposed to fear–inducing stimuli a little bit at a time (Richard and Lauterbach 2006). Exposure therapy is really just a therapeutic application of habituation. The process typically entails hundreds or thousands of presentations of the fear–inducing stimulus, beginning with the least intense or least salient examples. Because fear resists habituation, the treatment typically takes a long time.

Formally, resistance can be defined as the tendency for certain types of stimuli (notably intense, fear–inducing, or painful stimuli) to resist habituation.

Speed of Habituation: A number of factors are known to influence the speed of habituation. We have already touched on these factors; however, it is appropriate to assemble a single succinct list:

1. *The number of presentations*. With more exposure, the likelihood of habituation increases.
2. *The rate of repetition*. More frequent presentation leads to faster habituation.
3. *The predictability of the repetition*. Habituation is faster when the presentations are predictable.
4. *The stimulus intensity or magnitude*. Habituation is faster for less energetic stimuli.
5. *The animal's history of past cycles of habituation and spontaneous recovery*. If the animal has habituated to a stimulus in the past, then it is likely to habituate more quickly the next time around.

Habituation Summary: By way of summary, there are seven central concepts related to habituation (see Thompson and Spencer 1966). *Habituation* is a simple form of non–associative learning in which an organism shows reduced responsiveness to repeated stimuli. After habituation occurs, simply leaving the organism alone for a period of time will lead to re–sensitization so that a future presentation of the stimulus will result in a full response. This is referred to as *spontaneous recovery*.

Alternatively, an organism can often be re–sensitized to a stimulus by encountering a novel stimulus. The effect of the novel stimulus might be likened to pressing a "reset" button—so that responsiveness is partially or fully restored. This phenomenon is known as *dishabituation*. Any novel stimulus that produces dishabituation is referred to as a *dishabituating stimulus*.

In responding to a stimulus, there is a range over which an animal will treat similar stimuli in an identical manner, i.e., *stimulus generalization*. If an organism has a history of habituating to a stimulus, then subsequent habituation is facilitated (see, e.g., Humphrey 1933; Coombs 1938). That is, an organism will more quickly habituate to a stimulus that it has habituated to in the past. This phenomenon is known as *potentiation* of habituation. Finally, organisms are slower to habituate to some stimuli compared with other stimuli, exhibiting *resistance* to habituation. For example, quiet sounds will produce faster habituation than louder sounds.

It is important to note that these concepts are supported by a large volume of classical research in the behavioral sciences (see Thompson 2009 for a historical review). Moreover, the various phenomena related to habituation have been observed in every species examined, including humans. For example, in their comprehensive review of the phenomenon, Thompson and Spencer offer the following summary: "In reviewing the behavioral habituation literature, it is striking to find virtually complete agreement on the parametric characteristics of the phenomenon in such a wide variety of animals and responses" (1966: 18). In the context of music, these concepts might seem irrelevant, or at best tangential. However, as already noted, music is among the most repetitive stimuli experienced by humans, so one might expect that habituation is never far away when listening to music. As we will see later, these concepts appear to have direct applicability for understanding patterns of repetition in music.

2. Processing Fluency

Apart from the effect of repetition on attention and responsiveness, repetition also has a relationship to enjoyment. To begin with, repetition leads to familiarity, and familiarity influences preferences. In the 1960s, research on the effects of familiarity led to the discovery of something dubbed the *mere exposure effect*—commonly referred to as simply the *exposure effect*.

Exposure Effect: People and animals show a marked preference for familiar stimuli (Zajonc 1968). It is not simply that people prefer familiar foods and smells over unfamiliar foods and smells. We prefer familiar environments, objects, people, and voices. Researchers have manipulated the amount of exposure to different kinds of stimuli, and have shown that they can influence preferences simply by the amount of exposure. This can be done with all kinds of stimuli ranging from nonsense words to geometric shapes—including tone sequences and whole melodies (Wilson 1975, 1979). When we are shown photographs of ourselves, we prefer the mirror images to the actual photo. That is, we prefer the version of ourselves that we regularly see in the mirror (Mita, Dermer, and Knight 1977). A preference for the familiar is not limited to humans: ethologists have shown that all kinds of animals prefer familiar over less familiar stimuli (reviewed by Bornstein 1989).

When told of this research, people commonly find the results obvious. However, many people also expect that if a person continues to be exposed to a stimulus, at some point, the preference declines. As the saying goes, "Familiarity breeds contempt." Indeed, a few studies have observed that frequently repeated stimuli are rated by some participants as less pleasing—even when habituation is avoided. However, this intuitive change of preference disappears under a very revealing circumstance.

An important discovery has been that the exposure effect is evident whether or not a participant is conscious of having perceived something. Participants do not need to be consciously aware of which stimuli they have encountered before in order to show a preference for the most familiar (Kunst–Wilson and Zajonc 1980; van den Bosch, Salimpoor, and Zatorre 2013). In experimental research, two techniques have been used to prevent participants from becoming consciously aware that some stimuli are more familiar than other stimuli. One technique involves subliminal presentation where visual stimuli are presented too quickly to register in consciousness. The second technique involves distracted presentation, where the stimuli are presented while the participant is attending to some other task.

By way of example, Monahan, Murphy, and Zajonc (1997; reported in Berkowitz 2000: 30) exposed viewers to individual Chinese characters for just 5 milliseconds. Participants simply see a brief flash of light and are unable to describe or identify which character was presented. Nevertheless, when asked to select which Chinese characters they prefer, participants show a striking preference for whatever characters they had been exposed to most frequently. They preferred certain Chinese characters without knowing why.

