Measuring cultural value using social network analysis: a case study on valuing electronic musicians

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Abstract

In evaluating how creative a program or an artefact is, a key factor to consider is the value inherent in that program or artefact. We investigate how to measure subjective, cultural value: value which has been expressed by members of a community towards other members. Specifically we focus on a case study asking: *to what extent can we use social network activity to examine the value that electronic musicians place in each other's work?* Focusing on activity by electronic musicians on the music social network SoundCloud, we combined qualitative and quantitative research to understand and trace significant 'valuing activities' in SoundCloud data. Exploring interaction on the site in this guided way has enabled us to compare, contrast and assess what value is attributed to different members of the electronic music community on SoundCloud. In this paper we report our results and consider how this work offers a methodology for computational analysis of cultural value. We hypothesise that this methodology is extensible to other creative domains; potentially this could lead to a tool for automated cultural value judgement methods on large social network datasets. Hence we move towards computationally generated evaluations of value, a fundamental part of creativity.

Keywords: Social network analysis, value metric, evaluation

Introduction

How can we measure the value of creative entities to a community? (especially unquantified value, expressed through esteem rather than money?) And how could such value judgements be automated across large amounts of data and implemented within computational systems?

Value judgements are a vital part of creativity; the usefulness or value inherent in a creative system and what it does is intricately connected to how creative it is (Ritchie 2007; Jordanous 2012a). In computational research on creativity, we would like our systems to be able to perform evaluation of their own processes. Autonomous judgements of value, integrated within a computational system, are desirable but only occasionally realised in computational creativity.

Value itself can be difficult to identify and measure. In particular, a distinction exists between the more easily identifiable *economic value* of creative works and their producers, compared to their inherent and intangible *cultural value*.

Cultural value is attributed through peer interaction and underground expressions of esteem rather than measures such as sales of artefacts or ticket sales. There is a 'relative independence of a status order built from peer esteem from one built purely upon popularity or sales' (Lena and Pachucki 2013, 239). For example, electronic music is a creative domain consisting of many underground subcultures, where economic or popular recognition is often not achieved and quite often not even pursued to any great degree. Value attributions become difficult to recognise due to lack of official recognition or monetary reward for electronic musicians.

So how do you measure or evaluate cultural value? Here we address this question through a case study on electronic musicians. In the Valuing Electronic Music (VEM) project[1] we investigated how electronic musicians show their appreciation and value for other musicians, via qualitative interviews and quantitative research around SoundCloud,[2] a social network for musicians (particularly for electronic musicians). Our aim was to gauge how value is attributed and recognised through interactions between electronic musicians. In particular, we wanted to identify features of inter-artist networking and peer evaluation contributing to value production that are detectable in quantitative analysis of digital interactions. The main aim relevant to computational creativity is to determine what computational analysis could be performed as a proxy for cultural value.

We argue that the approach developed in the VEM project is adaptable to assessment of value in a range of cultural contexts. We offer a method for empirical evaluation of cultural value through analysis of social interactions.

Value evaluation in computational creativity

Where evaluation of computational creativity systems includes some value judgements, objective metrics have to be carefully selected to ensure value is evaluated in an appropriate and representative manner. In computational work, though, objective metrics have key advantages over subjective data collection, which can be time consuming (especially if collating user feedback) and problematic in terms of identifying representative samples of users. Also, it is difficult to integrate such testing within a computational sys-

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[1] See http://valuingelectronicmusic.org
[2] http://www.soundcloud.com

tem's processes and respond to the feedback, particularly if system testing is carried out towards the end of research projects. But there is a need for autonomous value judgements that could be integrated within computational creativity systems; creativity is not just about new work but also the development and refinement of this work (Boden 2004).[3]

The term *value* encompasses many different aspects such as appropriateness, relevance, usefulness, correctness, worthiness and/or quality. A minimum (probably insufficient) definition of creativity could be $novelty + value$ (Jordanous 2012b). Jordanous (2012a) defines value as:

- 'Making a useful contribution that is valued by others and recognised as an influential achievement; perceived as special; "not just something anybody would have done".

