

Cognitive mapping and its implication for understanding cultural behaviors and experiences in libraries

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Highlights

- Cognitive mapping helps explore international students library engagement and personalization of their library journey
- Mapping techniques are an accessible way to develop narratives without language barriers or textual mechanisms
- Cognitive mapping is beneficial in revealing the complexity of cognition, perception, experience and behavior

Abstract

Cognitive mapping is a method typically adopted in ethnographical research to learn about library user behavior and experience in a cross-cultural context. Through reporting practical findings from a case study, where it served as a key method, the usefulness of cognitive mapping in revealing cognitive style and perceptions of the library and in understanding cultural users' behaviors and experiences is explored. Cognitive mapping offers an open exploratory way to help self-reflection of personal contexts regardless of language constraints. As such, it provides for the study of multiple cultural communities. In addition, its potential of usage in a virtual environment is presented. One limitation of this method is the extent to which it can reveal the holistic picture of library experience in isolation. As such, it works well when applied with other data collection techniques to form a flexible yet robust methodological framework to learning about library cultural groups.

1. Introduction

The scale of internationalization in libraries, especially in academic libraries, has extended dramatically in the past two decades; it is not only a by-product of globalization but also a result of missions and strategies enacted by cross-cultural communication initiatives (IFLA & UNESCO,

2012). Within this context, there is always a necessity and a responsibility for libraries to support inclusion and ensure participation of all users in its community, and this need has been particularly acknowledged by IFLA in facing the post-pandemic challenge (IFLA, 2021). International library users, who are working or studying in a different domain other than their national home setting, have not been extensively studied, despite their significant and increasing numbers. Where they have been, the research approaches have often been limited to surveys, as noted by Click et al. (2017), who conducted a systematic review of the literature which had studied international students and academic libraries between 1990 to 2014. These studies assisted in demonstrating their preferences or viewpoints and tendency of choices on a large scale but it was difficult to elicit personal reflections or in depth contextual understanding (Click et al., 2017). The literature review for this study found that there had been some ethnographic approaches, including cognitive mapping, to understand library interactions within library contexts (Asher, 2013; Bauer, 2018; Lanclos, 2013). However, many dimensions and complexities in understanding international engagement with libraries had not been probed. As such, this article seeks to provide an alternative approach to understanding international users' behaviors and experiences with and within the library.

As an ethnographic method, cognitive mapping has been borrowed by librarians in short-term user experience (UX) projects focusing on applied problem solving to study behaviors, activities, evaluations and other aspects of user-library interactions mainly in the physical library space (Asher, 2013; Lanclos, 2013; Lanclos & Asher, 2016). Methodologically, there have been some explorations around the mixture of cognitive mapping with other qualitative techniques (Gourlay et al., 2015; Kjaergaard & Jensen, 2008); and trials of cognitive mapping with other quantitative approaches such as questionnaires (Sharman, 2017). Nevertheless, borrowing ethnographic approaches in library UX research is still at an exploration stage and there is a gap in structuring the methodology of researching international community's library experience.

1.1 Problem statement

The present study intends to explore the research method of cognitive mapping in investigating international library users' behavior and experience in academic libraries. Specifically, three research questions were put forward and drove the investigation:

- What does cognitive mapping allow us to probe in terms of library behaviors and experiences?
- What are the essential benefits and values of cognitive mapping in understanding cultural groups?
- What limitations does cognitive mapping have in exploring library behaviors and experiences?

This study aims to offer insights into the methodological design of cultural library user research in the context of a representative group of international Chinese library users studying in a UK university. It takes a close look into the literature of cognitive mapping and demonstrates how critical findings can be made through combining this research method with other approaches.

2. Literature review

2.1 Evolution of cognitive mapping

The term cognitive mapping was first introduced in 1948 by psychologist Edward C. Tolman who researched into finding how cognitive maps help human and animals find their way in a complicated environment (Tolman, 1948). In his study of learning how rats and human use cognitive maps to find a route in a maze, he found that the difference they showed between representations of their cognition and the actual physical environment could demonstrate the elements they consider important (Tolman, 1948). Tolman's study flagged a shift from behaviorism to cognitivism, and his cognitive map stands for a mental representation of knowledge (Overdijk, 2017). George Kelly, who is also an American psychologist, put forward the personal construct psychology theory, which provided a new perspective on solving the problems of personal and organizational relationships by using cognitive mapping (Eden, 1988). Kelly observed that the way people understand and react to a context or problem is largely dependent on how they 'construct the world', and this also influences their behavior (Kelly, 1991).

From the 1960s, extensive research on cognitive mapping and its relationship with human spatial behavior was carried out by geographers. Foundational works of urban geographers such as Kevin Lynch's *The Image of the City* used cognitive maps to elicit the features, feelings and reflections of residents' daily routes. The map is viewed as a symbol-structure which acts as a conceptual framework to retrieve geographical information (Lynch, 1960). In another geographer's research on mental image, cognitive mapping is described as a process of using past knowledge and experience to understand and deal with current and future situations (Downing, 1992). People encounter information and learn from their surrounding environment in either conscious or unconscious ways; they use such cognitive knowledge to instruct their present and future life, which holds the view that people receive information from the outside world, construct knowledge and create subjective representations from their own experience and understanding (Jonassen, 1991). They believe that individuals understand the world from their personal experience; that is, they do not simply receive knowledge from the outside world, rather, they form the personal unique reality based on their past experience (Ertmer & Newby, 2013). This learning process or knowledge acquisition is the result of the reconstruction of existing knowledge and new experience. As concluded by Doolittle (2014), "learning is the adaptive and self-organized construction of knowledge that is a function of both one's prior knowledge and experience, and one's current socio-cultural activity" (p. 487). That is, the knowledge people form through learning is not an accurate reflection of the information they get, but rather, it is a self-regulated process in light of their past knowledge and experience (Doolittle, 2014). This learning process is similar with the forming of cognitive maps.

Although at that time, researchers from different fields were adopting the concept of cognitive mapping in their research, there was a general lack of in-depth discussion on its nature. Downs & Stea (1973) offered a formal definition of cognitive mapping as,

a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls and decodes information about the relative locations and attributes of phenomena in his everyday spatial environment (p. 8).

