

## Automated 'Wow' Generation In Musical Composition

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### 1. Abstract

The paper reports research to identify and then reverse engineer what evokes a 'wow' emotional response in listeners of musical compositions. The results of this analysis have then been compared to a systematic innovation methodology built on the analysis of close to three million innovations observed from a wide spectrum of human endeavour in order to identify similarities and differences. The result of this analysis is the fact that all of the examined musical 'wows' could be seen to fit precisely into a very small number of established patterns of inventive thinking. A final section of the paper discusses the possibility that these inventive patterns can be built into software-based composition tools in such a way that new 'wow' moments can be generated in an at least partially automated fashion.

### 2. Introduction

In 2002, the authors published an article on the subject of Design For Wow [1]. In that article we made the hypothesis that 'wow' design solutions across all forms of human endeavour came about when a conflict of some kind was resolved in the eyes of the person experiencing the 'wow'. The article featured a number of 'wow'-like design solutions from a variety of different areas. A subsequent article [2] extended this analysis to encompass certain musical compositions that were known to consistently evoke a positive 'wow' response in listeners.

The aim of this paper is first and foremost to explore the 'wow' phenomenon in its musical context to see if there are any general rules and patterns that might eventually come to explain what 'wow' means. A secondary aim of the article is to explore the possibility that, should rules and patterns exist, it might be possible to systematically compose 'wow' moments into current and future musical compositions.

We begin our journey by describing the methods used to determine and uncover the musical 'wows' that will form the spine of our argument

### 3. Method

In many ways what makes a listener elicit a 'wow' reaction is very subjective. What makes a person experience a wow one day might leave them cold on another. There is, in other words, an issue of emotional context to contend with. In the first instance, then, we have tried to isolate such issues by including inputs from a wide variety of sources; partly through scanning the extensive music literature, and predominantly through access to large numbers of staff and students at an upper school in the UK. In all, over 90 people have contributed to the study, via a series of music lessons that spanned several hours of curriculum time. Participants were asked two basic questions:

1. identify pieces of music or musical moments that more often than not create an emotional wow for you
2. identify what it is about that piece or moment that caused the 'wow' moment to occur

Once thoughts and ideas were collated, they were discussed in groups within the class. The aim during these discussions was to obtain some form of agreement over which pieces of music did or did not constitute a general 'wow' classification, and then to agree the musical basis for that wow. Our starting assumption for the second part of this discussion was that 'wows' occur when something happens that the listener was not expecting to happen. Hence, for each candidate musical 'wow' the groups contrasted what they *expected* to happen against what the composer *actually did*. We can see the results of this comparison later in our results Table. It is worth mentioning from the outset though that very early on in the analysis we could see that our starting assumption was a valid one. In fact during the process of reducing the total set of inputs down to the ones included here, we did not eliminate any example where there was no discrepancy between what did happen and what was supposed to happen.

We take some encouragement from this finding since it demonstrates strong consistency with both the Contradictions part of the Systematic Innovation Methodology [3], and with the central phenomena of what makes humour work. In this latter regard, a different earlier article [4] has discussed the underlying basis of jokes; that the joke teller sends the listener in one direction, while the punch-line lies in a different

direction. People 'get' a joke when they suddenly bridge this gap between where they are and where they were supposed to be – Figure 1. In other words, humour happens when our mind resolves this what-I-expected-to-happen versus what-actually-happened conflict. There is probably no better way of killing humour in a joke than by trying to analyse it. Likewise, there is a danger here that analysing a piece of music might turn out to be a wonderful way of spoiling our future enjoyment of it. We tried to pay particular attention to make sure we didn't fall into this trap, especially during the latter analytical phase of the study.

