The Instrumental Hobby and Long-Term Engagement with HCI

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Musical instruments keep hobbyist musicians highly engaged for years. In this theoretical paper, we discuss qualities of musical instruments affording this long-term engagement, in the hopes that HCI developers will begin to design interfaces with these qualities. This will result in interfaces that users find more engaging in the long term. Such interfaces would be useful in many applications, and would be particularly useful in applications based on long-term goals, such as education, productivity, rehabilitation, or physical fitness.


1. INTRODUCTION

Musical instruments draw a high level of engagement from musicians. Hobbyist musicians, in particular, exhibit a great deal of engagement with regard to practicing instruments. They are not paid for practicing, but many do so on a near-daily basis over the course of years. They are often self-taught, picking up knowledge and techniques from peers and internet research. For them, practicing is a form of entertainment on par with television. In contrast, numerous examples exist of interactive human-computer interfaces (HCI), designed for repeated use, which users find profoundly boring after short exposure.

Most literature from the intersection of music and HCI focuses on the development of new musical interfaces. Some of this literature focuses on the application of HCI principles to instrument design (e.g. Wanderley 2002, Wessel & Wright 2001). Some is written by expert musicians, and seems focused on interfaces for other expert musicians (e.g. Trueman & Cook 2001). Here, we take a different approach: instead of using concepts from HCI to improve musical instrument design, we look for qualities of musical instruments which inspire long-term engagement as seen in hobbyist musicians. Then we generalise these qualities for application in the development of HCI. This results in design strategies for the creation of interfaces users can adopt, enjoy, and use frequently in their spare time over a long term. Such interfaces would be valuable in many applications, including fitness, rehabilitation, education, and productivity.

2. THE MOTIVATION TO PLAY INSTRUMENTS

One theory explaining the behaviours of hobbyist musicians is the self-determination theory (SDT) of motivation (Ryan & Deci 2000). In SDT, behaviour results from intrinsic or extrinsic motives. Extrinsic motives are related to factors out of the individual's control, such as rewards or punishments (e.g. grades, remuneration). Intrinsic motives come from within the individual, and have more to do with the sense of enjoyment. Intrinsically motivated people freely choose to perform an activity without outside incentives. In empirical validations of SDT, it was found that intrinsically motivated participants tend to perform better and persist longer in a given activity than extrinsically motivated participants. It was also found that incentivising an activity with rewards or punishments serves to decrease the level of intrinsic motivation of activity participants.

The recognition of the intrinsic/extrinsic dichotomy is the biggest difference between SDT and other relevant theories of motivation such as Reiss's multifaceted theory of motivation (2004), Tinto's theories of student persistence (1975), or Maslow's hierarchy of needs (1970). These theories hold all motives to be similar in kind and additive, so an individual's motivation level is determined by adding up the impacts of a variety of physiological needs, outside incentives, sociocultural factors, and
intrinsic motives. Since amateur musicians and all other hobbyists are clearly motivated by internal enjoyment rather than external rewards and punishments, SDT seems to be the most useful theory of motivation for studies on music or hobby. Also, SDT is much cited in music education literature (e.g., Austin, Renwick, & McPherson 2006, Hallam 2002).

SDT recognises three intrinsic motives; mastery, autonomy, and purpose\(^1\). The means by which instrumental music facilitates these intrinsic motives can inform HCI design. In this paper, mastery, autonomy, and purpose are treated as qualities of activities and devices. All hobbies have at least one of these qualities, and instrumental hobbies have all three. Every hobby engages its practitioners over a long duration, and many hobbies could be useful as sources of inspiration on HCI with long-term engagement. Instrumental hobbies, however, are especially relevant for HCI, due to these reasons:

- Instrument practice is a way for musicians to gradually attain their long-term goals of musical expertise. Some interfaces are similarly based on the achievement of long-term goals.
- Instruments require practice for skill attainment, and skilled instrumentalists perform complex music more easily. This is a useful paradigm in HCI when difficulty cannot be avoided: practice-oriented HCI will facilitate the attainment of skill which will allow users to manage higher levels of difficulty.
- Instruments draw nuanced and masterful bodily movement from users. Embodied interfaces could benefit from doing the same.