They emphasized the forming process of cognitive maps, which is described as a complete mental process with five stages of acquiring, coding, storing, recalling and decoding. People get in touch

with information from complex, changing and unpredictable sources in their everyday life and take in information by imperfect information processing dependent upon abilities and different levels of understanding. Through this comprehensive process of receiving, storing, merging and decoding, people then form their own internal representations of the world (Downs & Stea, 1973, pp. 9–10). This process is defined as cognitive mapping and the product of this process is regarded as the cognitive map. This definition also indicates a connection between cognitive mapping and the sense-making process; the psychological process happening through the forming of cognitive maps can be understood as the mental reactions when people make sense of the phenomena around them. They encounter unfamiliar situations and gather information, understanding and processing it in their own way, while the cognitive map is one form of their expression or representation of this sense-making process. It is also indicated that the cognitive process is continually changing with one's developmental and learning experiences (Downs & Stea, 1973). In their research, Downs and Stea also indicated that people's cognitive maps can be essential when making spatial decisions and reacting in terms of behaviors in the environment (Downs & Stea, 1973). Cognitive maps can be manifested in everything, from individual decision-making to the attitude towards the world (Golledge & Timmermans, 1989).

Cognitive mapping holds a multidisciplinary nature as is indicated by Kitchin (1994) who reviewed its application in different academic fields and contexts, including geography, psychology, cognitive science, sociology, anthropology and education. In Kitchin's (1994) review there are four viewpoints on the form of cognitive maps. Because of the term 'map', researchers understand it in different ways, such as a cartographic map, a map-like presentation, a map in the mind and a hypothetical construct which has no literal meaning (Kitchin, 1994). The researchers who put emphasis on the map's geometrical and Euclidean characteristics argue that cognitive maps are cartographic maps and this point of view stems from psychology studies on animal wayfinding activities (Kitchin, 1994). The most commonly believed viewpoint takes the cognitive map as a map-like presentation or a map in the mind. In the realm of social science, these two understandings of cognitive map are commonly accepted. Understanding it as a map-like presentation, researchers state that the cognitive map is, "far from a cartographer's map; however, it is schematic, sketchy, incomplete, distorted and otherwise simplified and idiosyncratic" and it is "a product of experience, not of precise measurement" (Kaplan, 1973a, p. 276). They argue that it is a presentation of people's mind, integrating information and knowledge to form a representation, which has some map-like qualities. Researchers who understand a cognitive map as a map in the mind, use this term as a metaphor. In their viewpoint, a cognitive map is something that is stored in people's mind including abstract conceptual relationships (Kaplan, 1973b). Some researchers use this term as a hypothetical construct which refers to "non-observed processes and organizations of elements of knowledge" (Moore & Golledge, 1976, p. 8). This understanding of the cognitive map suggests it may contain more meanings and elements. The viewpoint adopted in this present study is that cognitive maps are map-like representations of people's minds. Because of this multidisciplinary feature, cognitive mapping is adaptable, enabling its application in a variety of academic fields and allowing the integration of knowledge from different disciplines.

Since it may be hard to grasp each and every understanding of cognitive maps, they could be categorized into two types: geographically-oriented cognitive maps (such as Asher, 2013; Bullingham, 2015; and Duke & Asher, 2011), and conceptually-oriented maps (e.g. Gourlay et. al 2015 and Kelly, 1991). For conceptually-oriented maps, it is helpful to see the sequence of thinking,

the elements that are missed out and the important level of different elements from cognitive maps. In geographically-oriented cognitive maps, user's knowledge of a particular place and how they find their way in an environment can be learned, and geographers can then find out whether a place is well known or not by its specific users and improve the design of the architecture accordingly (Kitchin, 1994).

2.2 Cognitive mapping and mapping techniques in social science

In social science, art-based or visual methods are commonly used as complementary techniques to triangulate qualitative data (Leavy, 2008). Such techniques, including photovoice, mapping exercises and image-aid activities, are believed useful in actively engaging participants to help them express and dwell on their opinions, perspectives and feelings (Benson & Cox, 2014). By expressing their opinions through visual tools, rather than merely words, enriched and sometimes unexpected data can be found and abstract topics can be made understandable and concrete as well (Cox et al., 2014). It is also believed to be highly accessible and helpful in eliciting representative narratives about the meanings of information from everyday life (Hicks & Lloyd, 2018).

Social scientists have adopted photovoice as an elicitation device to encourage participants to create photographs on a specific topic and let them explain and interpret the behind story (Given et al., 2011; Greyson et al., 2017). Mapping techniques, as another frequently used art-based method, are relatively complicated because of their different forms and application in varied disciplines. For example, geographic mapping is often adopted in geography and architecture research to mainly explore the geographic characteristics of space and environment (Cox & Benson, 2017); relational mapping is an effective tool in analyzing relations in complex systems (Radford, 2000); cognitive mapping and mental mapping has focused more on people's psychological and mental world and is used in exploring information activities of people (Blaut et al., 2003; Kitchin, 1994).

Cognitive mapping, as well as other ethnographic approaches, allows efficient collection of rich data in a short time. In the field of social science, it is used in a more general way to map how people understand the world (Pinch et al., 2009). The term 'cognition' is defined by Rosenthal & Zimmerman (1978, p. 2) as the "way people perceive and interpret events". Individuals react to the situation based on their existing knowledge and belief. Cognition is also described as a process of refining information (Rosenthal & Zimmerman, 1978). It is formed through accepting, storing, and retrieving information during learning activities. 'Map' refers to the cognition formation and presentation from the outside world (Downs & Stea, 2011, p. 313). It is pointed out that 'map' in cognitive mapping means the mind status of participants, thus it can be a "mind map or text based" map (Priestner & Borg, 2016, p. 14). The quality of the map is not decided by the drawing but depends on the contents or elements highlighted by participants. Cognitive maps are regarded as, "internally represented schemas or mental models for particular problem-solving domains that are learned and encoded as a result of an individual's interaction with their environment" (Swan, 1997, p. 188). Therefore, cognitive maps provide a presentation for what is known and believed, and exhibit the reasoning behind purposeful actions (Fiol & Huff, 1992). Within this context, this definition of cognitive mapping has similar implications with cognitivist's view on learning. Learning, from a cognitivism perspective, is viewed as a whole mental process of receiving, organizing, storing, and retrieving information in the mind (Marx et al., 1985). For cognitivists, the learner is at the center of the learning process, playing an active role in mapping personal

beliefs, attitudes, values and cognition upon mental activities (Doolittle, 2014). Both cognitive mapping and learning are treated as mental processes from input to output of knowledge with some transformative effects brought by personal experience.