- End product is relevant and appropriate to the domain being worked in.' (Jordanous 2012a, 258)

In his discussion of value, Ritchie (2007) makes extensive use of value ratings but leaves open what type of method should be used to generate these ratings. Domain-general heuristics for value judgements are difficult if not impossible to identify; value is relative to the domain and is embodied in different ways. For example, accuracy is vital for mathematical proof generation systems, (Colton 2008) but not for creative musical improvisation (Jordanous and Keller 2012).

One of this paper's authors recently reviewed evaluation of computational creativity systems (Jordanous 2011). She found that 43% of papers containing some content on system evaluation aimed to evaluate the value, quality or appropriateness of the system or system's output. Many types of empirical value measurements were found, as well as value measurements based on user feedback. The value of a creative system entails more than the value of its products; but this perspective was not evident in Jordanous's review. Typically, systems were evaluated based on the value or validity of the artefacts they produce, e.g. statistical tests for validity, calculations of how fit-for-purpose material produced during runtime was, how interesting their products were, or other domain-specific indicators of validity or value.

Social and cultural value, particularly in music   Blacking noted that the existence of musical geniuses such as Bach and Beethoven is reliant on the presence of a discriminating audience (Blacking 1973). We push this viewpoint further: the relationship between audience and musical performer is both vital for appreciating musical value and the division between audience and musical performer can be blurred. Turino (2008) contrasts 'presentational' musics, based around the quality of works and performances, with 'participatory' musics, where value is within the quality and intensity of social interaction. Turino reminds those in a Western Classical musical mindset of a vital aspect of music: the collective, participatory social aspect of musical

experiences, especially when incorporating collective listening, composition, performance and dancing. For example, social interaction and communication are key for creativity in musical improvisation (Jordanous and Keller 2012).

Csikszentmihalyi (1988) proposes a systems model of creativity as a dynamic process of interaction between Domain, Field and Individual/Person:

> '[creative] is the product of ... a set of social institutions, or *field*, that selects from the variations produced by individuals those that are worth preserving; a stable cultural *domain* that will preserve and transmit the selected new ideas or forms to the following generations; and finally the *individual*, who brings about some change in the domain, a change that the field will consider to be creative.' (Csikszentmihalyi 1988, 325).

Csikszentmihalyi's emphasis on interactions between domain, individual and field (Csikszentmihalyi 1988), can be situated within the broader area of *field theory* (Bourdieu 1993) where producers compete for recognition rather than financial gain. Bourdieu posits that all agents involved in music-making form part of the musical communities that attribute value to music-making activities, regardless of level of ability or profile. So 'hidden musicians' (Finnegan 2007) (everyday music-makers who are key to the musical life of communities but understudied by scholars and publics) play a significant part in determining who and what is valuable within musical practices (Dueck 2013). Exploring how hidden and star musicians link together in networks of evaluation and commentary lets us see how all depend upon one another, jointly producing the cultural context in which their music can have value. Although Bourdieu focused on what he termed 'legitimate' culture (i.e. serious literature, art music, etc), his ideas have since been adapted to other cultural forms e.g. Lopes 2000 (jazz), Elafros 2013 (hip-hop).

Social networking and new media websites have provided music makers with new spaces in which to negotiate and produce cultural value for their work, taking on tasks that would once have been the sphere of specialists in marketing, publicity and criticism. These phenomena appear to have had a particular impact on electronic music, which is typically made by lone, but highly networked, individuals and is often circulated non-commercially online. A recent report across UK-based professional musicians found that 64% 'us[e] web-based technologies to produce, promote, and distribute their music' (DHA Communications 2012).[4]

De Nooy argues that social network analysis can legitimately 'be used to gauge the amount of... symbolic capital' (De Nooy 2003, 325). De Nooy's proposed approach to the study of symbolic capital had been successfully implemented as a methodology for studying the production of cultural value by one author of this paper (Allington, under review). Allington used data harvested from online sources to study the production of value within Interactive Fiction (stories that develop in plot through user interaction). Centrality measures were used to assess the level of value associated with specific creators working within that community

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[3]Some computational creativity researchers use evaluation in the processes of creative systems (Pérez y Pérez, Aguilar, and Negrete 2010, engagement-reflection), (McCormack 2007, evolutionary computing), (Pease, Guhe, and Smaill 2010, generate-and-test).

