Understanding live coding events

K. Burland[1*] & A. McLean[1]

[1]*School of Music, University of Leeds, UK*

Karen Burland is Associate Professor of music psychology and Head of the School of Music at the University of Leeds. Her research interests relate to musical identities, the career transitions of musicians and on live music audiences and she supervises doctoral work primarily in these areas. She is currently a university student education fellow and is investigating the ways in which undergraduate and postgraduate students engage with, and perceive, employability activities during university and beyond. Her book *Coughing and Clapping: Investigating Audience Experience*, edited with Stephanie Pitts, was published in December 2014. Karen has published widely in well-respected journals and has participated in numerous interdisciplinary research collaborations. Karen's more recent research focuses on ecological approaches to creativity, understanding interaction and creativity in studio collaborations, investigations into the impact of institutional values on musicians' psychological and musical development, in addition to on-going concerns with audience research.

Alex McLean (http://slab.org) is a live coding musician, digital artist and interdisciplinary researcher based in Sheffield, UK. He is currently completing a research and teaching fellowship at the School of Music, University of Leeds, and beginning work on the five-year PENELOPE project lead by Dr Ellen Harlizius-Klück, at the Deutsches Museum Research Institute, investigating weaving as technical mode of existence. Alex is active across the digital arts, including co-founding the TOPLAP and Algorave live coding movements, the international conferences on Live Interfaces (ICLI) and Live Coding (ICLC), the Sonic Pattern symposia, the Festival of Algorithmic and Mechanical Movement, and the Dorkbot electronic art meetings in Sheffield and London. He also created the TidalCycles live coding environment, now an active free/open source project.

*Corresponding author. Email: k.burland@leeds.ac.uk

Abstract

As an arts practice, live coding has strong roots in musical performance, and the fact that its 'liveness' requires the performer to write and modify algorithms in real time (Collins et al, 2003) means that it is often treated as a kind of music improvisation. Organised live coding has now passed its tenth year (Magnusson, 2014), and during this decade it has been manifested in a variety of contexts. Whilst there is a growing body of research addressing aspects of live coding from the coder's perspective, little is known about the nature of the interactions between coders and their instrumentalist co-performers, and even less is documented about the audiences for these events.

This paper seeks to explore the motivations, experiences, and responses of live coding audiences and to examine their perceptions of the role and impact of the projected source code during live coding events. Audiences from a range of live performance events were therefore invited to complete an online questionnaire.

Through this work we aim to shed new light on the role of openness and technology in live coding performances, providing rich context for fuller understanding of this emerging practice and its impact on audience experience. We conclude by reflecting on the lessons that can be learned by studying live coding events and their audiences.

Keywords

Live coding, audience, Algorave, community, learning, code, multimodal

Live coding and audience experience

> The central tenet of live coding is the composer-programmer's execution of sophisticated algorithmic programme skills, musical knowledge and judgement, and the use of mathematical knowledge, experience, and practice to create virtuosic scripting languages and algorithmic techniques. Live coding involves a risky act of real time programming. It involves expertise in both field of music and mathematics. But one wonders how live coding and its creativities are judged by audiences? (Burnard, 2012, p.177)

A recent surge in audience research highlights the range of factors which influence audience motivations to attend live music events and contribute to their experiences whilst they are there (Burland & Pitts, 2014). Much of this work focuses on classical music traditions (e.g. Dobson & Sloboda, 2014; Pitts, 2014), jazz (Burland & Pitts, 2012), or popular music (Bennett, 2014), but there has been little research to date which has explored audience experiences of live