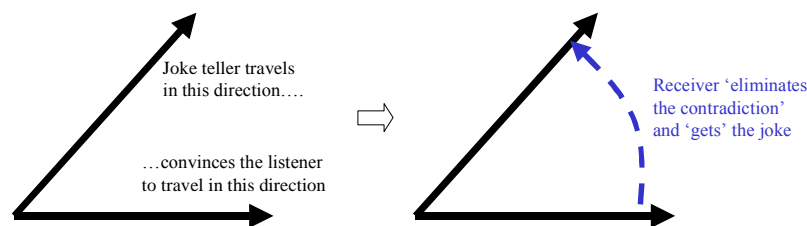


Figure 1. Conflict Elimination As The Basis For Humour.

Fortunately, our participants seemed highly motivated to think about and share their answers to the 'wow' question. To the extent, in fact, that the format looks like becoming a regular feature in the music teaching curriculum; the students enjoy the experience, and they also learn an awful lot about the 'rules' of musical composition. Actually, in light of the 'wow'=conflict-resolution hypothesis, they get to see how other people managed to break those rules.

#### 4. Results

The following Table includes the following information; the name of the piece and its composer, where in the piece the wow comes (included here primarily for those readers that might want to go and listen to a particular piece), what was supposed to happen, and what actually happened. The right-hand column in the Table attempts to match the 'wow' to one or more of the Inventive Principles currently known in the Systematic Innovation methodology. To date, based on the analysis of over three million successful innovations, only 40 such Inventive Principles have so far been uncovered [5]. One of the aims of the analysis, therefore, was to establish whether the analysis of musical compositions might reveal the presence of previously unknown Principles.

Clearly we are not trying to insinuate in any way that any of the composers actually used Systematic Innovation techniques to achieve their 'wow', but merely try to analyse what happened in order to see whether what did happen fits somehow into the existing framework.

The idea here is that if something doesn't fit the framework, then great because we get an opportunity to potentially expand the framework, and if something does fit the framework, also great because it adds another piece into the jigsaw puzzle that might one day present us with a framework that is in some way 'universal'. In either scenario, if it proves possible to 'reverse engineer' musical invention into some kind of finite framework, it opens the possibility that automated compositional tools may be possible.

Table 1, then, presents a compilation of some of the examples contained in the analysis. The full list can be found in [2].

| Piece                  | Composer / artist  | Track timing | What the listener expects  | What is done to create the 'WOW' response  | Principle            |
|------------------------|--|--------------|--|--|----------------------|
| You Make Loving Fun    | Fleetwood Mac<br>(Christine McVie)<br><br>(live version) | 0.45 – 1.16  | A continuing 8-beat quaver drum rhythm and a similar shape of melody to the verse. | The drums go to half time; the guitar plays a counter melody to a far 'jumper' bridge vocal. The chorus line is only revealed, curiously, in a coda at the very end of the piece. This bridge, consequently takes centre stage in the song, which is rare. | 19B<br>17            |
| Peg                    | Steely Dan   | 1.26 – 2.10  | The second verse, sung by Donald Fagen.  | A guitar solo, chosen from a huge variety of session player takes, which fits the jazzy harmonies as if it were notated – it isn't! An early instrumental solo is a notable variation on accepted song structure.  | 10<br>15             |
| Won't Get Fooled Again | The Who  | 7.30 – 7.49  | The ostinato synth figure to stop... somehow!                                      | The pattern changes to an insistent repeated note; cue Keith Moon to start playing 2 bar tom tom fills, increasing in complexity until a one bar semiquaver  | 17<br>19<br>38<br>12 |