[4]This figure may be higher for electronic music, which typically attracts music makers highly familiar with digital technology.

(Allington, under review). Allington's methodology formed the starting point of the present project (complemented with ethnographic research). We scale up from de Nooy's work with tens of producers and Allington's with thousands, to hundreds of thousands of users in the current work.

Identifying cultural value in electronic music

Looking specifically at electronic music, the Valuing Electronic Music project investigates how we can gauge what cultural value electronic musicians hold. With the above discussions guiding our work, we looked at how peer groups of electronic musicians showed appreciation of each other. Our quantitative work focused on tracing activities for ascribing value to users, through network analysis on large collections of data. This paper reports the project's findings, from the perspective of developing a methodology for empirically identifying and evaluating cultural value (that could in future be incorporated autonomously in a creative system).

Partly inspired by successes using social network analysis to make proxy judgements about value within a network of Interactive Fiction writers (Allington, under review), the research focuses on interactions between creative producers on the music social network SoundCloud, aggregating peer evaluations and tracing the production of value.

Our approach to cultural value judgements   Our quantitative research centred around collecting and analysing data from SoundCloud's API, about how users interacted with each other on SoundCloud. SoundCloud provides a good data source for technical reasons (a well-developed API provides access to all public data), for social reasons (it is widely used by amateur, semi-professional, and professional electronic musicians for networking and publishing music), and for ethical reasons (the data is clearly marked to site users as public). This sits in contrast to sites such MySpace, which has declined in popularity.

We initially collected data on all demographic information and activities that SoundCloud made public, with the intention of using our qualitative data to understand the relative importance of each activity. Demographic data that users had made publicly available include their location, URLs and avatars relating to their online profile, number of followers, details of record labels they were attached to, etc.[5]The activities that we collected user data for were the publishing of tracks, following and being followed by other users, liking a track, commenting on a track, creating personal playlists of tracks and creating or joining a group.

While the project was primarily a study of online data, this study was contextualised and enriched through study of SoundCloud users in the offline environments in which they primarily perform. In particular, our initial research on SoundCloud suggested there existed more-or-less closely-knit communities of co-located producers of electronic music. This implies that, even in the apparently transnational world of electronic music and online distribution, the social

production of value may still be influenced by localised real-time face-to-face interactions. Hence 'offline' qualitative work was conducted alongside our quantitative work, with each mode of research guiding and influencing the other.

We interviewed eight electronic musicians, representing various different types of musicians in different genres from grime to techno. We also attended three electronic music performances and made observations, and interviewed a panel of three musicians at a public event we organised in London in June 2014. Informing our qualitative research, we also actively engaged in the SoundCloud community e.g. 'liking' tracks we enjoyed and following musicians. The interviews helped us to explore the performers' perceptions of value. Using semi-structured interviews allowed us to cover areas of interest such as how the interviewees valued other people's music, while allowing the interviewee to guide the conversation towards areas they felt important. Observation data from gigs (e.g. order of appearance of various performers, prominence of performers' names on promotional materials, audience behaviour, etc) informed the interviews themselves as well as providing much-needed context for our relatively abstract online data.

A common theme emerging from our qualitative research was that rather than searching for *value* (as an entity to measure), we should be focusing on *valuing activities*. Actions by and interactions between musicians were reported by interviewees as a vital way in which they perceived that people appreciated them and their work. Similarly in observations during gigs and in specific questions to live performers, we often noted the importance attached to people's body language and responses to music. In these electronic music communities, the status attached to people also affected to what degree any valuing activities were. In particular, our interviewees typically gave higher credence to interactions with other musicians, compared to those with non-musicians (or those perceived as a non-musician, for example if their reputation as a musician was not known by the interviewee, if they had not mentioned their own musical activities during the interactions or if they had not included pointers to their own work in their SoundCloud profile or other online profiles). This is similar to Bourdieu's emphasis on cultural producers' esteem for one another's work (Bourdieu 1993).