coding events. Much of the previous work relating to audiences suggests that, regardless of genre, audiences are motivated by high quality performances and value opportunities to be situated in close proximity to performers in order to observe the ways in which the instrument is played, or to feel as if they are fully immersed, and perhaps active, in the performance (Burland & Pitts, 2012; Pitts, 2005). Technical mastery and repertoire choices are key drivers for classical audiences (Pitts, 2005), whereas for musics like jazz, the unpredictability of the performance and the sense that they are witness to the creation of music in real time is exciting and appealing to its audiences (Burland & Pitts, 2012). In many ways, it would be logical to expect that much of the appeal of jazz performances also holds true for live coding events; the music is often improvised, created in the moment, and the performers' awareness of their surroundings can have an impact on the way in which the performance unfolds. One of the unique features of live coding performances, however, is the established practice of projecting code during events (Mori, 2015; Blackwell, 2015); in most other musics the score is hidden from the audience (it is either visible to the performer/s only, or is memorised in advance of the performance) and therefore the process of musical creation is partially hidden. Blackwell (2015) describes the modes by which users engage with code, suggesting that their activities relate to interpretation, construction and collaboration (p. 4) and that patterns of use differ according to perspective (e.g., performer, audience). The implication, therefore, is that the projected code is an important part of the audience's experience and this is reflected in TOPLAP's (2004) manifesto which asks for 'access to the performer's mind, to the whole human instrument…show us your screens…the code should be seen as well as heard'. What we do not know, however, is who attends live coding performances and what their motivations to attend might be. We also do not know the extent to which the code contributes to, or detracts from, the audience experience. Is the projected code a pure enhancement to a live coding performance, or are there occasions when it can deter an audience? Are there optimal conditions for the projected screen during live performances? And what role does the coder him/herself play in audience's experience of the performance?

Researching live coding events

In order to explore the motivations and experiences of audiences at live coding events, an online survey was created and advertised at a range of Algorave[1] events and on social media over a three-month period, in order to encourage a wide response. As a set of techniques, Live coding is not tied to any particular genre, but the current surge in popularity of well attended Algorave-style events provides an opportunity to gain significant understanding of audience response to live coding. However, we should note that this will gives a strong bias

1 An algorave is defined as embracing 'the alien sounds of the raves from the past, and introduc[ing] alien, futuristic rhythms and beats made through strange, algorithm-aided processes" (Algorave.com/about, n.d.)

towards audience responses to algorithmic dance music in particular. Eighty-three participants completed the survey (~~sixty-six~~66 male, 16~~sixteen~~ female, one other) and the majority of participants were aged 18-45 years. A combination of multiple choice and open-ended questions focused on motivations to attend live coding performances, experiences at events and the impact of the projected live code. General musical interests and participation in other live music events were also explored. ~~(for full list of questions see appendix one).~~ Specifically, we had three main research questions:

1. Why do people choose to attend live coding events?
2. What is the role and impact of the source code?
3. What is the audience's response to music being visibly created in the moment?

Quantitative data were analysed using descriptive and inferential statistics, and qualitative comments were analysed using Thematic Analysis (Braun & Clarke, 2006). Indicative quotes are used to support the emerging argument and participant identifiers are indicated by a label such as P1.

Who attends live coding events?

As described above, our audience respondents were primarily male (76%) and aged between 18-45 years. The age of the respondents is perhaps unsurprising, especially given a recent survey by The Nielsen Company (2014) which confirms that listeners to Electronic Dance Music (EDM) in the US are aged between 18-49 years, the largest majority belonging to the 18-24 year category. As Figure one below suggests, however, audiences for live coding events are slightly older than for more mainstream electronic dance music events.

[Insert] Figure 1. Graph showing age distribution of live coding audiences

One explanation for this may relate to the nature of live coding events, which perhaps demand something more from their audiences: as discussed in the introduction, the projected code plays an important role in live coding performances and so it is possible that individuals with prior experience of coding or computer programming are particularly attracted to the events (more on this below). Indeed, this suggestion that prior experience motivates attendance is supported by examining the range of respondent professions; 22% worked in 'IT development' and were software/hardware/web developers and many of the 'academic' and 'student' respondents also identified themselves as having interests in coding – either as part of their work or as a pastime.

[Insert] Figure 2: Graph showing the professions of live coding audiences

It seems, therefore, that live coding events attract a rather specific and niche audience that tends to be knowledgeable about the music, the code and/or the technology involved. Indeed, in a recent survey of software developers (Stack Overflow, 2015), 92% of the respondents identified as male and were an average of twenty-nine years of age. Audiences for live coding events seem to be similar to audiences for new contemporary, electronic or improvised music (Artfacts, 2013) which implies that they may have an openness to new experiences and enjoy the spontaneity of seeing music being created in the moment. This is reinforced by the respondents' listening habits; they are regular music listeners and their listening preferences are mainly described as experimental, electronic, and improvised. Live coding audiences seem to be informed and immersed in the music, as listeners or practitioners: recent research by the Audience Insights Group (2015) suggests that electronic music is as much about the associated culture (of identity, belonging, sharing) as it as about the music itself which inevitably has an impact on an audience's commitment to, and experiences of, live coding events.