At least sixteen different experiments have been carried out testing the exposure effect using subliminal or unattended presentation of the stimuli. All sixteen experiments show that the exposure effect is independent of conscious perception (see Bornstein 1990 for a review). Moreover, these experiments also show that the exposure effect is *greater* under these conditions than when participants are consciously aware of the stimuli. When participants are aware that some stimuli occur more often than others, some of the participants appear to stifle their inclination to prefer the familiar and instead respond in a manner that suggests they prefer novelty over familiarity (see also Burgess and Sales 1971; Kihlstrom 1987; Bornstein 1990. For a review, see Huron 2006: 132–5). In other words, a preference for novelty occurs only when participants are consciously aware of which stimuli are most common and are able to think about what they are experiencing.

An even more compelling demonstration of the exposure effect is evident when a delay is introduced between the exposure phase and the testing of preferences. In an experiment, a person may be exposed to stimulus *X* much more often than stimulus *Y*. When asked to identify their preferred stimulus, some participants might select the more novel stimulus *Y*. However, when asked to return a few days later, they are likely to have forgotten which stimulus was presented more often. When asked to identify their preferred stimulus, they are more likely to select stimulus *X*—the stimulus to which they had been most exposed. The implication is that, independent of habituation, the preference for novelty is a conscious override of an underlying disposition to prefer the familiar (Bornstein 1990).

One might expect that with continued exposure, at some point, the exposure effect would disappear or reverse itself. However, the experimental research simply does not support this intuition. The exposure effect continues to strengthen with each stimulus presentation. Each additional repetition tends to increase the preference, although the amount of increase gets progressively smaller (Bornstein 1989: 270–71).

So what accounts for the origin of the exposure effect? Why should humans and animals prefer the familiar? Robert Zajonc (1968) proposed the first explanatory account, suggesting that familiar stimuli reduce the need to pay attention, and that this reduces an organism's arousal level. The result is a more relaxed state—which might be experienced as more pleasant (Berkowitz 2000). In effect, familiarity gives us the luxury of paying less attention to the world: familiar stimuli allow us to lower our guard and relax. Subsequent research, explored below, has led to better theoretical explanations.

Perceptual Fluency: Continued research related to the exposure effect has produced some curious anomalies. For example, research has shown that readers judge written stories as more compelling, more interesting, and more enjoyable when the font is easier to read. Similarly, readers also judge written arguments as more logical and convincing when the font is easier to read. Moving the eyes in a familiar pattern causes viewers to prefer the object tracked more than when the eyes are moved in an unfamiliar pattern (Topolinski 2010).

Altogether, this research suggests a more general principle: namely, that people prefer stimuli that are easier to perceive. Notice that familiarity facilitates perception: we are faster and more accurate in processing sounds and images that we have experienced frequently in the past. Consequently, the exposure effect can be absorbed into a broader concept known as *perceptual fluency*. The idea is that familiarity *per se* is not the operative principle. Instead, it is the ease of perception.

This idea is captured in an alternative to Zajonc's theory—the Perceptual Fluency/Attributional Theory proposed by Robert Bornstein and Paul D'Agostino (1994). Bornstein and D'Agostino argued that when we perceive a familiar stimulus, the ease of perception produces a positive hedonic effect that is then attributed to the stimulus itself. In short, the ease of perceptual processing makes us positively disposed toward the stimulus. However, they also note that when a person is aware of the familiarity, this unconscious automatic positive response can be overridden by cognitive attitudes.

Processing Fluency: Fluency effects are not simply restricted to perception. Fictional purported food additives are rated as less harmful when their names are easy to pronounce than when their names are difficult to pronounce (Song and Schwarz 2009). People judge sayings or aphorisms as more truthful when they rhyme than when they do not rhyme (McGlone and Tofighbakhsh 2000). For example, the rhyming aphorism "What sobriety conceals, alcohol reveals" is judged more truthful than its logical synonym "What sobriety conceals, alcohol unmasks." People prefer pictures when preceded by a related word. For example, when primed with the word "father," people tend to prefer a picture of a baby compared with a picture of a bridge. Conversely, when primed with the word "road," people tend to prefer the picture of a bridge compared with the picture of a baby.

Studies such as these suggest that the fluency is not simply perceptual, but more broadly related to mental processing. Accordingly, in recent years, the phrase "perceptual fluency" has tended to be supplanted by the phrase "processing fluency." That is, we prefer, not just easy perceptions, but also easy thoughts. Processing fluency embraces perceptual, motor, and cognitive behaviors.

Unlike perceptual fluency, processing fluency provides an answer as to why people would prefer the picture of a bridge over the picture of a baby when the bridge is preceded by a word like “road.” “Road” facilitates the mental processing of the bridge picture, and the positive hedonic effect arising from easy processing is attributed to the photograph, causing it to be preferred.

The Processing Fluency Theory of Aesthetic Pleasure: In 2004, Rolf Reber, Norbert Schwarz, and Piotr Winkielman published an influential article entitled “Processing Fluency and Aesthetic Pleasure: Is Beauty in the Perceiver’s Processing Experience?” The article presents a theory that is essentially a restatement of the Bornstein and D’Agostino theory published a decade earlier: Easy mental processing leads to positive hedonic feelings which are attributed to the stimulus, but this assessment may be discounted if the perceiver is aware of the processing fluency. The main difference is that Reber et al. replaced Bornstein’s and D’Agostino’s emphasis on *perceptual* fluency with the broader concept of *processing* fluency. In addition, their article provided a laudable introduction that situates the theory within the context of classic philosophical issues in aesthetics.