Data Collection   We wrote code in Python to collect public data automatically from SoundCloud, using the SoundCloud API and Python SDK.[6] It was impractical to study the entire network of users, which comprises tens of millions of accounts, many of them inactive or controlled by bots, and huge amounts of data to collect. We initially adopted a snowball sampling method: starting with a seed individual, collecting data for the seed and the individuals they are connected to, then collecting data for the individuals connected to our seed's connections, and so on). However, we encountered problems with this approach due to SoundCloud network structure and sheer density of data. Many millions of

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[5]More details at the SoundCloud API documentation at http://developers.soundcloud.com/docs/api/guide and our github: http://www.github.com/ValuingElectronicMusic/network-analysis.

[6]This code is open-source and available at http://www.github.com/ValuingElectronicMusic/network-analysis - it is built from existing code by Allington for social network analysis, also available from the ValuingElectronicMusic github.

users would frequently be found within just two degrees of separation of a single individual. Undeclared restrictions placed by the SoundCloud API on downloads of information meant that we were prevented from collecting full data on all of those people, with an upper limit of 8199 in place. For example, if a given user had over 100000 followers, one would be unable to discover the identity of more than 8199 of them.

Following discussion with experts at a workshop organised as part of the project, we decided to adopt a different approach. We switched to a two-fold data collection approach of (i) a sample of 150000 randomly selected SoundCloud users and (ii) ego-networks consisting of the networks of users around our interviewees and their followers/followees. In each case, we collected all publicly available data about each user, along with data on all tracks uploaded by these users and those who followed them. Due to the download restrictions of the SoundCloud API we could only download up to 8199 items of data per information request, but in practice this only affected data collection for a very small number of highly popular SoundCloud users. Some minimal data cleaning was needed, mainly for reconciling locations of users where different people used different variations of a location name (e.g. Cairo and Al Qahirah, or NYC and New York), or neighbourhoods within cities rather than cities.

Genres of electronic music are varied and broad, including: house, trance, techno, trap, EDM, ambient, grime, etc. Initial research showed that while the predominant types of music on SoundCloud are in electronic music genres, SoundCloud tracks are often tagged as belonging to a subgenre of electronic music, rather than as 'electronic'. To locate data corresponding to electronic musicians, we could not merely search for those who published music tagged as 'electronic', nor would it be appropriate to treat all electronic music genres as belonging to one community (as confirmed by our interviewees). Instead we made use of the fact that most musicians actively participating on SoundCloud (uploading music, interacting with other users) were electronic musicians. In our data collection, then, we collected data on randomly chosen musicians such that we could later filter the data by genres or other pertinent factors (to be informed by our qualitative research).

Working out what data to look for In interviews, we asked if there were valuing activities the participants would highlight as important on SoundCloud, and if so, which ones. In general, even minimal acts of valuing such as playing someone's track were considered to have some value. Participants highlighted indication of a longer term public support base via number of followers, and the use of the commenting facility for people to leave messages on individual uploaded tracks. Further, participants valued activities which arose from or led to offline connections and collaborations, although this type of activity is difficult to track quantitatively.[7] Activities such as playing or 'liking'

someone's track or including a track in a personal playlist or group were not highlighted, possibly because it is less easy to trace the provenance of this kind of valuing activity to individual musicians and hence less easy to judge the credibility of the person being interacted with.

The facility to follow and be followed by other SoundCloud users was widely used by users, and afforded analysis or user interaction on a wider scale than at the level of individual comments, allowing us to detect general trends in much larger samples of data. While the follow activity does not require much engagement compared to making a comment on someone's track, nevertheless this activity identifies a SoundCloud user as showing their valuing of another user, in a publicly accessible manner. Qualitatively, we found that there was value attached to having large numbers of followers, though the participants disagreed as to how important this was to them personally. Quantitative analysis revealed, however, that SoundCloud is not a media which compares to YouTube or Twitter in terms of magnitude of followers. In our 150000 user sample, only three accounts had over 100000 followers and all of these accounts represented agents involved in music that had enjoyed significant commercial/popular recognition, above the subcultural recognition that is more common in electronic music scenes.