The following sections describe the intrinsic motives in greater detail. The relationships between intrinsic motives and instruments are explored as well. We discuss a number of instrument qualities which contribute to each intrinsic motive. Some users will always exhibit more engagement than others, but HCI with these qualities should prompt more engagement in users over a long term. Therefore, these qualities can be thought of as HCI design tenets when long-term engagement is desired. These tenets are summarised in Table 1.

### 2.1 Mastery

People are motivated by mastery if they feel they are good at, or capable of becoming good at, something difficult. In looking at instruments for qualities contributing to mastery, we derived three concepts which seem useful for HCI development: incrementality of increases in challenge; maximum potential complexity of play; and immediacy, which indicates minimal obstacles in the way of practicing the activity.

#### 2.1.1 Incrementality

The motive of mastery is due in part to the pursuit of flow (Csikszentmihalyi 1990). Flow is an enjoyable mental state attainable through performing activities which are complex but not overwhelming. Extrapolating from this, it follows that the challenge involved in any flow-inducing hobby will conform to a specific profile over time: it will start small for beginners, then increase gradually as skill is attained (Figure 1). If challenge increases too quickly, participants may become overwhelmed and quit, and if it increases too slowly, participants may become bored and quit. The way this challenge profile is manifested varies from activity to activity. Video games, for example, manage challenge through levels and scoring. Instrumental music, on the other hand, lets learners manage it for themselves: there is such a diversity of music available to learn that beginners—and musicians of all skill levels—have an abundance of music at the appropriate level of difficulty to try.

![Figure 1](image)

*Figure 1: Compares incrementality profiles. A) Ideal profile for long-term engagement. B) Users will grow bored in the short term. C) Users will be overwhelmed at the outset. D) Users will be engaged in the short term, then overwhelmed at the challenge jump.*

There are differences in incrementality between instruments, and these differences illustrate the relationships between incrementality, the size of the participant base, and the dedication of the participant base. For example, it takes practice to play the first notes on an oboe. There are fewer players of this type of instrument than others such

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1 Per Ryan and Deci, the intrinsic motives are labeled competence, autonomy, and relatedness. We adopt nomenclature used by Pink (2009).
as piano which are easy to play notes on. However, dedication is likely to be higher among oboe players as they have invested significantly more effort from the outset. Other instruments such as diatonic harmonica are not hard to take up initially, but have large challenge jumps corresponding with times when advanced techniques such as note-bending must be learned. These jumps in challenge are large enough that some musicians set aside the instrument instead of learning the new techniques.

2.1.2 Complexity
In many hobbies, the term “skill” is equivalent to “capability of accomplishing complex things.” This is the case in music, and there is such potential complexity in music that no individual can be said to fully master any instrument; some facet of playing the instrument could always be improved. This impacts long-term engagement because it means that the upward-trending challenge profile discussed in section 2.1.1 extends into infinity, so hobby participants can theoretically remain engaged forever. Instruments which do not seem to afford much complexity, such as kazoo, are often perceived as toys and are usually not the source of long-term engagement (Jordà 2002).

In HCI, interaction complexity need not be enforced upon users, but the potential for complex interactions should exist. Systems should not, for example, demand a high level of repetition from users, nor should they present highly repetitive feedback. Once users encounter the limits of a system's interactive complexity, their engagement may drop. For a metaphor about this, consider a video game: once players have defeated a video game, they may play that game much less.

2.1.3 Immediacy
Some instruments are practiced as a daily hobby, in part, simply because they are easy to practice in this way. These instruments can be left on a stand in a convenient location, so picking them up and playing a few notes takes little effort. This is an example of immediacy. Activities with immediacy have minimal obstacles, where obstacles can come in logistic, temporal, or economic forms. Anything which serves to delay someone who wishes to practice an activity constitutes a reduction in immediacy.

There are differences in immediacy between instruments, and these differences illustrate a relationship between immediacy and instrument popularity. Traditional harps have less immediacy than harmonicas because they are not portable and much more expensive. Traditional organs have less immediacy than guitars because guitars are fairly ubiquitous while organs are rare and fixed to specific sites. Software instruments have less immediacy than flutes because of the delay involved in starting up the computer and launching the software. Since immediacy impacts the likelihood of someone taking up an activity and persisting within it, in HCI a relationship will exist between immediacy and the size of the user base. Immediate HCI will tend to be cheaper to obtain, more portable or ubiquitous, easier to set up and use, and will have minimal latency and startup times.