What motivates audiences to attend live coding events?

The survey asked respondents about the factors that motivate them to attend and to choose particular events, and these can be seen in Figures 3 and 4 below. It was clear from the open-ended questions that opportunities to attend live coding events were infrequent but that the respondents were keen to attend as often as possible. Since the respondents were generally knowledgeable about either the music or the technology involved, they made choices to attend based on their self-identities as coding enthusiasts; their identities were developed through enjoyable previous experiences and their knowledge of the music, its artists and practices which facilitated greater immersion in the culture of live coding events.

[Insert] Figure 3. Graph showing factors which motivate audiences to attend live coding events

[Insert] Figure 4. Graph showing the factors influencing choice of particular events

Chi-square analyses of the data suggest that of all of the factors above, there are significant relationships between attendance and the following four factors:

liking the artist (X^2 (1, N=83) = 5.71, p=.017), enjoying high quality music (X^2 (1, N=83) = 9.44, p= .002), enjoying previous events (X^2 (1, N=83) = 16.11, p<.001) and being a coding performer (X^2 (1, N=83) = 5.19, p= .023). These data further highlight the impact of prior knowledge and skills on motivation to attend live coding events. There was also a relationship between attendance and a lack of desire to try something new (X^2 (1, N=83) = 4.27, p= .04), suggesting firstly that audience members identify strongly with live coding events/practices, are clear about their expectations for such events based on their previous experiences (and therefore these are not *new* experiences any more) and secondly, that a general openness to new experiences does not necessarily characterise a typical audience member – this has to be supplemented by other knowledge or skills. The most significant result above, however, relates to having enjoyed previous events; this finding suggests that there is something special about audience experiences during live coding performances that 'hooks' the audience and instils a sense of commitment and enthusiasm.

Experiencing live coding events

Given the profile of the audience considered so far, it is perhaps unsurprising that their enjoyment of live coding performances relates to the nature of the music itself – to its experimental and unpredictable nature, and therefore its sense of being new and unique – as well as to social factors, such as community and learning. In addition to these broad factors, the projected code itself has an additional and important role to play, which will be discussed in further detail below.

The code, learning and community

There is a clear sense from the data that live coding events were characterised by being both 'cool' and 'geeky' at the same time; these are events which capture the individual's imagination and demand intellectual engagement. For example, one respondent stated: 'I find live coding cool, I'm almost mesmerised watching the screen with the code on it and hearing the changes in the music from that' (P82). Live coding audiences appear to expect (and value) the opportunity to trace the music's development by watching the code and hearing resultant changes. This is quite unlike other kinds of musical performances, where the musical score is usually only viewed by the performer (for example in classical music) or is fully prepared (or scripted) in advance of the performance (for example some popular music performances) and this suggests that the processual transparency afforded by the project code enhances the experience for the audience (there is more discussion about this below). Seeing the projected code provides a connection between the performer and the audience; it provides opportunities to admire the performer ('it's like watching a top guitarist do his thing – but with a keyboard. A computer keyboard' (P83)), to observe the performer's commitment and emotional engagement ('strange

form of music performance that…represents the 'suffering' of the performers trying to produce something satisfying' (P41)) and it provides opportunities for learning; for example, one respondent stated that she enjoyed 'meeting interesting like-minded people and [learning] how different people make different noises with code' (P6). There is frequent mention of the opportunities to 'learn about new possibilities' (P34) during live coding performances and this highlights that, for the informed audience member, the chance to develop skills and to gain 'inspiration/ideas for my own projects' (P24) is a fundamental feature of the live experience of coded music (cf. Guzdial, 2013).