Finally, Reber’s work scored an important success by giving the theory a name that has attracted attention among arts scholars—*the processing fluency theory of aesthetic pleasure*. The ensuing positive reception to this theory might be regarded as self–referentially consistent with the research itself: Labroo, Lambotte, and Zhang (2009) showed experimentally that simply providing a memorable and simple label for a research finding can enhance the finding’s perceived importance.

The research history notwithstanding, there exists ample evidence for a two–step theory—that ease of mental processing leads to a positive affective state, and that the positive feelings are then misattributed to the stimulus itself. As a consequence, frequently encountered stimuli tend to evoke pleasure and are preferred. As originally noted by Bornstein and D’Agostino (1994), the important caveat is that this unconscious automatic response can be overridden by cognitive attitudes. As Briñol, Petty, and Tormala (2006) have shown, if ease of fluency is consciously interpreted as bad, then easily processed stimuli or thoughts will be less valued.

3. Psychologically Inspired Strategies for Music Repetition

As we have seen, the psychological research points to two very different effects of repetition. On the one hand, repetition leads to processing fluency and so increased liking for the repeated stimulus. On the other hand, the research also suggests that repetition leads to habituation, in which familiar stimuli lead to a reduction in responsiveness. At face value, the research suggests a sort of entanglement in which the two processes inevitably contradict each other. Processing fluency offers an opportunity by which repeated sound patterns might be expected to be experienced positively. Yet habituation appears to take away the positive response by attenuating the overall responsiveness. Repetition is both good and bad.

However, processing fluency and habituation are not simply mirror images of each other. They are quite different mental processes with their own distinctive properties. By paying attention to these properties, we might suppose that it is possible to create patterns of repetition that take advantage of the positive hedonic effects of processing fluency while minimizing habituation.

In light of the foregoing discussions, let us consider a practical problem. Suppose a composer wants to create a musical work that listeners find enjoyable, but requires the least amount of work on the part of the composer. In the following account, we will make two assumptions. First, we will draw heavily on the positive hedonic effect associated with processing fluency. The underlying assumption is that a motivating impetus in musical organization is the pursuit of pleasure. Some readers may understandably be unnerved by this emphasis on the evoking of pleasure. Art has no predefined function, which means that it can be harnessed to serve any number of purposes including no purpose at all. Sometimes art is successful because it educates us, inspires us, challenges us, disturbs us, or even insults us. But if art never offered any element of pleasure, it would cease to play much role in human affairs (Huron 2006: 366). The assumption here is not that pleasure is the ultimate goal of music making, nor that the evoking of pleasure *ought* to be the ultimate goal for music making. Instead, the assumption is that the evoking of pleasure will inevitably be attractive to both listeners and musicians, and that one should not be surprised if much music making succumbs to these allures.

In addition, a second assumption will be made that musicians will be attracted by repetition as a way of amplifying the effects of their musical labors. From a musician's perspective, repetition significantly reduces the amount of effort involved in creating musical works or experiences. Simple repetition can transform one minute of music into (say) four minutes of music. Repetition allows the musician to create long musical works from a modest collection of original musical materials.

How, then, might a musician achieve a maximum hedonic effect with a minimum of compositional effort? In the ensuing discussion, we will consider eight compositional strategies. For each strategy, we will identify its advantages as well as its shortcomings. With each successive strategy, we will attempt to improve the approach, either by amplifying the advantages or minimizing the shortcomings of earlier strategies.

Strategy 1
Approach: For our first strategy, we will compose a short passage. This will represent our entire musical work.

Advantages: The main advantage of this strategy is that very little work is required. Because the music is short, it will be easy to remember and easy to perform.

Disadvantages: The main disadvantage of this strategy is that any pleasure will be short–lived for listeners. Since all of the material is novel, little or no processing fluency will arise.

Strategy 2
Approach: Like strategy 1, strategy 2 will involve composing a short passage. However, we will then repeat this segment over and over.

Advantages: Once again, the main advantage of this strategy is that little work is required. Because the amount of original material is small, the music will be easy to remember and easy to perform. An additional advantage is that the music will now benefit from processing fluency. In fact, with increasing repetition, processing fluency will be maximized. (Let us refer to this as the "trance strategy.")

Disadvantages: Unfortunately, after some number of repetitions, listeners will habituate: responsiveness will decline, and, for many listeners, pleasure will also decline. (See later discussion.)

Strategy 3
Approach: Like strategy 2, strategy 3 entails repetition of a short composed passage. However, with the advent of habituation, we will stop the music. We will then wait in silence for spontaneous recovery to occur. Then we will start the music again—pausing again with the advent of habituation.

Advantages: Little work is required, and the music is easy to remember and perform. The strategy benefits from processing fluency, and minimizes habituation.

Disadvantages: Unfortunately, the music will be interrupted by long periods of silence. Spontaneous recovery might take several minutes, hours, or even days. Consequently, the strategy is not practical.

Strategy 4
Approach: Once again, the composer creates a short passage, which is repeated a relatively large number of times. However, with each repetition, the composer makes slight modifications to the passage. (Let us call this the "variation strategy.")