Fiol and Huff (1992) summarized a number of advantages of using cognitive mapping, including: being able to focus attention and trigger memory; helping to highlight priorities and key factors; to aid in the supply of missing information; to reveal gaps in information or reasoning that need more direct attention. Kitchin & Freundschuh (2000) pointed out that cognitive mapping can be used to comprehend how people understand the spatial relations gained through primary experience and secondary media. In some cases, it is also used to get a drawing of people's cognitive process and to discover how people understand the environment that surrounds them (Kitchin & Freundschuh, 2000).

In the library context in particular, cognitive mapping, likewise other ethnographic approaches, has been adopted in library UX research, which is also described as “ethnographish”, distinguishing from the typical ethnography research (Lanclos & Asher, 2016). Library UX research has more targeted problems to solve and focuses explicitly on improving the library system and service design. Andrew Asher and Donna Lanclos are pioneers who adopted ethnographic methods in researching library UX (Asher & Miller, 2011; Duke & Asher, 2011; Lanclos, 2013; Wu & Lanclos, 2011). A practical toolkit from the ERIAL project (Ethnographic Research in Illinois Academic Libraries) that Asher worked on was published (see more at <http://www.erialproject.org/project-details/methodology/>), outlining an instruction on how to perform ethnographish approaches in library UX research, which included cognitive mapping (Asher & Miller, 2011). Despite the growing interest in adopting ethnographic thinking in learning about library users, there remain many unexplored areas and a huge potential to discover its unique values and massive possibilities in combination with other approaches to studying diverse groups of people.

3. Data collection and analysis

3.1 Population for the study: International Chinese students

A dominant trend in UK higher education is the enlarging scale of internationalization of the student base; with the globalization strategy of many universities, the number of international students is increasing every year (Houlihan et al., 2017). The contextual factors, behaviors, needs and requirements of those international educational recipients need to be identified constantly for higher education providers to design more inclusive and diverse learning environments for all. Cultural differences in international educational recipients have been found to be important in the library context. Hughes (2005)'s study of exploring international students' information behavior using library resources, shows that language has a significant impact on students' information behaviors using online resources, while cultural factors are the ones that influence their wider educational experience. The time they consume to find certain library resources and the effort they put in to search for study-related materials are caused by the unfamiliarity with language, but more importantly, by their cultural background and past learning experiences and habits (Hughes, 2005).

Students from most Asian countries, especially mainland China, have grown up in Confucian heritage societies that follow the Confucian ideology formed over their long history (Chris &

Arthur, 2014; Thomas & Inkson, 2017). The educational beliefs of Confucianism put stress on memorizing, understanding and questioning based on what has been learned; Western education has tended to be more personalized, interactive teaching and learning, focusing on the individual, giving more space for them to think, learn and raise questions independently (Chris & Arthur, 2014; Goldin et al., 2017). In the UK specifically, “active learning and the acquisition of transferable skills” is strongly stressed in HE delivery (Varga-Atkins & Ashcroft, 2004, p. 40). Studying abroad for Chinese students not only means learning in a different educational system, but more importantly, adjusting themselves psychologically and socio-culturally with their underlying culture identity (Bodycott, 2012). In Hughes’s continuing study of international students studying in Australia, students from six countries, including China, showed their limited previous experience of using libraries in their home countries. The educational mode in Eastern teaching culture is more ‘teacher-based’ and ‘textbook-based’, and pays more attention to students’ independent work, leading to less requirements on using the library service (Hughes, 2010, p. 81). Although most of the international students in her study showed a positive attitude towards library services in Australia, they expressed strong wishes on receiving “subjective-related, extensive learning opportunities” on information literacy education to support their learning and library experience abroad (Hughes, 2010, p. 86).

Despite international Chinese students constituting the largest single group among all the international students in UK (HESA, 2022), research into this population in an academic library context is insufficient. Thus, with an aim to discover the values of cognitive mapping in studying international library users and its potential in eliciting a holistic picture and cultural library experience in combination with other approaches, this study chose international Chinese students learning in the UK as the sample group to make up the research gap.

3.2 Data collection

Before the formal data collection, a small-scale pilot study (trial study) was conducted to test the research methods and explore the feasibility of studying the research sample (Lewis-Beck et al., 2004). Six participants who were studying at University College London (UCL) engaged in the pilot study, and they were from UK, France and China (see Appendix A for demographic information of participants). The participants were recruited with a purposive sampling strategy to test the feasibility of the research methods (cognitive mapping with semi-structured interview) on different cultural language groups and in particular on the effectiveness of eliciting the expressions and reflections of Chinese students (Fu et al., 2019). Additionally, the pilot study informed the formal session design. Some participants reflected that it was hard to start off drawing; thus, to ensure that they fully understood the topic and knew what to do in the cognitive mapping exercise, one to two minutes were given in the formal session before the start of the drawing to let them think about the topic in preparation. Methodologically, the purpose of conducting the pilot study was to test the research methods, shape the research question and confirm the sample group.

After that, the formal research commenced with a preliminary investigation by quantitative library log analysis targeting the Chinese users’ community in UCL, followed by the main qualitative data collection through cognitive mapping and semi-structured interviews with 15 Chinese students participating (see Appendix A for demographic information of participants). Through the log analysis investigation, which covered library usage data from September 2017 to August 2018, UCL library Chinese users were identified by capturing the system language of ‘Chinese: zh-cn’

(Chinese-PRC) and the location 'UK' (Fu et al., 2021). The 'zh-cn' category was identified as the largest single language group among all language users except for English users in the UCL library system. To be noted, this language category excludes Chinese (Hong Kong), Chinese (Taiwan) and Chinese (Singapore). Their distinctive information behavior was demonstrated in the log analysis (relatively low bounce rate, longer session duration and more page views in each session compared to average usage) (Fu et al., 2021). While different behaviors of other cultural groups whose first language is not English may exist, the amount of Chinese library users identified in the log data was considered more distinctive and worthy of further investigation, as they constituted a significant number. Therefore, when recruiting participants for cognitive mapping and interviews, only students who had their undergraduate (UG) degree in mainland China and were taking a postgraduate taught (PGT) course at UCL at that time were chosen, with the aim of controlling the variables of the group. Notwithstanding the possible impact from regional disparities that generally exist among Chinese students (Liu & Ma, 2018), and considering the research aim was mainly to explore and discover the phenomenon rather than to examine or generalize, this parameter was purposely omitted when analyzing the data in order to focus more on the commonality.