The community of 'like-minded people (see P6 above) was also an important part of the audience experience. One of the questions in the survey asked respondents to describe a typical audience member and most responded with comments such as 'geeky', 'nerds', 'open-minded and curious' and 'cool, polite and tidy' (!). Perhaps more importantly, most respondents considered themselves to fit the typical profile 'like a glove' (apart from women and older respondents who jokingly acknowledge their atypicality in this context). It is possible that perceptions of an open and like-minded community encourages the possibility of sharing and learning and encourages subsequent attendance and future involvement in coding at home or as performers.

Unique and unpredictable experiences

Like audiences at jazz events (cf. Burland & Pitts, 2010), live coding audiences value the unpredictable nature of the events. Comments about 'the geekery and haphazard nature of the performance' (P8) and the 'presence of the unexpected' (P12) were frequent and relate in part to the technology involved: '[It] is really 'live', not a playback of prepared files. It can go wrong. It's improvised. It's bleeding edge technology' (P21). In many ways it is difficult to have expectations for the performances, other than that they might be unpredictable, and it is this which appeals to the audience members: 'The unpredictability of live coding and generative music/visuals [is appealing], I don't enjoy going to performances where I know what to expect (from myself and from other performers)' (P43). The sense that the experience is unpredictable for performer and audience alike strengthens the sense of community described above, but also distinguishes what is special about live as opposed to recorded listening. There is a sense that audience and performer co-create the performance as the performer is able to react in real time to the feedback from the audience.

There is also unpredictability in the kind of music to expect at a live coding event; whilst the music sits comfortably within the context of electronic dance music, it is a versatile style of music: 'I like the style of music; although it's a 'bleeding edge' form in the sense that many are doing stuff with networks, bespoke computer music languages, new controllers and the like, the music can

often be quite happily rooted in genre: house, techno, noise, ambient and similar. It appeals to my taste' (P81). In trying to establish what the experience of live coding performance is like for its audiences, it is clear that the liveness of the music, and the unpredictability of the music and its technologies, contribute to the enjoyment of the event. However, this is enhanced by the broader context of being able 'to witness the future of music' (P50) or 'the next big thing' (P53).

Experimental and new music

There is frequent reference in the data to live coding being a new music which is constantly evolving and pushing the boundaries of live music performance. Part of the appeal is that performances provide opportunities to see 'how live coders push the state of the art' (P11) and 'a new mechanism for expression being experimented with' (P15). Interestingly, this is not just about a music in development, but also about the act of performance and 'seeing a music movement in development, and the opportunities to open up that performer/audience barrier in new ways, which live coding affords' (P45). Obviously, the awareness of the originality or uniqueness of live coding relies on a certain contextual knowledge. Therefore, it is hardly surprising that the demographic of the audiences is as depicted above, nor that the respondents value and appreciate the technical aspects of the craft. There are parallels here, however, with audiences for other musics which can be seen as new or improvised – Pitts' work with Contemporary Music/Art organisations also describes audiences as similarly open-minded about innovative artistic practices, and Burland's work with free improvisers and jazz audiences also highlights the appeal of witnessing spontaneous music creation. Therefore, one suggestion is that audiences are attracted to musics where their involvement in the musical experience can potentially have an impact on the creation of the music in real time, but where there is some unpredictability about the extent to which that might be successful or not!

Engaging with the code

As previously discussed, one of the most significant differences between live coding events and other live performances is the presence of the projected code (or the 'score' for other musics). Whilst engagement with the 'score' is not expected in other musics, here the code plays a vital role in the audience's experience, and consequently live coding performances are enhanced by their multimodality.

Multimodal experience: enjoyment vs. distraction

For many individuals, the projected code enhances enjoyment of the event: 'It's cool. Curiosity to understand the code underneath the music is a fun experience. It's something new, not really seen elsewhere. The changing of code as a visualisation seems to 'fit' the entire event' (P53). The 'unique