Advantages: Somewhat more work is required, but much less than if the music were through–composed. The music is somewhat more difficult to remember and perform. The advantages for the listener depend on the extent of the variation. If the modifications are not too extreme, the repeated presentations will still benefit from processing fluency (although less so than for exact repetition). If the modifications are enough to escape "stimulus generalization," then the likelihood of habituation is reduced. In short, this variation strategy has the potential to create rather long works that benefit from processing fluency while circumventing habituation. Ostensibly, the strategy provides a potentially very good compositional approach for evoking high pleasure with minimal effort.

Disadvantages: The principal disadvantage is that more work is required to concoct the different variations.

Strategy 5
Approach: In this strategy, the composer creates *two* brief passages. The passages are composed so that they are sufficiently contrasting that they can act as dishabituating stimuli for each other. Repeat the first passage until habituation begins, then introduce the second passage as a dishabituating stimulus. Repeat the second stimulus until habituation begins, then switch back to the first stimulus. Repeat.

Advantages: Since two passages are needed, this strategy requires double the amount of work compared with strategies 1, 2, and 3. However, this strategy requires considerably less work than the variation strategy. The music is relatively easy to remember and relatively easy to perform. For the listener, the pleasure is much longer than for strategies 1, 2, and 3.

Disadvantages: Ultimately, habituation will set in. With each return to the previous passage, due to the history of past habituation and dishabituation, *potentiation of habituation* will occur.

Strategy 6
Approach: This approach is the same as for strategy 5 with one difference. With each successive sequence of repeats, the number of repetitions is reduced in order to offset the possibility of potentiation of habituation. For example, the two patterns might begin with four repetitions each: A A A A B B B B A A A B B B A A B B A B.

Advantages: Once again, the composer need only create two relatively brief passages. The music will be relatively easy to remember and perform. For the listener, the pleasure evoked can be very long compared with the other strategies.

Disadvantages: Although habituation is significantly delayed, after a while, the material will be "exhausted" and habituation will be unavoidable.

Strategy 7
Approach: This approach involves a further refinement. Suppose you have heard four instances of "A" followed by a single instance of "B." Which passage ("A" or "B") should follow next? That is, which of the two passages will generate the highest processing fluency? Since the listener is more familiar with passage "A" than passage "B," the greatest processing fluency will be associated with passage "A." In other words, processing fluency is maximized by returning to a single passage and using the other passage principally as a dishabituating stimulus. Consequently, the revised strategy would lead to patterns such as: A A A A B A A A B A A B A.

Advantages: Once again, little work is required. The composer need only create two relatively brief passages. The music will be relatively easy to remember and perform. For the listener, the pleasure due to processing fluency will be greater than for strategy 6.

Disadvantages: Compared with strategy 6, the approach results in slightly shorter music for the given set of musical materials.

Strategy 8
Approach: Our final approach adds a further refinement. When the musical material is finally about to succumb to habituation, this is the time to introduce yet another novel (dishabituating) stimulus. For example: A A A A B A A A B A A B A C A A B A. Let us refer to this approach as the "rondo strategy."

Advantages: The strategy offers the same advantages as strategy 7 with the additional benefit of extending the length of the musical work with a minimum of additional compositional effort.

Disadvantages: Compared with the other strategies, there are no readily identifiable disadvantages.

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Starting with the twin phenomena of habituation and processing fluency, we have seen that these phenomena lead logically to three repetition strategies that appear well–suited to optimizing the amount of listener pleasure with a minimum of effort. One strategy we have referred to as the "trance strategy." Inspired by their similarity to common forms in Western music, we have referred to the other two strategies as the "variation strategy" and the "rondo strategy."

The variation strategy hinges on the phenomenon of *stimulus generalization*—subverting habituation by making minor changes to repeated material while using similarity to tap into the positive feelings evoked by processing fluency. The rondo strategy hinges on the phenomenon of *dishabituation*—subverting habituation by introducing novel materials at crucial points, and shortening later repetition cycles to offset the potentiation of habituation.

Trance: The "trance strategy" produces a considerably different effect. Habituation by itself does not negate the pleasure arising from processing fluency. Recall that habituation is an *attentional* mechanism that exists in order to filter out low–information stimuli. The whole point of habituation is to free the mind from having to attend to redundant stimuli. When an environment ceases to be informative, the principal source of attention and stimulation switches to one's own thoughts; in the face of highly repetitive sounds, the listener necessarily turns his/her attention inward. The ensuing experience therefore depends critically on the individual's internal state including his/her cognitive interpretation of the experience.

If a listener's physiological arousal is already relatively low, then extreme habituation is apt to lower the arousal further. This can provoke nature's most common response to a sustained changeless environment—sleep. Alternatively, the listener may experience one of several relaxed unfocussed states commonly described as *reverie, dreamy*, or *hypnotic*. Conversely, if the listener's physiological arousal is high, extreme habituation might lead to *trance, hypnotic stupor*, or *daze*.

Once again, in the relative absence of external stimulation, the listener's internal state and interpretation are crucial. Studies of music–induced trance emphasize the importance of cultural context and cognitive interpretation in defining the experience (e.g., Becker 2004; Herbert 2011a, 2011b; Jankowsky 2007; Rouget 1985). If a person remains awake, the lack of novel stimulation might produce strong feelings of boredom, annoyance, or frustration. However, in the case of reverie or trance, habituation is not the enemy but the enabling key. Processing fluency is given free reign, even as the listener is released from attending to the (uninformative) external world. Depending on the listening context (including cultural scripts, personal attitudes, and physiological arousal), the extreme processing fluency may lead to a state of substantial pleasure, ranging from mild bliss to rapture or euphoria.