In the qualitative data collection stage, from May to June 2019 the 15 participants were invited individually to take part in a one-hour session which consisted of a cognitive mapping exercise and a follow-up semi-structured interview. In the cognitive mapping exercise, they were invited to draw a cognitive map of their perceptions and experience of the library in six minutes. They were required to use three different colored pens and to change the color every two minutes to show the sequence of drawing. This way of doing cognitive mapping is taken from the approach Asher and his colleague used in their ERIAL project (Asher & Miller, 2011).

Different from a concept map, which is more structured, organized and created for common understanding, the format of cognitive maps is diverse and individual-driven. There is no settled rule for drawing up cognitive maps, and whether it is graphic or textual is dependent on individual's personal preference of describing and expressing themselves. Therefore, before the start of drawing, the researcher played an important role in explaining the research landscape and guiding this activity towards the questions that need to be answered whilst seeking not to bias the participant response. It was explained to the participants that they are encouraged to include anything related to their library experience, including their activities, behaviors, feelings, and any other aspects they regard as "library experience". They were also ensured that there was no rule on the presentation of the map and there was nothing expected of their drawing skills or what to produce, or in other words, there is no wrong way to draw the map.

After mapping, they were asked to explain their drawing and a supplementary semi-structured interview given in Chinese was done with each of them to allow participants to fix their thinking gradually through the explanation of what, how, and why they had drawn their map; and to ask some pre-set questions in connection to the quantitative findings from the library logs in order to reveal a more holistic picture of experiences, behaviors and feelings. There are several reasons for using English and Chinese separately for cognitive mapping and the interview. The cognitive maps were required to be drawn in English as the topic of drawing is their experience of using the UCL library system and services where the information is in English; therefore, it would be more accurate in drawing and describing the library experience in English. Notably, although they were asked to draw the cognitive map in English, several of them used Chinese to indicate certain

elements as an instant reaction in this short and limited time. Thus, additional notes were added using a black pen during the supplementary explanation where the Chinese was translated into English and unfinished parts were completed by the participant, if necessary. Additionally, as the elements that appeared on the cognitive maps were coded directly in the data analysis, it was more sensible to use the exact words or phrases drawn by the participants, instead of translating them based on the researcher's understanding. This is also a good way to see how the Chinese students express themselves and their experience in English, but at the same time, in a drawing activity, which would not give them too much pressure in expressing themselves. The semi-structured interviews were conducted in Chinese as previous research has found that conducting interviews in English with those whose first language is not English causes issues with reliability and validity (Marshall & While, 1994). Their understanding of the questions and free expression may be constrained because of the language. Therefore, in order to make the participants feel comfortable and at ease to express themselves, Chinese was used during the interviews.

3.3 Data analysis process

The data analysis process started from the collection of cognitive maps and the translation and transcription process for the interview data. A transcribing tool called Xunfei from iFlyTek company was used to automatically transcribe all the interview recordings into Chinese text. The machine transcription cannot guarantee a 100% accuracy, especially with Chinese, where the meaning depends largely on the language context; therefore, all the recordings were listened to again and checked for accuracy by the researcher. Regarding ethical issues with the transcribing platform, Xunfei has a privacy regulation that protects the data uploaded by its user (See details at <https://www.iflyrec.com/html/helpCenter/privacyPolicy.html>).

A qualitative content analysis was conducted to identify elements that appeared on maps, to categorize and allow meanings to emerge (Schreier, 2012). The elements appeared on the map and supplementary explanations were inductively identified and coded. In the identification process, the unit of an element can be a short phrase, a term, a segment on the map, or sentences in the supplementary explanation that can represent a complete and unique meaning. Next, the interview transcriptions were read through and codes were created inductively based on the segments of information that can reflect complete and unique meanings; the segments may be sentences or paragraphs. The elements were then coded and named as nouns, terms, concepts or statements, which formed the codes. By the support of qualitative analysis software (NVivo12 in this case), the codes were created by selecting segments of the cognitive maps and quotes from supplementary explanation transcriptions (see Appendix B for the overview of the data analysis process). All codes were then explored to identify the key meanings (themes) from the data and the findings were presented as the themes with examples from both cognitive maps and interview quotes.

4. Findings

4.1 Context as the label of behavior

A crucial theme that emerged from Chinese students' cognitive maps was context, which is reflected from drawing elements and relevant quotes such as locations, status of being (situation), and identity-related activities. The students engaged were inclined to organize and present their

thinking in a categorized instead of a scattered way, and under this drawing theme, it is the context which performed as the label to group and illustrate (see Insert Fig. 1 as an example from one participant). Their activities, behaviors, opinions, and perceptions about library experience were labelled and expanded on this map, by the three “scenarios” and one “expectation”.

Insert Fig. 1: Context as the label of behavior (Color sequence: green-orange-red)

Library experience itself contains a broad range of elements which are often hard to describe and reflect upon in a limited time given, particularly considering the language barrier international students face, whereas they can recall their status of being in the corresponding environment in relation to the library and the use of library services via mapping without interventions from the researcher. Context or scenario being the label to describe behaviors, is essentially a problem-solving way of thinking and a constructive approach of presentation. In addition, instead of describing their subjective feelings in the form of speaking during interviews or other narrative approaches, it was found that Chinese students naturally drew out their perceptions in response to the context, the atmosphere, and the surroundings of their being in cognitive mapping exercise (for example, in “scenario 1”, the student experienced a “study atmosphere” which helped to focus on work).

4.2 Technology as the key to experience

From the cognitive maps and the later interviews, it emerged that Chinese students perform most of their learning activities digitally and that they use digital devices to create a pleasant personal workspace or personal learning ‘library’, which is regarded as an important component within their library experience. Affordance of the digital technology and physical sensation are found in this study to be key elements to Chinese students’ library experience, which includes the user-friendly design of the interface, ergonomic design of tools, proper implementation of technologies and the design scenario (see Fig. 2). They create their own safe and familiar ‘territory’ of learning through digital technologies that they claimed can create a sense of comfort and address their unique needs for learning (for example, see Insert Fig. 1 “expectation” part for a multi-screen workspace design). This replicates the experience of having many different books and materials open as they can have a glimpse of all the sources at one time. It demonstrates the idea that people’s feeling of control over technology directs the way they perceive and handle digital devices, which coincides with previous research that, “each experience is mediated at the same time by technical agents and by its media world” (Best, 2009, p. 411).