aesthetic' (P75) of the code also enhances the event in other ways, adding 'intimacy to the performance that is different from traditional music: there is a more direct connection what the performer is doing and thinking' (P75). Other individuals value the projected code because they do not perceive the music to be complex or engaging. For example one respondent stated that '[The code] must be shown. If not I find these events to get boring quickly because the generated music usually has little change over time' (P26) and another that '[The code is] very helpful for me to appreciate the event, especially when the musical quality is not up to my standards' (P33). The multimodal experience created by the projected code serves to enhance appreciation of the experience and to provide another source of enjoyment. For some participants the code, rather than the performer, is described as the focus of the their attention: this contradicts Perera's (2013) suggestion that 'as with any performance, a live coding audience focuses their attention on the performer or ensemble. An algorave places the programmer–musician centre stage, as a traditional clubnight does a DJ' (p.140). It is well reported in other contexts that being able to see a performer in close proximity enhances the live performance experience (cf. Burland & Pitts, 2012) and in many ways, the code allows a musician to demonstrate 'their playing technique through the act of performing, the projected code demonstrates visibly the craft of the live coder' (P47) and therefore becomes a representation of the performer.

As stated in the previous section, the code adds interest to the music as it provides additional insights into how the music is being created. For example, respondents stated that '[the code] is a big part of what makes live coding such a uniquely interesting art form' (P23), and that '[t]he code is very important to me. It shows what the performer tries to accomplish' (P21). The projected code facilitates learning and makes the creative process more transparent, and therefore adds value and meaning, and is an important part of the craft of live coding performance.

However, the projected code was not always seen to contribute positively to the events. For example, some respondents suggested that the code had a negative impact on the overall atmosphere of an event: 'I feel in the community there's a real focus on deconstructing the code rather than dancing, which feels maybe detrimental for people who aren't as invested in the coding aspect' (P54). When the audience does not have a shared goal for their experience during a live performance, this can have a detrimental impact on individuals' experiences. For example, Burland & Pitts (2014) suggest that a sense of being surrounded by likeminded others enhances experiences of live music performances and that instances where this is not fulfilled can detract from the event and in some instances prevent future attendance. There are indications that this is also true in a live coding context: 'people often default to staring at the projection. I think it's better when there are multiple projections, or the

projections are at weird angles or projected over the performer, so it's there but as part of the immersion rather than a presentation to be read' (P25). Therefore, opportunities to ensure the code is displayed on screens around the venue may enhance the overall atmosphere as it allows movement away from a single locus of activity which might alienate a less knowledgeable audience member. Other respondents found constant focus on the code to be difficult: 'it's a lot like the frets of a guitar: occasionally I peer at them, appreciate the technical skills, try to understand a bit, but mostly I can't focus on it' (P25). These factors, as well as some of the more negative presentational aspects, such as the font being 'too small to be legible' (P49) provide some support for Perera's (2013) suggestion that the code is not always essential to the enjoyment of live coding performance. However, live coding performances often demand patience of their audiences and in such cases the code can be an asset: 'One of the things with live coding is patience, as a set starts up it's often quite sparse so the audience almost have to be patient with it. The projected code in some way negotiates that by showing that something is happening' (P45). If the code takes on the role of 'performer' in live coding events then the way in which that is accessible and visible becomes crucial in order for the audience to have an optimal experience.

Audience expectations for live coding events

In the same way that audiences for other kinds of events have expectations for events (cf. Burland & Pitts, 2012) audiences for live coding events have expectations for the quality of the code: the code has to connect with the aural experience ('It is important for me to be able to relate the code to the outcome' (P14)) and should complement the experience rather than monopolise it. For example, one participant stated 'Mostly I am annoyed by the visual display as it pulls the focus away from the human performers and the listening. And because projection is usually large, one is "pulled in" to read' (P41). There is an obvious contradiction within the sample of respondents here; on the one hand the projected code is seen as an essential part of the live coding experience, but on the other it can be a source of frustration as it becomes a sole focus of attention. Many of the participants enjoy the opportunity to learn from the projected code; their expectations for the code are high and there is disappointment when these are not met: 'I am most interested when I can follow the coding process but disappointed when all the code is already written down and there is no real coding process to follow or no time to at least read the prepared code. Then I just focus on the music or visual result' (P37). There is also an expectation for 'algorithmic gymnastics' (P80), which suggests that high levels of technical virtuosity are also required from some audience members. There is a sense that the audience also expect some communication from the performers and observe that the code does facilitate this, although there is recognition that the presentation of the events still needs improvement: 'I really

enjoy seeing the projected code. I still think the community has a long way to go in terms of stagecraft while preserving the legibility of code' (P11).