Interim results and redirections in our quantitative research Following Allington (under review), initial quantitative research (Jordanous, Allington, and Dueck 2014) saw us seek the top-ranked users according to centrality measures. (Centrality measures highlight the most influential nodes in a network.) We also attempted to visualise the networks but found that graphs for samples greater than 500 users would be unreadable. We measured recommendation and influence through indegree rankings (a measure based around how many users follow another user). In an initial test sample of 1500 users, we identified key users. This ranking did find some key players in electronic music whose data had been captured in our sample, such as Tiésto. Our results, however, did not help us understand the network at a deeper level, particularly regarding our search for cultural value through peer esteem. While indegree is more sophisticated than merely measuring the number of followers per account, there was some similarity between these two rankings. A 'Justin Timberlake' account, for example, comes in at position 20, despite having no interactive activity on SoundCloud and therefore no identifiable contribution to cultural value through SoundCloud interactions.

We started to explore more sophisticated methods such as PageRank and eigenvector rankings to help identify key players in SoundCloud's networks. However we started to notice a mismatch between qualitative findings and the shape of our quantitative data, stemming from earlier observations about the nature of sub communities within electronic music. In interviews, when we asked questions about valuing and appreciation, participants often replied in terms

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[7]Collaborations between two SoundCloud musicians are tricky to detect in SoundCloud data, as tracks on SoundCloud can only be attributed to a single creator. Tracks with two or more associated creators tend to either be uploaded by one of the collaborators with

text pointing to the other collaborator(s), or via the creation of a new SoundCloud account representing all the collaborators, which is distinct from the collaborators' personal accounts.

of relationships and interaction. When we probed further, the participants tended to answer in terms of the genre(s) they produced music in, reframing the question to focus on that sub-community they were part of.

Understanding that we should look for subnetworks and cliques within our data, we investigated on what grounds we should cluster our data, through interviews and through inspection of our data for commonly occurring links. Genre was one important clustering factor suggested in the interviews. Somewhat surprisingly for an online network, geographical location was another factor we were guided to investigate. Participants reported how offline interactions at particular places fed back into the social network interactions. The importance of offline contacts could not be ignored, especially given the social network 'fatigue' reported by some participants in building their profiles. In terms of location having an influence on a musician's perceived value, our interviewees talked about the importance of their location for raising their profile and credibility. Though some had experience of being based elsewhere, many of our interviewees were based in London, which - as we find below - is an important centre for electronic music. One participant in particular reported a conscious decision to base themselves in London for profile-raising reasons.

Analysis of clusters of users and sub-networks   Learning from experience, our quantitative research focused on what sub-communities and clusters existed in our data. We took two directions: 1. constructing and studying multiple networks of electronic music producers and their connections, and 2. using the comments-based data to identify the language used between peers to express value.

We built networks of accounts and tracks, based on 'follow' relationships, which we could re-apply centrality measures to. Clusters and cliques in these networks were also identified where possible, based on available metadata about users and tracks such as genre. We should note here that many users do not provide location information, particularly if not active users (though we focus on those users who actively engage with other users on SoundCloud).

Inspecting the data on comments about tracks, we noted that the overwhelming majority of comments tended to be positive, unlike commenting activity typically observed on sites such as YouTube (Pihlaja 2012). In our analysis of the comments data (filtered from spam where possible) we used the Open Office dictionaries for English, French, Spanish and Italian to identify and extract English language comments to reasonable accuracy.[8]   We treated the English-language comments on tracks as corpora based on track genres. Corpus analysis allowed us to identify evaluative vocabularies associated with particular genres, groups, and locations, by comparing these subcorpora on the lexical level. Given that SoundCloud comments were typically positive (or spam), we posit these vocabularies as genre-specific indicators of value as expressed in that genre.

Table 1: Follow relationships by frequency of locations

	Location of followed	Location of follower	n
1	London	London	3799
2	Melbourne	Melbourne	2274
3	Berlin	Berlin	1375
4	Paris	Paris	1253
5	New York	New York	1190

Computational analysis: Results and discussion[9]

Geography   Analysis of locations in our random sample revealed London as the most common city location for music makers (users who had uploaded tracks to SoundCloud); 200 accounts out of the 17357 eligible accounts were attached to users based in London. London music-makers had the highest mean number of followers, though a disproportionately high standard deviation reveals results were skewed by a small number of very highly followed accounts.