Fig. 2: An example of a cognitive map of technology as the key to experience (Color sequence: grey-red-black)

On the map above, the participant emphasized the importance of technology and its interface design in forming, shaping, and influencing their library experience. The technologies they mentioned include, for example, VUI (Voice User Interface), BCI (Brain-Computer Interface), and IOE (Internet of Things), and mobile, wearable, portable ways of interface design which they wished to coordinate and to support their interaction. The “storyboard” part on the map, notably, shows the imaginary ideas about BCI which was aimed to merge the physical and digital, the

human brain and technology, and the student proposed its usage in the library context. At a root base, their emphasis and expectations for technology naturally revealed from the maps demonstrated the language or meaning construction supporting their need, in experiencing the major role of academic library, academic information seeking, they desperately ask for some kind of agent to understand what they need and to help with the information seeking process. The affordance of digital technologies facilitates the way students interact with the physical world and reflects the opportunities that the academic library could use to engage its users with an improved quality of library UX and learning activities in that context, which is in line with what has been illustrated by Billett (2001) in his study set in the context of the workplace.

Language is the main concern and barrier to education for non-English speaking international students' learning abroad. Technology, and its related interfaces, create a virtual environment that they are familiar with and feel safer in, which serves as an important context in helping their transition to a different educational system. This is in harmony with previous research findings that digital technologies play active roles in helping students mediate the transition to a different learning context (Hicks, 2018).

4.3 Cognition reflected from cognitive maps

Cognitive style, as the manner of performing, is believed to reflect an individual's stable and signal cognitive preferences during the problem-solving, decision-making and information-processing (Jablokow, et al., 2015). Cognition is regarded as the way people perceive and interpret events (Rosenthal & Zimmerman, 1978). The presentation, organization and expression of the elements on the maps help to demonstrate how participants process information and interpret their experience in the drawing practice. To some extent, the maps could reflect the cognitive style of the Chinese participants engaged the study. The findings from this study demonstrate several notable cognitive tendencies of this cultural group.

First, from the overall organization and structure of the maps, Chinese students, compared with students from UK and France who participated in the pilot study, tended to use more sketches, icons, keywords, representative images to present their ideas in a short time, instead of large chunks of textual expressions (see Fig. 3 for a comparison). Previous research on cultural cognitive styles has found that people in the East Asian tend to perform a holistic cognitive style (focus on relations of objects and their contexts) while those in the West tend to have an analytic cognitive style (focus on objects, their attributes and organize them taxonomically) (Koo, Choi, & Choi, 2018). From the comparison, Chinese participants did reveal their holistic cognitive style where they put stress on the context of the objects and specific services in the library; while the UK/France participants demonstrated their analytic cognitive style that they used textual descriptions to depict the attributes of the things in the library and they used mind map style to group their ideas.

Insert Fig. 3. Sample cognitive maps collected in the study from international Chinese students and UK/France students

This finding also coincides with previous studies which found that cognitive style and level influences the organization of ideas generated by individuals (DeFranco, et al., 2012). This can

suggest the concretization process the Chinese participants went through in recalling, interpreting and organizing their thinking, illustrating the subjective experience via concrete objects (such as devices, bookshelves, design interfaces, etc.).

The second notable cognitive tendency of the Chinese participants is in terms of how they responded to the drawing topic. The drawing theme was focused on “library experience” which did not define the type of library services nor the positive or negative aspects which could be conveyed; nevertheless, under this broad theme, and to focus the drawing within a limited time, Chinese students generally started with the problems they encountered and the corresponding expectations around this which then constructed their maps. Notably, several participants used Chinese to indicate their problems when a short time was given, the English translation was added during the supplementary explanation. This reflects the instant cognitive responses to a problem, tend to be expressed by native languages, which is a direct reflection and, in some ways, a more accurate expression of their thoughts.

Lastly, from 4.1 and 4.2 where they recalled the context of library usage and put strong emphasis on the technological delivery, it implies how much they underlined the personal context in the library rather than the social aspects of it. Although the topic did not define the scope, it is still surprising to find that none of the participating Chinese students recalled their social experiences in relation to the library. Additionally, in most of the recollection, it was individually based, with the technological tools as an assistant, aiding the development of a personal territory. These cognitive projections demonstrated from the maps, indicated the students’ activities and habits using the library services and personal usage was highlighted in recalling this experience.

It is worth noting that before the drawing, the researcher explained to each participant the meaning of cognitive mapping and assured that there is no settled way of drawing up a cognitive map; however, there still existed possibilities that Chinese students might have a cultural understanding of mapping that differs from UK/France students, so that the patterns observed might be related to other factors rather than cognitive style nor linguistic variables.

5. Discussion

5.1 Implications

5.1.1 What does cognitive mapping allow us to probe in terms of library behaviors and experiences?

In this study, through cognitive mapping, international Chinese students’ library context, crucial elements and corresponding behaviors and activities in the academic library setting were uncovered. Cognitive mapping, as a research method, proved to be effective in helping the self-revealing of behaviors and subjective experiences in the library context to emerge. Instead of designing specific questions from the perspective of the researcher, cognitive mapping gave less restrictions about the scope of questions and answers, therefore it demonstrated obvious advantages in naturally eliciting participants’ personal perceptions and reflections on a topic. Imagery is proven to be an effective way to explore personal contexts, eliminating linguistic constraints (Hicks & Lloyd, 2018). It served to identify the complexity of the context that participants experienced.

Cognitive mapping provides a way to see how individuals make sense of the environment around them and how they self-reflect on their behaviors in such an environment. The portrayal of this sense-making arouses a particular cluster of an individual's knowledge and experience in the given context; it also shows how they present knowledge structures from their mind into a visual form in a limited timeframe, giving clues to their cognitive styles in relation to information processing and problem solving. This finding responds to information processing theory in the way they demonstrated how cognition is a process of memory selection, construction and presentation of information in people's mind (Farnham-Diggory, 1972). The use of cognitive mapping in this study extends its viability as far more than just a visual approach enabling reflection on spatial memories, and in addition acting as a sense-making tool to help participants reflect on their cognition, behaviors and past experience.