Conclusions

This paper aims to explore audience motivations to attend, and their experiences of, live coding events, examining in particular the role and impact of the source code and the visible creation of music in real-time. The findings suggest that live coding events attract knowledgeable and informed audiences who want to have unpredictable, surprising and original experiences. In this respect, they share many characteristics with audiences for jazz and contemporary classical music (Burland & Pitts, 2012; Pitts & Gross, 2015). Live coding audiences share much excitement about the innovative and experimental nature of the music which inspires them to attend events as frequently as possible, but also to make their own coded music at home (or publicly). However, live coding audiences are distinct in relation to the relatively narrow range of professions they represent, which focus largely on roles related to, or involving, technology. With this in mind, the transparency of the projected code is a strong appeal of these performances which offer opportunities for learning and sharing new ideas. There is a clear sense of community associated with the events – audiences identify strongly with each other and feel that they are together contributing to the future face of the music. The performances themselves seem to rely heavily on the multimodal experience – there are instances where either the code or music are unsatisfactory and in such cases the opportunity to appreciate one mode or another is appealing. There is a call amongst the respondents here for the stagecraft of live coding performances to be improved – reports of illegible, incomprehensible or disappointing code were frequent – and stories of how the projected code can spoil the atmosphere of events need to be kept in mind. We have demonstrated that it is possible to conduct detailed analysis of the performers' activities which can reveal much about the processes behind the emergent code and the interaction between performers, but the extent to which this responds to, and impacts on, the audience is an area which still requires further investigation.

Live coding performance is still relatively new and the openness of the field to constant challenge and evolution is refreshing, and it is this uncertainty which is undoubtedly appealing to its performers and audiences. Understanding the ways in which this music, which is sometimes challenging and impenetrable to those not in the know, manages to generate new and young audiences is extremely valuable as other forms of music and art face the constant threat of declining audiences. This paper has highlighted the ways in which audiences respond to the multimodal nature of live coded music and offers a starting point

for future explorations of the ways in which audiences interact with, and experience, new and cutting edge music.

References

Artfacts. 2013. *Music Participation*. Australia Council for the Arts. Accessed 15 February 2016. http://artfacts.australiacouncil.gov.au/music/participation-7/#attendance.

Audience Insights Group. 2015. *Electronic Music, Technology and Youth Culture*. Accessed 15 February 2016. http://sfxii.com/wp-content/uploads/2015/04/Electronic-Music-Technology-and-Youth-Culture.pdf.

Bennett, L. 2014. Texting and tweeting at live music concerts: flow, fandom and connecting with other audiences through mobile phone technology. In *Coughing and clapping: Investigating audience experience*, edited by Karen Burland & Stephanie E. Pitts, 89-100. Farnham, UK: Ashgate

Blackwell, A.F. 2015. Patterns of user experience in performance programming. *Proceedings of the First International Conference on Live Coding (ICLC)*, University of Leeds, UK, 13-15 July 2015. Accessed 2 March 2016 from https://zenodo.org/record/19315#.VtidvKlhxhp.

Braun, V. & V. Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3: 77-101.

Burnard, P. 2012. *Musical creativities in practice.* Oxford: Oxford University Press.

Burland, K. & S.E. Pitts. 2012. Rules and expectations of jazz gigs. *Social Semiotics,* 22(5):523-543.

Burland, K. & S.E. Pitts (Eds).2014. *Coughing and Clapping: Investigating Audience Experience.* Farnham: Ashgate. .

Collins, N., A. McLean, J. Rohrhuber & A. Ward. 2003. Live coding in laptop performance. *Organised Sound*, 8(3): 321–330.

Csikzentmihalyi, M. 2008. *Flow: the psychology of optimal experience.* New York: Harper Collins.

Dobson, M. C., & J.A. Sloboda. 2014. Staying behind: Explorations in post-performance music audience dialogue. In *Coughing and clapping: Investigating audience experience,* edited by Karen Burland & Stephanie E. Pitts, 159–173. Farnham, UK: Ashgate

Guzdial, M. 2013. Live coding in Education. In *Dagstuhl Reports 3* (9)*: Report from Dagstuhl Seminar 13382: Collaboration and learning through live coding* edited by Alan Blackwell, Alex McLean, James Noble, & Julian Rohrhuber, 135-136. Leibniz, Germany: Dagstuhl Reports.

