2019

# Visual analysis of information world maps: An exploration of four methods

Devon Greyson
*University of Massachusetts Amherst*

Heather O'Brien
*University of British Columbia*

Saguna Shankar
*University of British Columbia*



Recommended Citation
Greyson, Devon; O'Brien, Heather; and Shankar, Saguna, "Visual analysis of information world maps: An exploration of four methods" (2019). *Journal of Information Science*. 90.
https://doi.org/10.1177/0165551519837174

# Visual analysis of Information World Maps: An exploration of four methods

Participatory arts-based methods such as drawing, photography, and video have been used in qualitative research for some time [1]. Participant-generated media have the potential to shift the power dynamics of the researcher-participant relationship, inspire different insights and more abstract thinking than verbal interviews alone, and may be especially apt for researchers "exploring everyday, taken-for-granted things in their research participants' lives" [2]. Everyday information practices—the socially constructed ways in which people seek, find, manage, share, and use information in their non-professional lives—are a topic of growing interest across disciplines, in the current "information age." However, information as a concept can be challenging to articulate and study, as it is non-tangible and ubiquitous.

To address such challenges, information science researchers, who tend to be interdisciplinary scholars drawing upon a range of epistemologies within the social sciences and humanities, have adopted and created participatory arts-based methods to elicit and record information conceptualizations, behaviors, practices, and activities [3, 4]. However, with exceptions [e.g., 5], the tendency in qualitative research on information practices has been to transcribe and analyze the interviews that emerge through participatory arts activities, rather than to treat the resulting media as sources of data in and of themselves [3]. Wildemuth provides an overview of approaches to visual data in information science research, noting challenges in analyzing visual artifacts as primary data, such as degree of integration with related textual data from interviews or field notes, and variability among participant-generated artifacts [6]. Challenges related to the researcher's role and ability to interpret visual artifacts as have been noted across social science and humanities disciplines, and notably in fields such as anthropology and sociology [7]. This paper examines the challenge of making meaning of visual

media generated through a specific arts-based method, Information World Mapping (IWM). IWM was designed to elicit rich data about individuals' views of their social information worlds [8]. By social information worlds, we mean the contexts for people's information practices, including the people, places and things that provide, force, withhold, share, take, store, and help make sense of information for an individual or community.

IWM is part of a growing body of scholarship on visual (ranging from computerized data visualization for social network analysis to graphical interpretations of research findings) and arts-based (including both visual and non-visual arts) methods in Library and Information Studies (LIS). For instance, a recent multimedia presentation at the Association for Information Science and Technology conference highlighted three projects using visual methods with children and youth [9] to discuss the merits of visual methods with these populations. Information behavior researchers have been utilizing participant generated photographs, and geographical, conceptual, and relational maps within or alongside interviews to understand the complex information worlds of late high school/early university students [10], and immigrants in New York [11], for example. Recently, Cox and Benson [12] reviewed Photovoice and mental mapping in information research and Pollak [13] published an overview of participant and non-participant visual methods. These works surfaced the opportunities and challenges of adopting visual methods in information studies, exploring the ways in which visual methods may enhance qualitative research (e.g., data quality, transparency, comprehensiveness, and so on), as well as related ethical considerations, such as the intellectual property of the resulting artifacts.

While this overview of arts-based and visual methods in LIS is not exhaustive, it demonstrates a clear and present interest in understanding how such methods can be incorporated into information-related studies to understand the role that information plays for specific

populations and in specific contexts, i.e., to appreciate how research participants "see" their worlds, where and how they locate information, and the environmental influences on their information practices. The IWM method integrates elements of Photovoice [14], information horizons [15], and relational mapping [16][1], and has been used with populations including young parents [8, 17], students from refugee backgrounds [18], newcomer refugees [19], and vaccine-hesitant mothers [20].

By asking interview participants to draw their information worlds—the people, places and things involved in their practices of seeking, encountering, obtaining, assessing, sharing, and otherwise using information—IWM elicits participants' depictions of their networks, relationships, and practices. IWM was created for use within semi-structured interviews, and encourages participant control over depictions of their information worlds from their own perspectives, as well as verbal interpretation of the images by their creators. Critical incident technique is commonly used in IWM interviews to facilitate participant interpretation of the resulting maps. IWM may be used at a single point in time, or longitudinally, with multiple maps generated over time to explore changes in an individual's information world.