5.1.2 What are the essential benefits and values of cognitive mapping in understanding cultural groups?

Compared to data collection methods such as interviews or surveys, there are fewer prompts needed within a cognitive mapping exercise, and as such, it allows participants to develop their own narrative as they draw the map. This leads to a greater capacity for self-expression and to the generation of more discursive, unbiased, and unexpected results. Cognitive mapping took place before the semi-structured interview, as it is a more open exploratory way to open up the scene in the first instance. Rather than fixing their thinking in a spoken process, cognitive mapping allowed participants to express themselves in a less structured form, which helped to remove some of the barriers around language and textual representation, gave them a certain level of freedom to express their thinking and feelings and thus, unanticipated findings might be obtained.

The use of cognitive mapping is particularly found to be an effective elicitation tool to explore someone's position in the world, especially with people whose first language is not English, and it is helpful in researching user groups across languages. There is no preference in terms of the language used or the requirement on expression when using cognitive mapping and so it does not restrict the way people reveal their thoughts, which contributes to research crossing languages where there are often issues around understanding subjects in a different language. The supplementary explanation after the drawing of cognitive maps guaranteed the integrity and accuracy of the extracted meaning. In this study, through this form, international Chinese students freely drew up their library experience without worrying about language or narrative expressions.

In this particular research context, the cognitive mapping was supported with semi-structured interviews which were conducted in Chinese, which guaranteed their understanding of the interview questions and a fluent expression of their thinking. It provided them with a comfortable method to express themselves and allowed them to think and talk in their natural way which assisted in reflecting their experiences. It also allowed a comparison between what they delivered through their instant reflection with the means of drawing and through their supplementary explanation via narratives. However, had it not been possible to conduct the interviews in a native language, then the cognitive maps would have helped break down some of the initial language barriers to data collection. The intention of the research was to focus on human experience, not language research, in terms of understanding what they had meant, not how they said it through language.

5.1.3. What limitations does cognitive mapping have in exploring library behaviors and experiences?

Cognitive mapping provides a flexible and effective way to give sufficient space for cultural groups to present their own stories by self-reflection, yet this flexibility brings about the two inevitable limitations of this method in holistically revealing behaviors and experience.

The first limitation was about the researched population. The sample used in the study only represented a very limited proportion of the international Chinese student community; also, the sample was only representative of the PGT students who only spent one year of study in UK. The regional differences, family background, educational background or gender of Chinese students might vary considerably, and these may have an impact on education quality, past library experience and their existing knowledge and skills and hence, their library experience. Nevertheless, the aim of the study was to inform the methodological design of learning about cultural groups, and the goal was not to generalize the findings to all international cohorts. It was more about providing insights into the Chinese group and informing the future cultural studies in the library. All these potential variables deserve attention in future studies.

The second limitation came from the form of drawing. In this study, the time given to draw was limited (six minutes) to get their instant reactions about the topic. Although it did reflect the instant responses, the complexity of the drawing topic and the time constraint might lead to the issues that some individuals might find it challenging to respond to the drawing theme and draw up their map from their mind in such a short time span. Despite that, a follow-up supplementary explanation allowed them to explain their drawing and add any missing points. Nevertheless, there still existed possibilities that they might lose their train of thought and limited their answers to what has been presented on the map. This limitation has been criticized and it has been noted that people may deviate from the research topic during mapping as the method is unstructured and the result is unpredictable; in addition, some people may feel uncomfortable with drawing their ideas with limited directions, particularly with a limited time given and dependent upon their drawing ability (Gibbons, 2019). To counter these inherent limitations of cognitive mapping, the researcher explained the drawing topic clearly before the start of the task and the participants were encouraged to ask questions if they felt unclear about the topic or what was being required of them. They were reassured that there was no wrong way to draw up their map and that they could include anything as long as they felt that it was relevant, which would ensure the relative freedom of thinking and drawing under a settled topic. What's more, all participants were given one to two minutes before the start to think about what they wanted to draw, and the researcher made sure that they were ready to proceed. However, for other studies in which the instant reactions may not be the focus, the form of drawing and the time allowed can be altered and extended as needed.

The third limitation of this method would be the potential sampling bias in the way the cognitive maps were collected and how representative the participants were of the population being studied. As a qualitative approach typically small numbers of participants are approached (Asher & Miller, 2011). Therefore, the combination of this data collection approach in conjunction with other methods in researching the same group of library users is supposed to provide a greater reach and potentially address any claimed sampling bias. In this research, the log analysis enabled a university wide population to be further analyzed (Fu et al, 2021). It served as a potentially more 'objective' reflection of user online behaviors of the library system. However, a log analysis could

not provide a depth of understanding of user experiences in particular. The cognitive maps coupled with the semi-structured interview did enable further development. The interviews enabled a development of understanding of perspectives and checked on that understanding in terms of the maps. Without this, it is possible that maps could be misinterpreted. There was study noted in the literature review did adopt questionnaires with cognitive mapping to study library users, which supplied large-scale quantifiable data (Sharman, 2017). Other cognitive mapping approaches in the library context have demonstrated its value when mixed with other qualitative approaches of verbal explanations (Lanclos & Asher, 2016). It should be noted that with all methodological choices there will be limitation considerations.

5.2 Future directions

There are some possible further additional values of cognitive mapping which could be explored in future studies. The first point to focus on lies in additional exploration of the potential of cognitive mapping to learn about cultural groups and engage virtually with the wider public. In delivering the methodological impact of this method, cognitive mapping was introduced and practiced with the researchers' instruction at the virtual iConference held during the Covid lockdown in March 2020 (Fu et al., 2020). At the iConference, all participants at the cognitive mapping session were given the same instructions in tandem. They all drew, photographed and then uploaded and shared their maps, thus enabling many maps to be generated in a short amount of time. Additional discussion, in the form of a focus group, was then conducted. The possibilities of using this method online have further potential for future collaborations and data collection at a distance and as a focus group activity, which should help library and information studies (LIS) researchers and practitioners that also work with international communities. In addition, it enabled the quantity of maps collected to be significantly increased enabling larger sample sizes for participants.