|  |                     |  |  |   |          |
|--|---------------------|--|--|---|----------|
|  |                     |  |  | snare fill leads to one of the greatest screams in rock, heralding the intro chords and the final coda.   |          |
| Hold On  | Yes                 | 3.25 – 3.41  | Another chorus repeat  | A lead guitar ostinato pattern over a steadily rising bass /chord progression building to the chorus repeat – adding considerably greater impact  | 35       |
| You and I  | Queen (John Deacon) | 0.42 – 0.57  | A chorus (even though the title appears in the first verse)                                    | A third section sung in choral harmony and answered by a layered guitar melody. It is a real aural surprise – not to everyone's taste! Genuine prettiness in rock n roll.   | 10<br>7  |
| Piano Concerto No.1 in B flat minor – first movement | Tchai-kovsky        | 5.56 – 8.00  | Either a full statement of a new theme or a return to the better known opening anthemic melody | Two alternating statements of new themes (on wind and strings respectively) over a minute's worth of music, before the former is decided on with a rhapsodic romantic piano figurations and a tutti (full orchestra) accompaniment. | 1<br>3   |
| Night and Day  | Cole Porter         | From the beginning up to the first statement of title line | An introductory melody with chordal accompaniment before the main body of the song.            | A lone tom tom and lower brass underpin a single note melody for 4 bars before it shifts chromatically upwards, until a quick descent of 2 notes precedes a repeated single note on 'you, you, you'. 20                             | 17<br>10 |

|                                |  |                        |  |  |                 |
|--------------------------------|--|------------------------|--|--|-----------------|
|                                |  |                        |  | bars on....we have the first chord. For the 1940s - wow!   |                 |
| God Only Knows                 | The Beach Boys (Brian Wilson / Tony Asher) | 1.04 – 1.28            | Either a contrasting bridge section or an instrumental over the verse accompaniment.                         | A completely unexpected four bar syncopated figure of customarily 'Wilson – layered' block chords. This leads straight into a polyphonic vocalised arrangement of the verse with contrasting melodies. This would have been unheard of even in the Beatles recordings.                                     | 31<br>35<br>1   |
| Shine On You Crazy Dia-mond    | Pink Floyd (Waters, Wright and Gilmour)    | 3.53 – 4.31            | If you haven't read the sleeve or tracklisting, one would expect the next track                              | The immortal guitar motif of B flat – F – G – E. It is played unaccompanied for four times independently, with a reduced gap between statements each time, resulting in the first steady tempo and 12/8 instrumental groove on the record, rather surprising considering 4 and a half minutes have passed. | 15/3<br>17<br>5 |
| Let's Face the Music and Dance | Irving Berlin                              | The opening 20 seconds | A return to the opening phrase and a cadence in the minor key, or a modulation at the end of the eighth bar. | A modulation to the relative major key in the middle of a bar in the middle of the phrase. This betrays an untrained musician who was willing to break a rule to gain an effect. Berlin's ignorance pays off in glorious style – a subtly  | 17              |

|                    |                                  |                   |  |   |               |
|--------------------|----------------------------------|-------------------|--|---|---------------|
|                    |                                  |                   |  | life affirming moment.  |               |
| Trout Mask Replica | Captain Beefheart                | The whole 4-sides | Steady beats, rhyming lyrics, tonal melodies                                       | doing away with a steady beat, neatly rhymed lyrics and tonal melodies. Delta blues, free jazz and beat poetry, images from outside music ('play it like windshields wipers in a rainstorm)   | 3<br>35<br>36 |
| She Loves You      | The Beatles (Lennon & McCartney) | 2.16 – 2.20       | A final major triad chord in vocal harmony   | The bass guitar plays the G root note, while the 6 <sup>th</sup> note (E) is added to the B and D to create G6 – a harmonic development for the RnB rooted Beatles  | 1<br>5        |
| This Charming Man  | The Smiths (Morrissey & Marr)    | 0.01 – 0.12       | A four or eight bar band introduction with guitar chords setting the 'groove'      | A spiky solo guitar intro, half rhythmic and half lead in character lasting 3 bars and 3 beats, the upbeat accompaniment and major chords masks the fact that the guitar melody/riff is inherently minor in key. It is, strangely, a metaphor for the Smiths' music as a whole. | 2<br>37<br>15 |
| Right Off          | Miles Davis                      | 19.00 - 23.00     | Continuation of the basic beat that has been ever present for the first 19 minutes | Vivid shift to a considerably different beat to underpin a blistering extended guitar work-out from John McLaughlin. One of the defining moments of jazz-rock.  | 19B           |

Table 1. Musical 'Wows'.