In previous work, we discouraged the use of the maps as independent data sources because a particular strength of IWM is its ability to center the perspectives of marginalized research participants/populations. We feared that researchers' interpretations would contradict participants' own perspectives and analyses of their maps if they were not situated in the context of the interviews. However, as IWM continues to be shared with interdisciplinary audiences and utilized with varied populations, we have been encouraged to revisit this decision. To assess the

[1] For more detail regarding the origins of and influences on the development of information world mapping, we refer readers to a previous publication by Greyson, O'Brien and Shoveller [8].

appropriateness and utility of visual analysis, as well as the fit of specific methods with the objectives of IWM, we tested four different approaches to visually analyzing IWMs. The methods—qualitative content analysis, compositional interpretation, conceptual analysis, and visual discourse analysis—were chosen to represent a variety of epistemological standpoints as well as methodological strengths and weaknesses. Comparing multiple analytic approaches to explore the relative strengths, weaknesses, and findings of contrasting methods is an approach used in qualitative social science [21], statistical methodologies [22], and applied practitioner-oriented research [23]. Following examples including Hartel [24, 25] and Hartel and Noone [26], this paper continues to examine and compare analytical methods to understand their impact upon visual data sets. The purpose of the current paper is not to report on the full findings of each of these analyses, but rather to investigate the research questions guiding this methodological exploration:

*RQ1. Can visual analysis of IWMs contribute analytic depth or valid new findings to interview data?*

*RQ2. If so, which methods seem promising, and for what purposes?*

## Method

Our strategy for this investigation was to conduct four "proof of concept" analyses, each applying a specified visual analytic method to a set of pre-existing IWMs. Suitable research questions for each method were developed and explored with an appropriate sample of IWMs. Here we describe the IWM data sets and provide a brief overview and rationale for each of the four methods used. Details of the specific procedures applied within each method, along with our findings regarding methodological strengths and weaknesses for analysis of IWMs, appear in the results section.

## Data

The 52 IWMs used for this exploration came from two studies conducted in Greater Vancouver, Canada with different participant groups. Set one (29 maps) was drawn by pregnant and parenting youth as part of a broad investigation of their health information practices. The second set (23 maps) was drawn by adult mothers who had changed their minds about children's vaccination since their school-aged children were infants.[2] The "young parent" set of maps were used as supplemental data sources in prior analyses of textual data from the overarching study [17], whereas analysis of the "vaccine-hesitant" interview data was just beginning at the time of this investigation. Both studies were approved by research ethics boards at [UNIVERSITY BLINDED FOR REVIEW], and both used the IWM activity within semi-structured interviews, sandwiched between open-ended questions about information behaviors and critical incident technique questions; readers seeking more information about how to employ the IWM, including the interview guide, will be interested in Greyson, O'Brien, and Shoveller's guiding article about the IWM method [8].

## Overview of Selected Analytic Approaches

The four analytic approaches selected for visual analysis of IWMs were: qualitative content analysis, compositional interpretation, conceptual analysis, and visual discourse analysis. These methods were selected to encompass a variety of theoretical perspectives, bring different analytic strengths and weaknesses, and build on and diversify previous literature on analysis of visual information research artifacts. Figure 1 illustrates the data analyzed in each approach and the research questions for each investigation.

[2] For more information on the studies within which these IWMs were created, see Greyson, O'Brien, and Shoveller [8] and Greyson and Bettinger [20].