Cross–Cultural Patterns of Repetition: In an informal cross–cultural survey of musical forms, we found a significant proportion of musical works that simply repeat a single passage over and over—from beginning to end. These forms appear to be especially commonplace in cultures associated with low or subsistence economic development, such as Australian Aboriginal music and the musics of Native American origins.

Two types of verbatim repeated forms might be distinguished: those works that repeat the identical passage each time (what we are calling a "trance strategy"), and those (sung) works in which new lyrics are employed with each (or most) repetition(s). We might refer to the latter as a "strophic strategy." European folksongs and psalm–singing provide ready examples of strophic forms in which several verses are sung to a repeated melody. To be sure, there are intermediate examples between strophic and trance forms. For example, the playground song *99 Bottles of Beer on the Wall* entails only a minor change of lyrics with each iteration.

In the case of strophic songs, if the lyrics represent the principle point of interest—and therefore the principle focus of a listener's attention—then the mental effect will be similar to a variation strategy. However, if a listener does not understand the language of the lyrics, or pays little attention to the lyrics, then habituation is apt to ensue quickly. A long, sung, strophic ballad may tend to evoke a trance experience.

Although the strophic strategy is common in Western music, the trance strategy is much less common compared with some other cultures. The variation strategy and rondo strategy appear to be much more commonplace in Western culture. What about the use of the variation and rondo strategies in other cultures? Musical practices exhibit considerable variability between cultures. A priori, there would be little reason to expect similar patterns of repetition in musics from different cultures. However, the psychological principles described here are believed by researchers to be ubiquitous. The research on habituation and processing fluency spans all sensory modalities (vision, olfaction, audition, etc.), and entails a wide variety of stimuli (Bornstein 1989, 1990; Thompson 2009). Most especially, the research also embraces multiple species. As noted earlier, the phenomenon of habituation has been documented in a wide range of species, including humans and single–celled protozoans. If the claims of psychologists hold any merit, and if these phenomena commonly influence musical organization, then we might well expect to see evidence of similar strategies in other musical cultures.

To this end, Ollen and Huron (2003) carried out a formal empirical study of musical organization in a broad sample of music from around the world. Our aim was to test a specific prediction arising from habituation theory. It is common for music to exhibit large amounts of repetition. Moreover, it is common for repeated musical passages to alternate. Do we see any evidence of the phenomenon of the potentiation of habituation? That is, when a passage is repeated, do cycles of repetition tend to get shorter as the musical work unfolds? Expressed as a hypothesis, we might predict that there will be a cross–cultural tendency for "early repetition." The pertinent work was reported in Ollen and Huron (2003). Here I will simply summarize that work.

In Ollen and Huron (2003) we assembled a cross–cultural sample of fifty recorded works including Calypso music, Inuit throat singing, Japanese New Age, Estonian bagpipe, Punjabi pop, Chinese guqin, Navaho war dances, Ghanaian drumming, Spanish Flamenco, Australian didjeridu, Hawai'ian slack key, Kalimantan ritual music, North African Berber music; Macedonian, Tuvan, Turkish, Ugandan, Gypsy (Romani), Malagsy musics; as well as a selection of overtly Western genres, including a Baroque flute sonata, Haydn string quartet, Sousa march, Ginastera piano music, Miles Davis jazz, Romanian foxtrot, British war song, American Bluegrass, Cajun music, Norwegian polka, easy listening, plus twenty similarly diverse culture sources. Recorded materials were selected from a used CD retail shop that offered an extensive collection of international and world musics. The sample of music explicitly excluded vocal works whose repetition structures can be strongly influenced by the narrative or poetic demands of the lyrics. In addition, we sampled only those works that exhibited repetitive structures with identifiable units of repetition. Exclusively improvisatory and through–composed works were omitted from consideration.

We analyzed the repetition structure for each work following a standardized protocol. Musical segments were assigned letter names, beginning with the letter A. Variations of a unit were indicated by appending a number. Hence, an analyzed structure of A A B A A1 C would correspond with a work whose opening segment was played twice in succession, followed by some novel material, a return of the opening segment, followed by a varied repetition, concluding with yet another novel passage.

In the first instance, we observed a marked tendency to repeat passages: on average, we found that 94 percent of all musical passages longer than a few seconds in duration are repeated at some point in a recorded "work." Moreover, we found a strong tendency for repetitions to be clustered together. For example, if a recorded work contains just two main musical ideas ("A" and "B"), they are more likely to be arranged in a pattern like A A A B B B or A A B B B A than the pattern A B A B A B. Compared with a random ordering of segments, real music exhibits a tendency to have "clumps" of repetition. Pertinent to our hypothesis, we found a significant tendency to repeat more in the first half of recordings than in the second half of the recordings—consistent with a cross–cultural preference for early repetition. That is, structures like A B B B B C C B and A A A B C are more common than the reverse structures (A B B A A A A C and A B C C C).

Incidentally, the 94 percent figure cited above probably underestimates the amount of repetition in our musical sample. "Repetition" need not be verbatim in order to convey useful predictive patterns. For example, the meter for many works is constant throughout the work. Even if a work were constructed using pitch sequences without any repetition, the stable meter would still help listeners predict some elements of the music. Another source of predictive patterning can be harmony. It is possible to construct a twelve–bar blues work without any verbatim melodic repetition. However, the underlying harmonic pattern will still provide an element of predictability that can be coded in memory. Similarly, stable instrumentation can become a predictable element, since most musical works exhibit comparatively few changes of instrumentation.