Secondly, for future research, there could be more analysis and exploration of the way Chinese students organize their thinking in a visual form through comparison of the way of organizing elements on cognitive maps with those of other cultural groups. This would elicit deeper understanding towards their thinking process and may reflect factors that influence their cognitive styles. Equally, other cultural groups should be probed. The potential to better understand different cultural groups and to then personalize and support their access to library provisions, does merit further research. Cognitive maps have great potential in helping bridge language gaps and enabling the articulation of complex spaces, including digital and physical boundaries.

6. Conclusion

The internationalization of academic libraries and LIS education requires a shift. Library provision should not be limited to the adoption of local visions, resources, services, teaching methods. All user groups must be better catered for. In probing this space, methodological designs that incorporate the understanding of cultures, habits and values are very much needed. The evolving information experience requires LIS researchers to develop "flexible yet sufficiently robust enough" research methods to improve the understanding of information activities and experiences in diverse contexts with individuals (Hicks & Lloyd, 2018, p. 229). Cognitive mapping engages individuals with language constraints in exploring their position and personal experience in the world. It provides real insights into eliciting self-reflected behaviors and experience and drawing out the rich picture with other approaches in the library context.

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Appendix

Appendix A Demographic information of participants


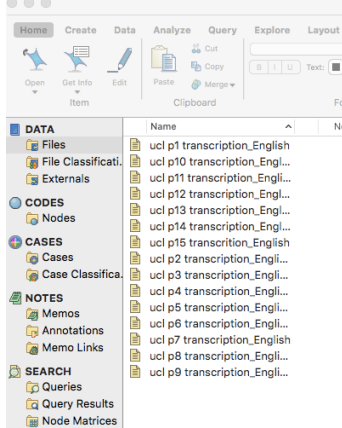
Table 1 Participants information in pilot study


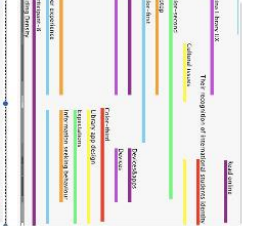
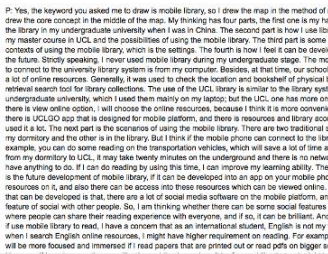
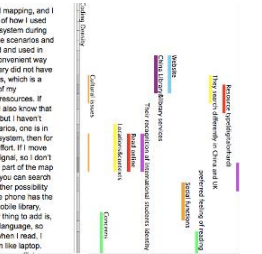


Participant number	Gender	Nationality	Discipline
a	Male	Chinese	UG: BSc Information Management for Business (School of Management)
b	Male	Chinese	UG: BSc Information Management for Business (School of Management)
c	Female	France (EU)	PGT: MA Publishing (Department of Information Studies-DIS)
d	Female	UK	PGT: MA Publishing (Department of Information Studies-DIS)
e	Female	UK	PGT: MA Librarian (Department of Information Studies-DIS)
f	Male	UK	PGT: MA Librarian (Department of Information Studies-DIS)

Table 2 Chinese participants' information in the formal data collection

Participant Number	Gender	Discipline
1	Female	MA Museums and Galleries in Education (Institute of Education-IOE)
2	Female	MA Museums and Galleries in Education (IOE)
3	Male	MSc project & enterprise management (The Bartlett School of Architecture)
4	Female	MSc Digital Humanity (Department of Information Studies-DIS)
5	Female	MSc Digital Humanity (DIS)
6	Female	MSc Digital Anthropology (Department of Anthropology)
7	Female	MSc Human-Computer Interaction (UCL Interaction Centre)
8	Female	MSc Digital Anthropology (Department of Anthropology)
9	Female	MA Linguistics (Phonology)
10	Female	MA Comparative business economics (SSEES)
11	Female	MSc Digital Humanity (DIS)
12	Female	Advanced Materials Science (Engineering)
13	Female	Advanced Materials Science (Engineering)
14	Male	Space syntax: architecture and cities (Bartlett)
15	Male	MSc Drug Design (Medicine)