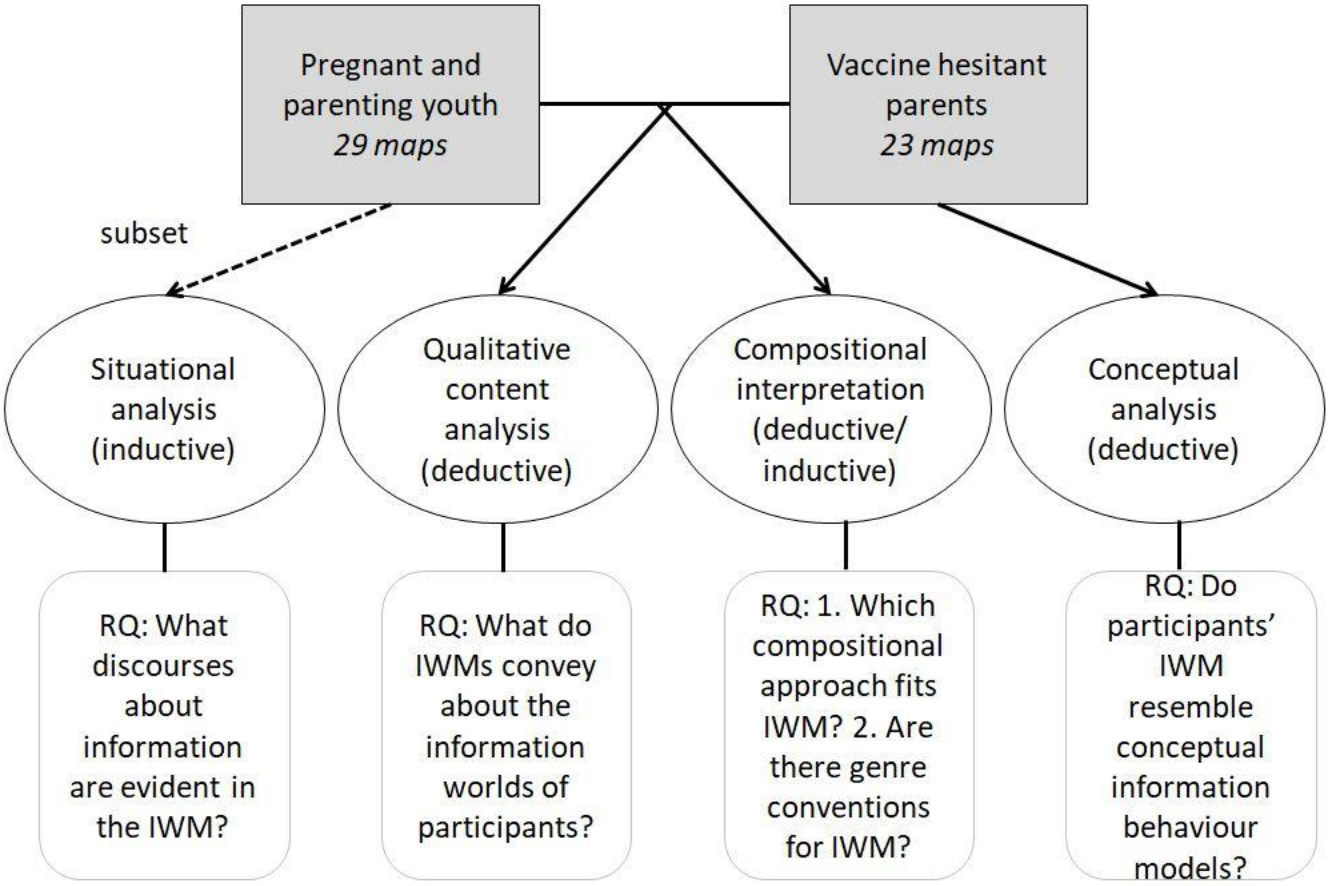


**Figure 1. Data, methods, and research questions**

**Qualitative content analysis.** Qualitative content analysis (QCA) is a flexible, systematic method for interpreting and making meaning from visual or verbal material [27–29]. In QCA researchers systematically engage in a sequence of steps, beginning with an established research question, to build, test, evaluate and refine a coding frame, apply the coding frame consistently, and identify broader themes and patterns [29]. QCA, which may be applied in inductive or deductive analyses, is frequently employed in information research studies, but has primarily been used with textual data [30, 31]. Therefore, one goal of this analysis was to

determine the effectiveness of utilizing QCA with the IWMs as independent data sources. The specific type of QCA we selected for this exploration was directed QCA, using a deductive codebook. Directed content analysis aims to "validate or extend conceptually a theoretical framework or theory" [28]; thus appropriate research questions would center on validation or conceptual testing of theories or models. Since IWM was founded upon existing methodologies (Photovoice, relational mapping, and information horizons) and information practices frameworks, we elected to use directed QCA.

**Compositional interpretation.** Scholars of visual culture [2, 32] draw attention to specific features of artifacts (e.g., framing, ordering, organization, shape) using language drawn from art history and media studies for describing and interpreting visuals. Analyses of composition are often based on interpretation of common visual elements to explore the coherence and overall integrity of elements that enable people to make sense of visual artifacts' deeper meaning. However, in our exploratory investigation, our research questions centered on whether compositional interpretation was a usable method with IWMs, not yet approaching questions regarding the use of artistic conventions to gain in-depth understanding of the form and meaning of the images.