2.2 Autonomy
People are motivated by autonomy if they feel they freely choose to do an activity, and do it in their own way. In day-to-day life, lack of autonomy has been shown to greatly restrict motivation even when there is a high degree of mastery and purpose. For this reason, incentivising activities with reward or punishment has been shown to be counterproductive in terms of engagement in most cases—it reduces feelings of autonomy (Ryan & Deci 2000). For a metaphor about this, consider the many employees who dislike their jobs despite the high levels of skill and teamwork involved. In looking at instruments for qualities contributing to autonomy, we derived two concepts which seem useful for HCI: ownership of activity, and operational freedom within the activity.

2.2.1 Ownership
In musical instruments, mastery and autonomy are related. The diversity of music affords its incrementality and complexity. This diversity also affords a completely individualised path of learning for instrumentalists. Ergo, each musician can consider their playing style to be unique, best suited for them, and therefore “owned” by them. Evidence for the uniqueness of each musician's playing style can be found among professional musicians as well as hobbyists—for example, Franz Liszt and Art Tatum were both considered absolute masters of the piano, yet their styles and techniques were highly dissimilar. In HCI, one tactic for creating a quality of ownership might be using abstraction, as advocated by Sengers and Gaver (2005), so users must define the meaning of interfaces for themselves. Another tactic might be the integration of options and end-user configurability.

2.2.2 Operational Freedom
Hobbyist musicians do not perceive many restrictions on their freedom to play an instrument in their own way; this is related to the quality of complexity discussed in section 2.1.2. However, as noted by Jordà (2002), instruments have affordances, and players of an instrument are likely to have similarities with one another because the form of the instrument leads to certain playing techniques. Expert musicians are sometimes
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Table 1: Summarises the design tenets in this paper and describes how they impact engagement among users.

<table>
<thead>
<tr>
<th>Motive</th>
<th>Tenet</th>
<th>Description</th>
<th>Impact</th>
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<tbody>
<tr>
<td>Mastery</td>
<td>Incrementality</td>
<td>Whether progression in difficulty from beginner to expert is gradual</td>
<td>Impacts number of people initiating and persisting within an activity.</td>
</tr>
<tr>
<td></td>
<td>Complexity</td>
<td>The maximum complexity of output; the height of the ceiling of expertise</td>
<td>Impacts longevity within an activity.</td>
</tr>
<tr>
<td></td>
<td>Immediacy</td>
<td>Whether obstacles to participating in the activity are low</td>
<td>Impacts number of people initiating and persisting within activity.</td>
</tr>
<tr>
<td>Autonomy</td>
<td>Ownership</td>
<td>Whether users have options or configurability</td>
<td>Gives users the sense that the interface is best suited for them</td>
</tr>
<tr>
<td></td>
<td>Operational Freedom</td>
<td>Whether interactions seem determined by the user or by the interface</td>
<td>Lack of free operation limits enjoyment, leads to boredom.</td>
</tr>
<tr>
<td>Purpose</td>
<td>Demonstrability</td>
<td>Whether the user can demonstrate expertise to others;</td>
<td>Incentivises mastery; draws new users</td>
</tr>
<tr>
<td></td>
<td>Cooperation</td>
<td>Whether users can work together</td>
<td>Adds sociability; fosters a learning, teaching, and motivating community</td>
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</table>

capable of going beyond the natural affordances of an instrument, but for the most part playing techniques will be similar because of the tendency toward efficiency and ergonomics. In HCI, there are occasions when specific types of user interaction must be emphasised—for example, rehabilitative systems often need to discourage poor movement habits (e.g. Wallis et al. 2007). Operational freedom in instruments presents one model of encouraging or discouraging specific interactions while maintaining a feeling of autonomy.