Although Ollen and Huron (2003) showed a tendency for early repetition, this still leaves unanswered the question of whether listeners *prefer* music that exhibits early repetition. In a subsequent study (Ollen and Huron 2004) we carried out a pertinent perceptual experiment. The study made use of a series of 110 brief atonal piano textures that were specially composed for the study. The passages ranged in durations from 0.3 to 11.8 seconds. Using these passages, we constructed short "modernist–sounding" compositions by randomly assembling a pallet of two or three segments. Using the randomly selected materials, a composition was created following one of forty–four pre–existing forms (e.g., A A A B A A B A). For each created composition, a reverse symmetrical form was created (e.g., A B A A B A A A). Forty–four compositions were created using this process, twenty–two employing a pallet of two randomly selected segments ("A" and "B"), and twenty–two employing a pallet of three randomly selected segments ("A," "B," and "C"). For each pair of stimuli, we used the same musical material.

Having constructed our stimuli, twenty–nine listeners heard pairs of symmetrical forms and were asked to choose which of the pair they preferred. The order of the symmetrical forms was randomized for each participant. In addition, each participant heard entirely novel compositions constructed from different atonal passages. The results of the experiment showed a statistically significant perceptual preference for forms exhibiting early repetition. That is, a form like A A A B A was preferred to its mirror image: A B A A A.

Notice that the preference for early repetition we observed in our listeners may be an artifact of Western enculturation. That is, listeners familiar with Western music might simply be responding according to established patterns characteristic of Western music. Regrettably, no similar data has been collected for non–Western listeners, so we cannot claim that a preference for early repetition applies to people from other cultures. This caveat notwithstanding, the experiment minimally suggests that early repetition is musically preferred—at least among one group of Western–enculturated listeners.

Energetic Music: Recall from our discussion of habituation that intense or energetic stimuli are more resistant to habituation. There are good reasons why organisms might attend to especially energetic stimuli. Consequently, energetic sounds can offset the loss of attention associated with habituation. The principal acoustical property associated with stimulus energy or intensity is loudness—although timbre, tempo, and other factors also contribute to the experience of intensity or energy. Accordingly, increasing dynamic levels can help to forestall habituation, whereas decreasing dynamic levels accelerate habituation.

Especially for works that involve lots of repetition, organizing the work as an extended crescendo may prove useful. Maurice Ravel's *Bolero* and Led Zeppelin's *Stairway to Heaven* offer illustrative examples. Similar gains can arise through increasing tempo, and/or increased textural density or activity.

4. Units of Repetition

In the discussion to this point, no consideration has been given to the duration of the units of repetition. In our examples of different compositional strategies, we posited passages of indeterminate but "brief" duration. However, the same logic applies to both longer and shorter passages. As we have seen, habituation arises more quickly when stimulus repetition occurs in rapid succession. On the other hand, the longer the time delay between repetitions, the longer a listener goes without the hedonic benefit of processing fluency. So should the units of repetition be short or long? Is there some optimum length or duration for a repeated passage? Unfortunately, neither habituation theory nor processing fluency theory provides guidelines for estimating a potential optimum unit length. It may be that there is no optimum; moreover, if an optimum exists, it may prove to span a rather wide range.

In the absence of any theoretical guidelines, we might simply turn to consider musical practice. In Ollen and Huron (2003) we analyzed musical repetitions in our world–music corpus using two different definitions of a unit or segment. One definition of a repeated unit was rather strict or narrow. We also analyzed the music using a less strict or broad criterion. In the case of the strict criterion, the average unit of repetition was 5 seconds in duration. In the case of the broad criterion, the average unit of repetition was 23 seconds in duration. Using the broad criterion, complete works spanned an average of eight sections or units. That is, there was an average of eight large sections over the entire span of the work. However, these averages mask a remarkably wide range of units of repetition. In our world–music sample, the shortest observed unit of repetition was at the level of individual beats (i.e., less than a second), whereas the longest unit of repetition was over three minutes in length (194 seconds). As music scholars have long known, units of repetition in music commonly exhibit a nested or hierarchical structure (e.g., Lerdahl and Jackendoff 1983). It may be that such hierarchies allow multiple concurrent levels of repetition, and that each level facilitates processing fluency. Indeed, it may be that processing fluency is the principal reason why nested hierarchies are favored in musical organization.

Apart from the duration of repeated units, musical organization also appears to exhibit a wide range in the degree of precision of repetition—whether the repetition is truly exact, or very loosely similar. These two forms of variability are schematically illustrated in Figure 1. The horizontal axis represents the duration of the repeated segment; the vertical axis represents the perceived segment variability. Segment variability is a subjective sense of the similarity of nominally repeated units: it ranges from exact "verbatim" repetition to successive statements of units that bear no resemblance to one another. In musical terms, we might dub the latter "through–composed" arrangements in which the music is constantly changing.

In the lower–left corner is the *metronome*: each metronome click is identical, and the rate of repetition is typically fast, usually on the order of a second or less. Towards the lower–right corner is the *encore*, where an entire musical work is simply played again. Here the unit of repetition can be very long—the duration of an entire work. Like the metronome, the encore represents a verbatim (or nearly exact) repetition.