Hartel [5] suggested that Rose's methodological techniques [2] were well-developed and presented opportunities for information science research. Drawing on Rose's visual approach led to Hartel's experimentation with a taxonomy [33] in order to interpret visual representations of information—an inspiration for the compositional interpretation technique explored in this paper. We explored how to systematically apply understandings of composition: first deductively using an existing taxonomy as a means to classify the structure of participant-generated artifacts [34], and then comparing this with an inductive classification scheme grounded in the data.

**Conceptual analysis.** Hartel and Noone [26] describe conceptual analysis as "a traditional means of interrogating visual concepts using existing theories or frameworks in scholarly literature." Furner further explores, from an archival perspective, the ways evidence about an entity may be read or inferred via conceptual analysis [35].While it is difficult to find conceptual analysis detailed as a method—visual or otherwise—with specific steps involved (and indeed the approach seems intertwined with other qualitative methods that involve systematic qualitative development of conceptual models, such as grounded theory [36]) there appears to be consensus that, just as a strong conceptual underpinning is essential to develop a high-quality study, conceptual analysis of findings in the early stages of analysis strengthens the work.

Systematic assessment of the ontological underpinnings of data can aid in modeling [37], identifying and structuring organizing frameworks [38], particularly in multidisciplinary studies. Jackson [39] provides one of the most assertive and complete explanations of and justifications for conceptual analysis as a philosophical approach, defining it as, "the very business of addressing when and whether a story told in one vocabulary is made true by one told in some allegedly more fundamental vocabulary." In the current exploration, we channeled Jackson's aims to find the universal within the data via conceptual analysis, but followed Hartel and colleagues by bounding this endeavor by deductively seeking application of and evidence for existing theories and frameworks.

**Visual Discourse Analysis: Situational Analysis.** Discourse analytic methods for textual data are not uncommon in information research **[**40–42**]**, but application of these approaches for visual data is not well explored. Among the myriad approaches to discourse analysis that exist, the specific method we selected was situational analysis (SA) **[**43**]**, a

postmodern grounded theory technique that involves diagramming of codes. SA can be applied to either textual or visual data (for textual example, see **[**44**]**), and is intended for "analysis of *extant* visual discourse materials on their own and/or as a related part of an integrated multicite/multiscape research project" **[**43**]**, making it ideal to explore as an add-on for secondary analysis of IWMs originally created to meet data elicitation objectives.

Certain epistemological aspects of SA also made it seem compatible with IWM, including a focus on social worlds and on power relations—often conceptualized in visual media as "the gaze" (e.g., Mulvey's "male gaze" [45], Foucault's "biopower" [46]). IWM aims to give participants control over the gaze as they draw, acknowledging that power differentials, social disparities, biases, and participant willingness and ability to share openly with the researcher affect IWM depictions. A deductive method, SA lends itself to exploratory and relatively open research questions, within which themes and answers can emerge.

## Results

### Qualitative content analysis

Our directed QCA of the 52 maps was grounded in the theories from which IWM was derived: information grounds [47], information horizons [15], information ecologies [48], information worlds [49], and everyday information practices [50, 51]. We applied QCA to understand the extent to which key concepts from these theoretical frameworks could be identified in the maps. Our guiding question for this analysis was: *What do IWMs convey about the information worlds of participants?*

Analytic Process. We examined the major tenets of the aforementioned theories to derive key concepts (see Table 1 for an excerpt from the resulting summary, and Appendix A for full summary table), which were compared to develop high-level codes: information practices, social

types, spaces, information resources, relationships, values, constraints and enablers, and specific topics (See Appendix B for code definitions). These high-level codes were then sub-divided into categories. For instance, within "social types," (people in information worlds that give information to or receive information from participants), we found it appropriate to distinguish formal (e.g., physicians, teachers) from informal (e.g., friends, family) roles.