On analysing individual ego-networks of our participants, we could identify clear clusters within the ego-network based on location of the users, indicating a preference for users to follow other users in the same geographical area as them. This hypothesis was supported by evidence in the larger random sample (see Table 1).

Other key cities identified through our random sample behind London were New York (171 accounts belonging to music-makers), Los Angeles (93), Chicago and Paris (both 81). In terms of followers, strong bidirectional links were identified between London, New York and Los Angeles (UK/US), and then between London, Berlin and Paris (major European capitals). Given that this part of our analysis was genre-agnostic, it was surprising to see cities such as Nashville and Mumbai, with strong musical connections to country music and Bollywood music respectively, featuring little in the interconnected data. Perhaps this is because these types of music do not enjoy the same associations with online/digital technologies and, more specifically, with SoundCloud (emphasising the need to ensure that the social interactions you are analysing are relevant to the creative communities you study).

Using eigenvector centrality based on a graph connected by follow relationships, we identified similar rankings; the central node in this graph was London (0.90093 centrality), followed by New York (0.24838), Berlin (0.20645), Los Angeles (0.20121) and Paris (0.10437). By country, the United States was top by some degree (0.96823 centrality, with the second highest centrality at 0.21216 for the UK). Germany, Canada and France were next in influence, with centrality of 0.07380, 0.05749 and 0.05193 respectively.

Genre   In raw frequencies, hiphop producers were most prevalent in our sample, with 155 users uploading tracks

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[8]Our approach did not pick up comments such as 'wooooot!!!' or 'loveeeeeeeeee', the type of which occur frequently in our data.

[9]The following is a synopsis of findings that are relevant to developing computational analysis of cultural value. Fuller reports of our findings are described in (Allington, Dueck, and Jordanous, submitted) and (Allington, Jordanous, and Dueck 2014).

Table 2: Follow relationships by genre

	Follower	Following	n
1	hiphop	hiphop	2443
2	house	house	2276
3	techno	techno	1415
4	progressive house	house	800
5	dubstep	dubstep	679

Figure 1: Co-occurrence of genres in track tags

tagged as 'hiphop'. House music was second (90 users), followed by rock (61), rap (59) and pop (49). However once we start to study the inherent cultural value through interactions between producers, we see different results as to the influence of different genres. We used eigenvector centrality based on follow relationships to study how producers of music within one genre interacted with music-makers in other genres. In our sample, house music producers were most influential, followed by hiphop, techno, and deephouse. Music tagged as 'electronic' is still prevalent, though its subcategories are widely used as tags instead. These fuller results (Allington, Jordanous, and Dueck 2014, Table 27) also evidenced the influence of electronic musicians (as opposed to musicians of other genres) on SoundCloud.

Many tracks were tagged with more than one genre term, and Figure 1 reveals patterns within genre tagging that empirically support existing genre classifications. Clustering together tags that frequently occurred together on tracks, we identified three macro-genres that could be categorised as 'EDM' (Electronic Dance Music), 'urban', and a miscellaneous 'other' category. The two named macro-genres 'EDM' and 'urban' align with an analysis of data from 2007 on all musical genres on MySpace by Lee & Silver (2014), identifiably corresponding to two clusters that they tagged as 'Electro/Dance' and 'Black & Brown' respectively.

Focusing on activity in the EDM and urban clusters (as the 'Other' cluster contains negligible activity) typically EDM producers follow other EDM producers, and similarly Urban producers follow other Urban producers. Looking at the genre level, a similar pattern of following producers within the same genre is noted (see Table 2).

Follower activity A common-sense hypothesis was supported by results: users who uploaded tracks to SoundCloud typically had more followers than those who did not (a mean of 127 followers per account for those who uploaded public tracks, compared to a mean of 19 per all types of users in our 150000-users sample). If we take our qualitative findings that number of followers is generally positively associated with value recognition, then we can underline that music-makers are valued in the SoundCloud community.