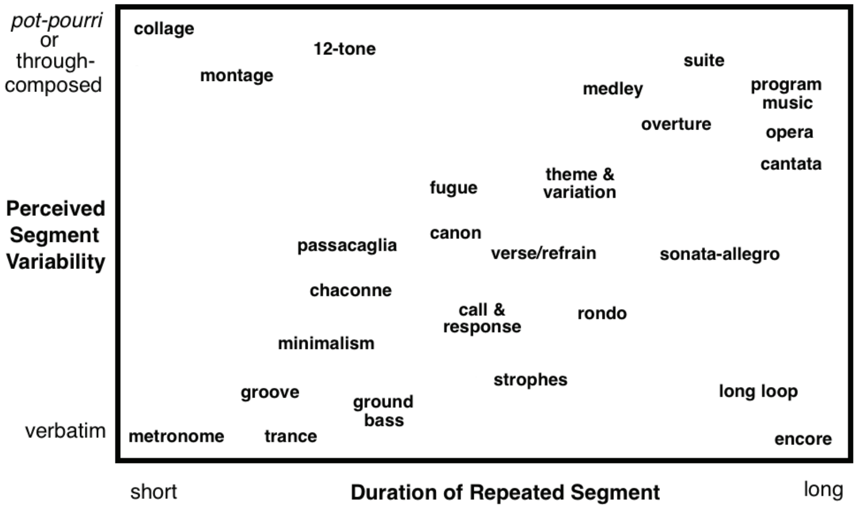

Figure 1: Schematic illustration plotting various common musical forms with respect to two factors: the typical length or duration of repeated segments (horizontal axis), and the perceived variety between segments (vertical axis). For example, the clicks of a *metronome* are perceptually identical ("verbatim" repetition) and employ a short period of repetition (each beat), whereas the *encore* involves verbatim repetition of a whole (comparatively long) musical work. N.B. Plotted items are only impressionistic.

The upper–right region of the figure represents music that is mostly through–composed with very little repetition; when repetition occurs, it tends to involve longer units of time. *Program music* is plotted near the corner. Here, the organizing narrative tends to result in a through–composed work; the narrative itself often tends to limit the amount of repetition. Finishing our tour around the periphery of the figure, we find the *collage* in the upper–left corner. Popular in the early years of electroacoustic music, the collage involves brief recorded snippets that are edited together in a sort of *pot–pourri* of sounds. Typically, the edited snippets are very short, and often, sounds are not repeated.

Moving horizontally along the bottom of the figure, we move from the metronome toward the *ground bass*. By "ground bass," we refer here only to the repeated bass line. The repetitions are typically verbatim, but the period of repetition is somewhat longer than the metronome. *Trance* patterns are commonly shorter in duration than ground bass lines.

In its simplest form, the strophic song (*strophe*) consists of a series of repeated verses—placing it roughly midway between the metronome and the encore. Where the unit of repetition for an encore might be many minutes, and the unit of repetition for a metronome less than a second, the strophic verse might range between 10 and 30 seconds in duration.

When the words change with each verse, there is some degree of perceived variability in the repeated units—which explains why the *strophe* is plotted slightly above the horizontal axis. If a song employs a two–part alternating *verse/refrain* structure, then the variety is effectively doubled, although the unit of repetition remains roughly the same duration. The *call and response* genre involves units that are slightly shorter than strophic songs but is likely to exhibit an intermediate variety between the *strophe* and the *verse/refrain*. *Theme and variations* (alternatively, "head and improvisations") continue the movement toward longer duration segments with increased variety. By comparison, the *rondo* (such as exemplified by the Dvořák *Slavonic Dances*) perhaps employs slightly longer units of repetition with less variety.

An *overture* typically presents several different melodies in succession. The melodies are comparatively long, but they tend to be presented once or with few repetitions over the course of the work. Compared with the *overture*, the melodies in a *medley* are usually assembled from more disparate sources and so are usually more varied or contrasting. An example would be Enescu's *Romanian Rhapsodies,* in which various melodies follow each other in relatively rapid succession. In comparison to a *medley*, the dance movements in a Baroque *suite* are normally more contrasting. Repetition may occur within the movements forming the suite, but the movements are commonly sequenced to form a sort of through–composed mini concert.

Near the *ground bass* we find *groove, trance, minimalism*, the *chaconne* and the *passacaglia*. As noted, *trance* patterns are commonly shorter in duration than *ground bass* lines. *Groove* patterns are similarly short, although they tend to exhibit greater variety than trance patterns or the ground bass. In the case of *minimalist* music, the units of repetition are relatively short—on the order of a few measures—while the degree of variability tends to be minimal. The *chaconne* arguably tends to involve a shorter period of repetition compared with the *passacaglia*.

Returning to the upper–right region, most *12–tone* music exhibits little repetition, and when repetition occurs the units tend to be short. Where the *collage* tends to involve disjointed materials spliced together, the *montage* endeavors to tell a sort of sonic story (the electroacoustic parallel of program music). Consequently, the segments tend to be longer with a greater probability of repetition than is found in musical collage. Other plotted points include the *long loop*—such as the one–hour music tape played in perpetuity at a clothing shop. Here the unit of repetition is a loop containing several individual works.