Appendix B Overview of the data analysis process

Step	Task	Example
<p>Generation of a cognitive map</p>	<p>Participant drew the cognitive map (three colored pens were used to show drawing sequence).</p>	 <p>On this map, for example, green was the first color, followed by purple and then blue</p>
<p>Supplementary explanation for the cognitive map</p>	<p>Additional notes were added with participant's explanation.</p>	<p>P: Yes, the keyword you asked me to draw is mobile library, so I drew the map in the method of mind mapping, and I drew the core concept in the middle of the map. My thinking has four parts, the first one is my habits of how I used the library in my undergraduate university when I was in China. The second part is how I use library system during my master course in UCL and the possibilities of using the mobile library. The third part is some of the scenarios and contexts of using the mobile library, which is the settings. The fourth is how I feel it can be developed and used in the future. Strictly speaking, I never used mobile library during my undergraduate stage. The most convenient way to connect to the university library system is from my computer. Besides, at that time, our school library did not have a lot of online resources. Generally, it was used to check the location and bookshelf of physical books, which is a retrieval search tool for library collections. The use of the UCL library is similar to the library system of my undergraduate university, which I used them mainly on my laptop; but the UCL one has more online resources. If there is view online option, I will choose the online resources, because I think it is more convenient. I also know that there is UCLGO app that is designed for mobile platform, and there is resources and library access, but I haven't used it a lot. The next part is the scenarios of using the mobile library. There are two traditional scenarios, one is in my dormitory and the other is in the library. But I think if the mobile phone can connect to the library system, then for example, you can do some reading on the transportation vehicles, which will save a lot of time and effort. If I move from my dormitory to UCL, it may take twenty minutes on the underground and there is no network signal, so I don't have anything to do. If I can do reading by using this time, I can improve my learning ability. The last part of the map is the future development of mobile library, if it can be developed into an app on your mobile phone, you can search resources on it, and also there can be access into these resources which can be viewed online. Another possibility that can be developed is that, there are a lot of social media software on the mobile platform, and the phone has the feature of social with other people. So, I am thinking whether there can be some social features of mobile library, where people can share their reading experience with everyone, and if so, it can be brilliant. Another thing to add is, if use mobile library to read, I have a concern that as an international student, English is not my first language, so when I search English online resources, I might have higher requirement on reading. For example, when I read, I will be more focused and immersed if I read papers that are printed out or read pdfs on bigger screen like laptop. However, if I read on small screen like the mobile phone, I can't be focused like that or I might have lower efficiency of reading. And I feel if I read Chinese resources, I won't have such concern.</p>
<p>Transcribing interview recordings into Chinese transcriptions; manual check</p>	<p>Used Xunfei software to transcribe recordings into Chinese for the first round; manually checked for the accuracy</p>	<p>Participant 1</p> <p>Chinese transcription</p> <p>Interviewee 1--IOE: MA Museums and Galleries in Education--Nanjing University--Female</p> <p>R: 你可以先把你刚刚画的 Cognitive map 解释一下吗？ P: 然后就是移动图书馆，然后第一个想到的就是我们用手机，然后用 PAD，然后这些设备，然后就想用这些读书的话，肯定要做一些笔记什么的，然后就想用了一些适合 PAD 用的一些 app，然后来做笔记，看电子书什么的，然后就想说书从哪来？就调了一个亚马逊，然后还有 UCL 自己的图书馆可以为 online 有好多书啊，杂志啊就很方便，然后后来我又想，因为要从学校里边借书什么的，然后有的时候在学校图书馆自习的时候，就可以用学校的那种设备，电脑什么的用他们的数字图书馆，就不用抱着书楼上楼下的跑，然后等到第三次换笔的时候，我就想有什么比较方便，或者我为什么要用这些，然后就想上次周末的时候，因为要借书就从几个不同的图书馆里借，然后就想用了一下午的时间去借书、借书，然后还书的时候被排了好多队，然后在不同的图书馆还书的时候排队很长，因为图书馆之间距离挺远的，有的要还到主馆，有的还到 IOE，然后书很重，大概有 20 多本抱着特别重，然后更坑爹的是那一天去学院休息，然后我又抱回来了，想还不能还，对，然后就想要是全部都能数字化的话就太方便了。借的时间又长，也不用到处去还书，也不用担心人家是不是放假了，我白拿来了什么的，因为我们这里的还比较方便，好岁就一趟地铁，要住的远的话这一天气死了</p>
<p>Translating Chinese transcriptions into English; importing English transcriptions into Nvivo12</p>	<p>Translation process and imported interview transcriptions in NVivo12 and familiarized with data.</p>	

Step	Task	Example
<p>Coding: identify elements and create codes (1st round of coding)</p>	<p>Elements from cognitive maps and explanations were identified and coded in NVivo12.</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Visual data analysis in Nvivo (segments of the image can be selected and coded)</p> </div> <div style="text-align: center;">  <p>Code stripes in Nvivo (colours are assigned automatically by the software)</p> </div> </div> <p>P. Yes, the keyword you asked me to draw is mobile library, so I drew the map in the method of mind mapping, and I drew the core concept in the middle of the map. My thinking has four parts, the first one is my habits of how I used the library in my undergraduate university when I was in China. The second part is how I use library system during my master course in UCL and the possibility of using the mobile library. The third part is some of the scenarios and contexts of using the mobile library, which is the settings. The fourth is how I feel it can be developed and used in the future. Study speaking, I never used mobile library during my undergraduate stage. The most convenient way to connect to the university library system is from my computer. Besides, at that time, our school library did not have a lot of online resources. Generally, it was used to check the location and bookshelf of physical books, which is a retrieval search tool for library collections. The use of the UCL library is similar to the library system of my undergraduate university, which I used them mainly on my laptop; but the UCL one has more online resources. If there is view online option, I will choose the online resources, because I think it is more convenient. I also know that there is UCLGO app that is designed for mobile platform, and there is resources and library access, but I haven't used it a lot. The next part is the scenarios of using the mobile library. There are two traditional scenarios, one is in my dormitory and the other is in the library. But I think if the mobile phone can connect to the library system, then for example, you can do some reading on the transportation vehicles, which will save a lot of time and effort. If I move from my dormitory to UCL, it may take twenty minutes on the underground and there is no network signal, so I don't have anything to do. If I can do reading by using this time, I can improve my learning ability. The last part of the map is the future development of mobile library. If it can be developed into an app on your mobile phone, you can search resources on it, and also there can be access into these resources which can be viewed online. Another possibility that can be developed is that, there are a lot of social media software on the mobile platform, and the phone has the feature of social with other people. So, I am thinking whether there can be some social features of mobile library, where people can share their reading experience with everyone, and if so, it can be brilliant. Another thing to add is, if use mobile library to read, I have a concern that as an international student, English is not my first language, so when I search English online resources, I might have higher requirement on reading. For example, when I read, it will be more focused and immersed if I read papers that are printed out or read pdfs on bigger screen like laptop.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Textual data analysis in Nvivo (unit of analysis can be words, phrases, sentences or paragraphs)</p> </div> <div style="text-align: center;">  <p>Code stripes in Nvivo (colours are assigned automatically by the software)</p> </div> </div>
<p>2nd round of coding</p>	<p>Data were reviewed and codes were revised in the second round; latent codes were added</p>	<p>(Same as upper image)</p>
<p>Categorization</p>	<p>Codes were organized and sorted into established coding frame; code tree was formed.</p>	
<p>Meaning exploration</p>	<p>Meanings behind the codes were explored, explained and analyzed.</p>	

Authors Bio

Dr. Yaming Fu is a postdoctoral researcher in the School of Information Management at Nanjing University, and a researcher at Shanghai Library (Institute of Scientific and Technical Information of Shanghai) in China. She received her PhD from the University College London (UCL) in 2021 in library and information studies. Her research interests include the library user studies, ethnography in the library, and digital humanities, on which topics she has published in journals such as *The Journal of Academic Librarianship*, and *Journal of Documentation*.

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Dr. Charles Inskip joined University College London (UCL)'s Department of Information Studies in 2013. He is an Associate Professor in Library and Information Studies and his research interests are in information behaviour, information literacy, and diversity, equity, inclusion and accessibility in library and information studies education and the profession. His work has been published in a number of journals including *Information Processing and Management*, *Journal of Documentation*, *Journal of Information Literacy*, *Journal of Information Science* and *International Journal on Digital Libraries*. His Arts and Humanities Research Council (AHRC) funded PhD was awarded in Information Science in 2011 and investigated information needs of creative professionals around the use of music in film, TV and advertising.