## 5. Conclusions: So What Does This Tell Us?

Perhaps the first thing we might notice about the results of both the Table 1 compilation and the overall results from [2] is that the right-hand 'what Inventive Principle can we see' column always has an entry. Further we might notice that there is no magical number '41' amongst the list. All of the musical wows, in other words, are consistent with the existing framework of 40 Principles. More specifically, then, we might begin to notice that not all of the 40 Principles are present in the list of examples. In fact there is quite a strong skew towards a relatively small subset of the 40.

One aspect that seems to emerge from a helicopter-perspective view of the whole Table is that there appear to be three basic categories of 'wow':

1. wows associated with a particular moment within a piece of music
2. wows associated with the overall structure of the piece of music, and
3. wows associated with high-level shifts within or around a given genre of music

Without wishing to delve too deep into Systematic Innovation jargon, what we have in these three categories is the standard sub-system, system and super-system view of the world – Figure 2. Thus, if we take a given individual piece of music and call it 'the system', then we can see wows associated with conflict resolutions at the system level. We can then zoom in and see wows within a piece of music ('sub-system') and wows that operate at a higher, 'super-system level' – where the conflict exists between a piece of music and its prevailing surroundings.

Let's explore each of these three categories of 'wow' in a little more detail in order to see if there is anything we can learn about each.

The bias towards the sub-system and system level is not surprising given that when we are listening to a piece of music, or focus is generally 'in the moment' and not contemplating the bigger musical picture. This being said, let us now examine each of the three levels individually in a little more detail.

### 5.1. Sub-System Level Wows

These are 'wow' moments that occur within a particular piece of music. They tend to occur over relatively short periods – perhaps in extreme cases (like Radiohead's career-launching guitar crunches in



'Creep', or Little Richard's scream in Tutti Frutti) in just a few moments.

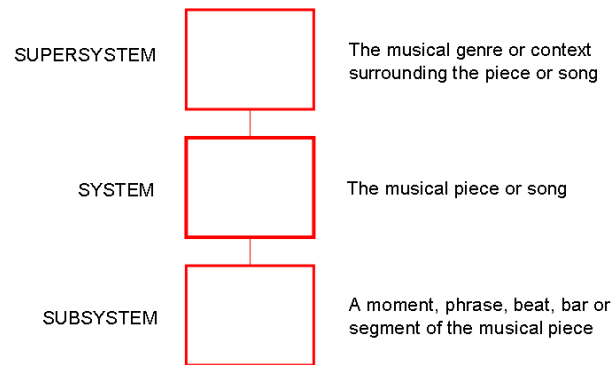


Figure 2. Different Level Wows In Music.

Closer examination of the pieces that feature in this sub-system category reveals that certain Inventive Principles feature more prominently than others. The most common sub-system-level wow seems to emerge from Principles 19 ('Periodic Action' – e.g. changing the beat unexpectedly), 17 ('Another Dimension' – e.g. taking the music to an unexpected note or key), and 5 ('Merging' – where we see things like the surprising combination or layering of different musical instruments or textures). Table 2 presents a frequency-ranked list of all of the Inventive Principles that our study showed create a sub-system-level 'wow'.

|   |    |      |                 |               |                     |
|---|----|------|-----------------|---------------|---------------------|
| Principles<br>(decreasing<br>frequency) | 19 | 17,5 | 35,13,<br>37,38 | 1,5,<br>20,31 | 2,3,10,<br>12,18,21 |
|---|----|------|-----------------|---------------|---------------------|

Table 2:.Inventive Principles Creating Sub-System Level Wows.