Commenting activity Taking the three macro-genres we identified, EDM producers were the most prolific commenters with 11711 comments, compared to 3673 comments by urban producers, and 2982 comments by producers of the 'other' genres. By genre, dubstep producers engaged in commenting behaviour the most (2569 comments), then techno (2254), hiphop (2081) and house (1725).
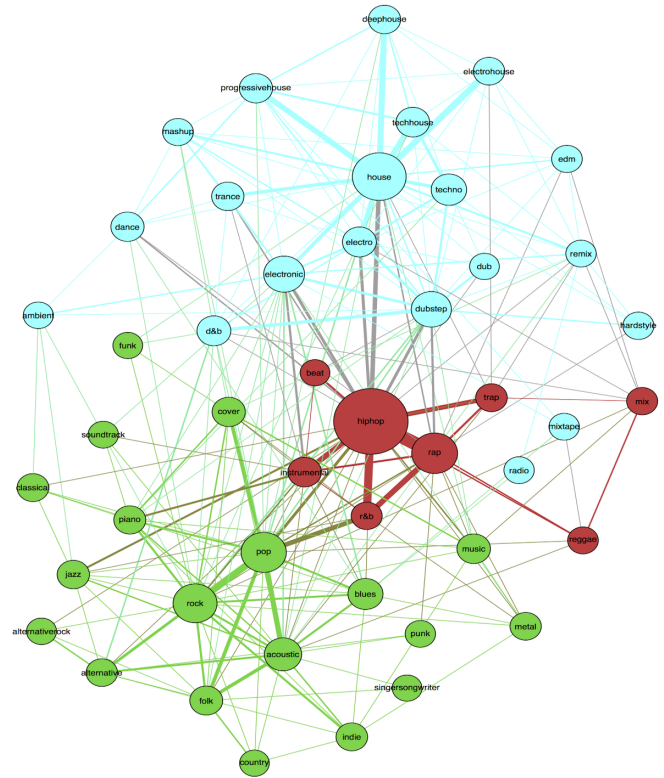
From the comments we have (as described above) identified genre-specific English-language vocabularies indicating value expressions. Keywords are presented for the top genres in Table 3, in order of 'keyless' (decreasing proportional frequency). This table shows the different types of vocabulary prevalent per genre, for example keywords in comments on techno tracks appear more polite than on hiphop tracks.

Evaluation of our approach

When is social network analysis appropriate as a proxy for measuring cultural value? As shown by the lack of useful results of SoundCloud users in cities like Nashville and Mumbai, one needs to ensure they are analysing appropriate social networks for their specific creative domain. There may not be a relevant social network directly for these acoustic-music-based communities, but general social networks such as Twitter may prove useful.

How could the VEM findings be useful to computational creativity researchers? Cynically, perhaps, we could set up a London-based SoundCloud account for a hypothetical electronic music computational creativity system we want to promote the work of, ensuring we (or the system) upload(s) tracks produced by our system. We could concentrate efforts on developing our hypothetical system's ability to interact with other music-makers' tracks who work in similar

Table 3: Genre-specific keywords for expressing value

	Dubstep	Techno	Hiphop	House
1	sick	set	dope	nice
2	tune	great	shit	house
3	nice	tracks	beat	super
4	big	loved	leave	production
5	mix	fantastic	song	support

genres, commenting on such tracks and responding to comments on its own tracks using keywords which have been identified as commonly used in the genre we are working in. We could develop our system to follow other music-makers based in strategically important cities such as London, New York, Los Angeles, Paris or Berlin, or who upload music of similar genres. While this would not necessarily develop the musicality of our hypothetical artificial electronic musician, we argue such moves (if executed plausibly) would help increase the cultural value attributed to our musician (notwithstanding the debate about the effects of identifying the account - or not - as that of an artificial musician (Moffat and Kelly 2006; Cook and Colton 2014)).

How could social network analysis be used more broadly within computational creativity? For this work to be most useful to computational creativity researchers, it could a. show how cultural value can be identified and gauged through research and/or b. offer a way of autonomously making value judgements about computational creativity systems. We believe that our work above demonstrates point a., how to tangibly identify markers that indicate cultural value. Allington (under review) has previously used similar network analysis to study Interactive Fiction.