2.3 Purpose

People are motivated by purpose if an activity provides a feeling of relatedness with others. Purpose seems to be important when choosing between otherwise similar activities. For instance, there are few differences between guitar and ukelele in terms of mastery and autonomy. Therefore the fact that ukelele players are less common is likely a result of purpose. In generalised hobby, the quality of purpose varies widely: some hobbies use competition, some hobbies are based on spending time with family, some hobbies are based on activism or volunteerism, and so forth. In looking at instrumental hobbies for qualities contributing to purpose, we derived two concepts which seem useful for HCI development: demonstrability of skill, and cooperation among users. These manifestations of purpose seem well suited for helping a hobby proliferate quickly through a populace.

2.3.1 Demonstrability

One reason instrumentalists learn an instrument is so they can attain skill and play for others. Often, instrumentalists choose to learn an instrument after hearing impressive performances (Manturzewska 1990). Demonstrability is related to mastery; it is the payoff for attaining expertise on the instrument. Demonstrability is also related to autonomy; music is thought of as a form of self-expression precisely due to its autonomous qualities. If interfaces are designed such that users produce something which can be displayed, performed, or shared in some way, this will encourage users to attain greater levels of skill, and these users will attract more users.

2.3.2 Cooperation

Music-making can be done in solo or ensemble settings. The option to play in ensembles contributes to the motive of purpose, as musicians are often motivated to practice by the prospect of jam sessions, drum circles, duets, and so forth. These represent social opportunities, allowing players to spend time with peers and make new friends. Cooperation also allows musicians to teach one another, inspire one another, and motivate one another. If interfaces are designed to be used in group settings, and efforts are made to increase community among users (for example, through online forums) this will help to increase overall engagement within the user base. It will also help attract new users and speed the attainment of skill in the user community as a non-competitive environment of knowledge sharing and group discovery develops. According to Tinto’s theories of student persistence (1997), positive social integration will also reduce an individual’s likelihood of quitting.
3. APPLICATION TO HCI DEVELOPMENT

This paper poses the seven tenets listed in Table 1 as a design framework for HCI with long-term engagement. Whenever HCI developers design systems which could benefit from more long-term engagement, these tenets can be used as catalysts for thought. Developers should ask themselves questions like: “Is this system demonstrable?” or “Would a different form of sensing make this system more immediate?” The seven tenets are not the only possible configuration of qualities inspiring long-term engagement: for example, many hobbies are competitive rather than cooperative. The popularity of the instrumental hobby indicates, however, that this configuration is compelling.

There has been some focus, by HCI theorists, on designing interfaces to deliver fun, enjoyable, positive user experiences (e.g. Hassenzahl & Tractinsky 2006, Blythe et al. 2003, Malone 1984). The ideas herein represent one possible approach for accomplishing this. Users should freely opt to use these interfaces, and the interfaces should draw these users repeatedly back over time. This would be beneficial in many types of HCI, including HCI designed only for fun or self-expression, instead of for utilitarian purposes. There are some practical HCI applications, however, where long-term engagement would be particularly useful. Rehabilitation and fitness systems fall in this category, along with any other systems dealing with long-term user goals. Unless users adopt and use these interfaces frequently over a long period of time, these systems are not likely to be successful.

Increased long-term engagement would also be highly useful in HCI dealing with difficult tasks, such as systems where complex real-time user reactions are required. These tasks, like instrumental music, require practice. Similarly, in systems designed to help users produce complex deliverables, engaging practice-oriented interfaces might help users become skilled at producing the deliverables more quickly and easily. For a metaphor about this, consider the difference between a composer and an improviser. Whereas a composer might painstakingly score musical events over the course of hours or days, an improviser might create music of the same complexity with little effort, taking only the requisite time to produce the notes on the instrument.

Embodied interfaces may also benefit from more long-term engagement. Instrumentalists, during practice, become highly aware of their movements. High movement awareness is beneficial in itself; ergonomic movement techniques such as the Alexander Technique are built around it (Jones 1997). In embodied HCI, if users would practice interfaces as they would instruments they might eventually be capable of efficient, nuanced, and technically skilled interface control.

3.1 Example Application: A Rehabilitative Game for Parkinson’s Patients

Although the system described here is currently under development, it has not been fully realised and tested yet; therefore this section is meant only to provide one example of how the tenets can be used during development. Research shows early-stage Parkinson’s Disease (PD) patients can slow deterioration in some symptoms by performing wide-amplitude movement exercises (Farley & Koshland 2005). In this rehabilitative example, an interactive rhythm game is designed to encourage wide-amplitude movements in PD patients.