5.2. System Level Wows

These are 'wow' moments that relate to the overall structure of a piece of music. Here we are experiencing wows that may well have a longer duration (the Miles Davis composition, 'Right Off', for example clocks in at over 26 minutes, and the wow lasts over a duration of over 4 minutes within that overall 26 minute period). As can be seen from the

Table, these system-level wows most often occur when a composer alters the structure of a piece from the prevailing norms. Things like putting bridges where the listener is expecting another verse, for example, are typical of this kind of system-level wow.

Closer examination of the pieces that feature in this category reveals that certain Inventive Principles feature more prominently than others. The most common system-level wows seem to emerge from Principles 10 ('Prior Action' – usually changing the sequence of a song structure) and 19 ('Periodic Action' – where, at the system level, we see several examples of unexpected shifts of pace in a song). Table 3 presents a frequency-ranked list of all of the Inventive Principles that our study showed create a system-level 'wow'.

|                          |             |       |      |             |             |                     |
|--------------------------|-------------|-------|------|-------------|-------------|---------------------|
| Principles<br>frequency) | (decreasing | 10,19 | 3,17 | 7,15,<br>37 | 1,35,<br>38 | 2,5,13,<br>20,22,31 |
|--------------------------|-------------|-------|------|-------------|-------------|---------------------|

Table 3: Inventive Principles Creating System Level Wows

### 5.3. Super-System Level Wows

These are 'wow' moments that occur beyond the boundaries of a particular piece of music. Looking beyond the statistically insufficient entries in the results table and analysing the bigger picture in its helicopter-view context we can see that, unlike the earlier sub-system and system level categories, the super-system wows appear to fall into two further sub-categories. For the sake of argument, we will call these two sub-categories 'interpolative' and 'extrapolative'.

Interpolative 'wows' occur at the musical super-system level when two different existing types of music are first integrated in some way to form a third type of music. Classic examples of this kind of interpolative wow may be seen in the work of bands like The Police (integration of rock and reggae), The Byrds (country and rock), and in composers like John Cage (classical and ambient).

Our list of wow examples features very few of these kinds of interpolative wows, despite the fact that we could see many as we delved back through musical history. In actual fact, a large part of the evolution of all forms of music occurs through the amalgamation and synthesis of existing forms [6]. The issue here seems to be one of

timing. When the Byrds released their seminal album 'Sweethearts Of The Rodeo', they effectively invented country-rock. At the time of its release, it was very definitely a 'wow'-like step into previously uncharted territory. Play it today, however, and although it still stands up as a great record, it merely sounds like 'yet another' country-rock album. The initial 'wow' has faded with time. [2] provides more examples. From the perspective of an artificial intelligence-based composition method, however, these super-system wows are probably the furthest from practical application, even though they too feature exactly the same 40 Inventive Principles.

## 6. Towards An Automated 'Wow' Composition Tool

There is a very strong correlation between musical 'wow' moments and the resolution of a conflict. Typically the conflict centres on shifts away from what a listener expects to happen in a piece of music.

All of the examples we uncovered in this study can be mapped onto the existing framework of the TRIZ 40 Inventive Principles. We make no claim that these 40 Principles are the only ones, but merely that so far they are the only 40. In fact, based on our limited number of cases, only 20 of the 40 have been mapped. 7 of these 20 Principles seem to occur with a much higher frequency than the other Principles. These seven are:

*19, 17, 3, 35, 37, 5 and 15*

This paper has primarily been about analysis of the past. We have made no attempt to show or suggest that the Principles found in past wows can be used to systematically create future wows. It is, however, our belief that the study has uncovered certain repeatable 'wow' patterns that can very definitely be deployed in a compositional sense. The George Box statement 'all theories are wrong, but some are useful', found at the beginning of the first Design For Wow article continues to be relevant here. We will never be able to prove (nor would we ever wish to try) that the ideas presented here can systematically help composers to create future musical wows. We can say, though, that they offer at least a first step towards such a goal. We will be looking to report on some of those first steps in the next stage of our research.

## 7. References

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