Magnusson, T. 2014. Herding cats: observing live coding in the wild. *Computer Music Journal,* 38(1): 8-16.

Mori, G. 2015. Analysing live coding with ethnographical approach: a new perspective.
Proceedings of the First International Conference on Live Coding (ICLC), University of Leeds,
UK, 13-15 July. Accessed 2 March 2016.
https://zenodo.org/record/19343#.VtiWjKIhxho.

Perera, R. 2013. Critical Engineering and Software Tools. In *Dagstuhl Reports 3* (9)*: Report from Dagstuhl Seminar 13382: Collaboration and learning through live coding* edited by Alan Blackwell, Alex McLean, James Noble, & Julian Rohrhuber, 138-150. Leibniz, Germany: Dagstuhl Reports.

Pitts, S.E. 2005. *Valuing Musical Participation*. Aldershot: Ashgate.

Pitts, S. E. 2014. Musical, social and moral dilemmas: investigating audience motivations to
attend concerts. In *Coughing and Clapping: Understanding Audience Experience* edited by Karen Burland & Stephanie. E. Pitts, 21-33. Farnham: Ashgate.

Pitts, S.E. & Gross, J. 2015. Understanding audiences for the contemporary arts. Paper presented at the European Society for the Cognitive Sciences conference, RNCM Manchester, UK. 17-22 August.

Stack Overflow 2015. *2015 Developer Survey.* Accessed 15 February 2016.
http://stackoverflow.com/research/developer-survey-2015.

The Nielsen Company. 2014. Who is the electronic music listener? Accessed on 16 February 2016. http://www.nielsen.com/us/en/insights/news/2014/who-is-the-electronic-music-listener.html.

TOPLAP. 2004. *TOPLAP Manifesto*. Accessed on 16 February 2016.
http://toplap.org/wiki/ManifestoDraft.

Appendix One: Audience Questionnaire

Information about you

1. Are you: ○ 17 or under ○ 18-25 ○ 26-35 ○ 36-45 ○ 46-55 ○ 56-65 ○ 66-75 ○ 76 or over

2. What is your gender? _____

3. What is your current occupation? _____

Attending Live Coding Events

4. What are your main reasons for attending Live Coding Events? *(Please tick all that apply)*

○ I have been before and enjoyed them. ○ I like the style of music
○ I enjoy hearing live music of high quality. ○ I am a coding enthusiast.
○ I really like the artists who are performing ○ I am involved in performances at this or similar events.
○ I wanted to try something new. ○ I came with friends
○ Other (please give details):

_____

5. How often do you attend Algoraves or Live Coding Events?

_____

6. How do you decide which gigs to attend? *(Please tick all that apply)*

○ The performer(s) ○ Particular instruments ○ Cost ○ Venue ○ My availability ○ Friends' availability ○ General interest in the event ○ Recommendation
○ Other *(please give details)*: -

_____

7. What appeals to you most about Live Coding Events?
8. To what extent do you engage with the projected code at these events?
9. What is the impact of the projected code on your experience of the event?
10. From your perceptions of other people attending these events, how would you describe a *typical* audience member?

- Age and gender

_____

- Musical interests/experience

_____

- Likely occupation

_____

- Other characteristics

_____

11. How closely do *you* fit the pattern you have described above?
12. What is your level of experience (if any) with computer programming?

Music in your life

13. How often do you attend live music events?

○ once a week ○ several times a month ○ every so often ○ rarely

14. What types of music do you most often choose when attending live performances?
15. How often do you listen to recorded music?

( )every day ( )several times a week ( )once a week ( )every so often ( )rarely ( ) never

16. What kinds of music do you prefer when listening to recorded music?
17. To what extent is listening to music and attending gigs an important part of your life?
18. Are you involved in singing, playing or coding music yourself? *If so, please give details.*
19. Would you describe yourself as a musician? *Please explain ...*