It is important to recognize that the positions of the materials plotted in Figure 1 are entirely impressionistic; they are not plotted on the basis of any measurements. To the extent that the Figure 1 captures our intuitions about musical organization, it illustrates the wide range of timescales for music–related repetition, as well as the high degree of variability in the precision of repetition. In short, musical practice does not appear to favor a specific frequency of repetition, nor does it appear to favor a specific degree of precision. This great variety is consistent with what is known about both habituation and processing fluency. Both habituation and processing fluency are known to occur over many timescales, from seconds to days.

5. Conclusion

This paper has presented what might be dubbed the *Habituation–Fluency Theory* of musical repetition. We have described two key psychological phenomena where repetition figures prominently: habituation and processing fluency. Repetition leads to processing fluency, which in turn tends to evoke a positive hedonic feeling in listeners. However, repetition also leads to habituation in which familiar stimuli lead to a reduction in responsiveness. Beginning with these two phenomena, we derived a series of compositional strategies. Three strategies are of particular interest: the *trance* strategy, the *variation* strategy, and the *rondo* strategy.

The *trance* strategy involves high levels of repetition that fully exploit the pleasure–inducing potential of processing fluency. However, high repetition induces habituation, which reduces attentiveness to external stimuli. The habituated listener tends to ignore the external world, and so tends to turn inward and focus on his/her own internal state instead. Accordingly, the resulting experience is critically dependent on listener disposition including cultural context (Becker 2004; Herbert 2011a; Rouget 1985). When listening to highly repetitive music, listeners may experience anything from acute boredom or annoyance to bliss or euphoria.

The *variation* strategy involves a passage that is repeated with persistent slight modifications. According to the theory, the variation strategy hinges on the phenomenon of stimulus generalization. That is, sufficient changes are made to circumvent habituation while simultaneously ensuring sufficient similarity to evoke processing fluency.

The *rondo* strategy involves sequences of repetition that grow shorter over the course of the work, with new material introduced sparingly. According to the theory, the rondo strategy hinges on the phenomenon of dishabituating stimuli. That is, new material is introduced at critical moments in order to forestall habituation, with the result that familiar material can be reused—with the attendant benefit of processing fluency. Note that composite musical forms can be created by mixing the variation and rondo strategies.

Notice that in comparison to the trance strategy, the variation and rondo strategies are likely to produce more *reliable* psychological effects. Due to habituation, the effect of the trance strategy is strongly dependent on the cognitive state of the listener. By circumventing habituation, the variation and rondo strategies are less reliant on listener disposition in order to achieve their effects.

A characteristic feature of the rondo strategy is the reduction in the number of successive repetitions as a work progresses (a feature dubbed "early repetition"). An analytical study produced results consistent with the presence of early repetition in a heterogeneous cross–cultural sample of musics. Evidently, early repetition is not limited to Western music making. Moreover, a controlled perceptual study produced results consistent with a preference for early repetition compared with late repetition—at least among a group of Western–enculturated listeners.

In considering the unit of repetition for music, we saw that the theory offers no guidelines for identifying an optimum duration. Actual musical practice suggests a wide range of durations for the units of repetition. Moreover, we saw cross–cultural evidence of nested or hierarchical repetition, which is consistent with the notion that processing fluency can act at many temporal levels concurrently.

The habituation–fluency theory relies on the positive hedonic effect associated with processing fluency. It bears emphasizing that our assumption is *not* that pleasure is the ultimate goal of music making, nor that the evoking of pleasure *ought* to be a goal for music making. Instead, the assumption is that the evoking of pleasure will inevitably be attractive to both listeners and musicians, and that one should not be surprised if much music making succumbs to these allures. Nor should it be assumed that the positive feelings evoked by processing fluency represent the only source of music–related pleasure (Huron 2005, 2010).

Finally, it must be noted that the discussion offered here is not intended to provide an exhaustive account of patterns of repetition in music, let alone of musical form in general. In the first instance, the subject of musical form entails much more than simply patterns of repetitions. Secondly, we may expect that other psychological phenomena might ultimately contribute further insights regarding repetition in music. For example, no effort was made to address the experiences of performers or performer–listeners. That is, the theory presented here focuses exclusively on the experiences of music listeners. In the broad sweep of human history, music listening as a passive activity isolated from participatory music making is historically recent and culturally narrow (see, e.g., Merriam 1964). In many existing cultures, especially those associated with developing economies, no distinction is made between musician, dancer, and listener. Consequently, focusing on the listening experience to the exclusion of the motor–behavior experience is necessarily limited. In defense of the restricted focus pursued here, much more is known about the psychology of listening to repeated acoustic stimuli than is currently known about the psychology of repetitive motor action, especially the social psychology of repetitive action in groups. In particular, there is little research dealing with the hedonics of movement—what motor actions and contexts typically induce pleasure in people who move. There may be important hedonic principles associated with repetitive motor action in social contexts that may potentially also shape music making. However, more basic research is needed in order to address the kinds of affordances pleasurable movement might contribute to the repetitive organization of music.[1]

Notes

1. In the past, it has been common to misconstrue empirically oriented research as establishing verified truths about the world. It bears emphasizing that there is no empirical proof, either regarding observations, purported facts, or nominally explanatory theories. All claims are open to challenge and reinterpretation. Nothing has been "established" in this paper; instead, various (challengeable) observations have been made that are consistent with other (challengeable) observations in the field of psychology. The key phrase here is "consistent with." Accordingly, the main message of this study might be summarized as follows: patterns of repetition that appear to be common in music are consistent with proposed theoretical strategies based on patterns that appear to exist in research reported under the rubrics "habituation" and "processing fluency."

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