3.1.1 Standard Rhythm Games

Rhythm games, as exemplified by popular video games such as Guitar Hero (2005) and Dance Dance Revolution (2010), challenge players to closely synchronise with a complex sequence of actions. This sequence of actions is given by the game, and action timing is usually related to a background song in some way. For this reason, it is useful to think of each sequence/song combination as a game session, or a song-game. Most rhythm games contain large libraries of song-games.

The example system will use a visual interface similar to that seen in Figure 2. This interface will contain three interactive elements: 1) Hands are visual indicators, the locations of which are driven by motion tracking on the player’s hands—Microsoft’s Kinect sensor (Latta et al. 2010) is one example of low-cost motion sensing which could work for this purpose. 2) Targets are areas of the virtual space that the player must touch in accordance with the game’s sequence of actions. Each target is attached to a musical pitch. 3) Notes make up the sequence of actions; these indicators radiate out from the centre toward individual targets. When a note reaches a target, the user’s hand must also touch that target. If it does, the
target's musical tone (which is a melodic tone designed to sound good with the background track) will play. If not, a less pleasant “flubbed” sound will occur.

Standard rhythm games are already fairly well-designed in terms of the qualities related to mastery. They have incrementality, because their song-game libraries are large and diverse enough that players at all levels will find song-games at an appropriate challenge level. They also have a measure of immediacy, as they are relatively low-cost and easy to set up. They are somewhat limited in potential complexity: once the most difficult song-games can be defeated with ease, players are unlikely to continue being engaged.

3.1.2 Applying the Tenets: A Creative Mode

The object of rhythm games—synchronising with song-game action sequences—is not conducive to the motive of autonomy. Therefore, in order to increase long-term engagement, a creative mode is added to this system. This creative mode allows players to create their own song-games. In the creative mode, there is no action sequence telling players where and when to reach for targets. Also, targets play sound whenever they are touched by the player, instead of only when notes simultaneously touch them; this effectively turns the interface into a virtual musical instrument. A background track still plays, but is chosen by the player and uploaded from among the player's own audio files. To create a song-game, players improvise along with their selected background track using the interface. The notes they play are saved as an action sequence into a centralised location. Then others can play that action sequence as a song-game.

This creative mode simultaneously solves many problems. It adds ownership because it lets players select their own background tracks. It adds free operation through letting players improvise. It adds demonstrability through the production of new song-games which are sharable (this is also a rehabilitative feature as therapists can create song-games attuned to their patients). It even adds complexity: for players, it results in an ever-expanding song-game library, and there is no upper limit on improvisational complexity for song-game creators. Cooperation is the only tenet not explicitly improved by the creative mode; however, it could be improved through the creation of online forums, wikis, and videos pertaining to the game. It could be improved further if a two-person creative mode were implemented, affording musical concepts such as call-and-response.

4. CONCLUSION

In this theoretical paper, we examined the hobby of playing instruments in order to find ways of making HCI more engaging to users over the long term. Instrumentalists are intrinsically motivated by qualities of mastery, autonomy, and purpose. Analysing these motives further in the context of instruments, we derived seven design tenets. These tenets are useful for the development of HCI that coaxes more long-term engagement from users. We name these tenets incrementality, complexity, immediacy, ownership, operational freedom, demonstrability, and cooperation. We provide a hypothetical example of a rehabilitative rhythm game, differing from other rhythm games in the addition of a creative mode for increased autonomy and purpose.

In summary, we believe that if the motives of mastery, autonomy, and purpose are explicitly designed into HCI, long-term engagement will be increased. Instruments provide these motives through the seven qualities discussed in this paper; therefore these qualities represent one way to increase mastery, autonomy, and purpose in HCI. The increased long-term engagement would be useful in applications dealing with long-term goals or applications which could benefit from frequent user practice. However, it would also be useful in maximising the impact of any HCI, because truly engaging interfaces, assuming they are readily available to users, are likely to become very popular.

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6. REFERENCES