What we pursue now is the afore-mentioned point b., a methodology for using computational network analysis to gauge the cultural value associated with a creative entity such as a computational creativity system. For such an approach to work, we need the system to be capable of interacting with relevant online communities in a plausible manner, as suggested above for our hypothetical electronic computer musician. We also need there to exist an appropriate social network for such interactions to take place in, or as a fascinating alternative, a multi-agent system or similar digital environment containing several interacting agents. For the actual analysis, we advocate using a combination of initial quantitative data analysis and qualitative research to identify key indicators of cultural value that can be traced in the social network interactions. With these conditions in place, we can analyse interactions in the network and compare our creative system or agent to others within the network to gauge the value inherent in its interactive social behaviour.

Future work Our results show that electronic music subcultures are geographically influenced and, within the UK, heavily London-centric. Our quantitative methodology could reveal important scenes associated with other cities, and whether we could identify musicians that are considered heavily influential and 'valuable' to the local scene(s).

Somewhat inspired by the 2014 Scotland independence referendum, we plan to examine electronic music scenes within Scotland to test our methodology. Our next step will be to apply the same approach to other creative domains to see if social network analysis can be applied more broadly for computationally analysing cultural value. We would welcome collaborations.

Further useful information may be gained from quantitative analysis of comments made by users on each other's tracks, though this was not so straightforward to analyse during the project's funded time. In this work we would have liked to explore and build networks of users based around 'comment' relationships between users. Such work will require considerably more intricate and varied analysis to filter links based around genuine comments. Ongoing work is currently examining the links between users based on commenting behaviours. We would also like to examine conversations; repeated comments or comments on multiple tracks from a user should indicate greater peer engagement. Conversations proved rather difficult to detect quantitatively due to the lack of a standard way to indicate who your comments are directed towards, but their analysis would be useful.

Conclusions

Value is recognised as a key aspect of creativity. In evaluating computational creativity, one large problem we face is in gauging the value of the work generated by our systems. Such evaluation is particularly problematic when we consider that value is often a cultural and intangible resource apportioned subjectively through the actions of peers.

To what extent can we use social network activity to identify the cultural value of creative entities? Here we addressed this question through a case study investigating how electronic musicians place value in each other's work. The Valuing Electronic Music (VEM) project combined ethnographic observation/interviewing with automated collection of quantitative data from the SoundCloud music networking site. Our approach has implications for how we could measure cultural value in other domains, as well as contributing to our understanding of cultural value in electronic music.

Challenges and rewards alike come from combining situated qualitative research with quantitative analysis of large datasets gathered online. Learning from (and feeding back into) the findings from interviews with electronic musicians, we used computational analysis to study interactions in social networks.[10] Through such analysis we extrapolated information about how musicians interact with each other on SoundCloud, and how they express appreciation of each other's work. Typically, it was more productive to study clusters of strongly connected cliques within the SoundCloud network, rather than a sample of the entire network. The SoundCloud user community tends to cluster according to several factors. We found empirical evidence of clusters forming around common musical genres, and also of clusters around certain privileged geographical locations such

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[10]Our approach echoes (Jordanous 2012b): to better represent creative activities using quantitative models, we need good understanding of the creative domain as well as the models themselves.

as London. One key 'take-home' finding from this work is that one can study cultural value computationally by studying social activity, but often it is most useful to study interaction between smaller sub-groups of a network, rather than taking an overall view of the entire network as a whole. In other words, to understand how people express value for each other's work, we should look for social interactions and the building of relationships within a community.

We found that while certain kinds of activity on Sound-Cloud have little apparent economic value (e.g. commenting on each others' tracks, publishing free downloads) these activities seem to generate cultural value that facilitates more economically valuable work. For the most part, music-makers assert their concern for all listeners, but close attention to their activity (and how they describe it) suggests that interactions with peers (i.e. fellow music makers, preferably within similar genres, areas or with other links) are especially important for the production of value for their work.

Our computational analysis of SoundCloud data allowed us to approximate the value placed in electronic musicians' work, showing that we can use social network analysis as a proxy for measuring certain types of musical and cultural value in a creative domain. We hypothesise that our methodology can be extended to analyse quantitatively the value inherent in other social networks centred around creative activity. We believe that this work contributes towards a significant type of tool in our 'computational creativity toolkit': an automatable method for evaluating social/cultural value.

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