We coded all 52 maps using this framework and collated our analysis in Excel worksheets (one for each set of maps) with columns for each code, as well as a column for observations that did not fit within the coding scheme or instances in which aspects of the maps were indecipherable or inconclusive. The collation of coded data allowed us to examine instantiations of the codes within and across maps and studies. Returning to the social types code, for example, we could see similar levels of reliance on family members in both sets of maps, but young parents were more apt to single out their own mothers while older parents mentioned their spouses and children more frequently. Similarly, physicians and other Western health practitioners were present in both sets of maps, but the vaccine-hesitant mothers depicted a greater variety of health professionals, including those who practiced alternative medicine.

| **Model or Theory** | **Overview of framework** | **Tenets or Propositions** | **Key concepts** |
|---|---|---|---|
| *Information grounds* | "Synergistic environments temporarily created when people come together for a | • May occur in any temporal setting<br>• Information sharing is not the primary reason for gathering; information flow is a by-product of social interaction<br>• Grounds contain different social | • Information sharing (informal/formal or incidental)<br>• Actors or social types |

| | | | |
|---|---|---|---|
| | singular purpose but from whose behavior emerges a social atmosphere that fosters the spontaneous and serendipitous sharing of information" (Fisher, 2005) | types. These actors play different roles in information flow<br>• Information sharing is formal and informal<br>• Information obtained is used in alternative ways<br>• Depending on physical or individual factors, sub-contexts may exist that form a "grand context"<br>• Grounds may vary based on motivation, membership type and size, and focal activities | • Temporal space or grounds: focal activity, membership size and type, purpose<br>• Social interaction<br>• Sub-contexts formed apart from the main or grand context |

**Table 1. Excerpt from Synthesis of Conceptual Frameworks Table**

**Reflections on the Method.** QCA was an effective means for gaining an overview of the information worlds of our samples. While we used the theories and models that underpinned IWM, other researchers could experiment with other general or domain-specific LIS frameworks to advance the context in which the work is being conducted. We generated basic descriptions of the data (e.g., catalogue of formal and informal social types), as well as a more manifest view of how participants' maps embodied the categories (e.g., mentions of specific family members or expert sources), and compared across map sets to explore differences based on health topics (i.e., vaccination and pregnancy) and demographics. However, we needed to exercise caution in our reading and comparison of the maps, as it was difficult to distinguish participants' intentions from researchers' interpretations. For example, we observed different depictions of general community members as social types in the maps: some young parents indicated that "concerned

citizens" were unhelpful and unwelcome sources of information, while vaccine-hesitant parents seemed to accept different points of view as part of their information worlds. However, we are not confident that participants would agree with this analysis, which came to light in part because of the researchers' own sensitivity to the surveillance to which young parents are subject.

In some cases, we could not rely on the maps alone, and made notes in the Excel file where we felt interview transcripts should be consulted to guide interpretation. For example, a vaccine-hesitant parent placed symbols (e.g., plus sign, question mark) beside information sources in their map; it was unclear what these symbols were meant to convey about the sources. In such instances, analysis of the IWMs alone would risk misinterpreting participants' intentions; these risks seemed acute in the rare cases in which no words were included in a map, and particularly serious when analyzing artifacts created by marginalized individuals or populations.

**Compositional interpretation**

We explored two research questions with all maps: *Which taxonomic approach to compositional interpretation fits with IWM?* And, *What emerging genre conventions are evident in IWM?* As non-experts in visual culture analyzing artifacts created by non-experts, we sought a way to scaffold our analytic process while striving for consistency and credibility. Thus, we first explored whether a pre-existing taxonomy could be used to examine structural patterns of IWMs.

**Analytic Process.** We began by coding all IWMs using a taxonomy of graphic types (e.g., map, picture, time chart, symbol, link diagram) designed to be universally applicable for visuals **[33]**. We grouped all maps by type, noting overlap between the types and types that fit no maps, and assessed the fit of the taxonomy (Table 2). Ultimately, we found that this taxonomy of graphic types was misaligned with our needs, as a taxonomy created by a visual culture expert

was not well suited to our research domains or to IWM artifacts. Engelhardt's taxonomy was intended to classify content created by professionals with training in visual culture (e.g., artists, designers), while IWM was designed to be accessible to participants, regardless of education, literacy, and previous artistic experience.

| Types of graphics codes | Count |
|---|---|
| Map | 0 |
| Picture | 4 |
| Statistical chart | 0 |
| Time chart | 0 |
| Link diagram | 33 |
| Grouping diagram | 43 |
| Table | 0 |
| Symbol | 0 |
| Composite symbol | 1 |
| Written text | 4 |
| Path map | 1 |

**Table 2. IWM classification using a universal taxonomy[3]**

Furthermore, 40% of Engelhardt's types were not were not observable in any of the IWMs, and many maps spanned multiple categories (Table 2). A greater issue, however, emerged in the lack of granularity in Engelhardt's taxonomy with regards to the relative ranking of information-related people, places, and things, which was an unavoidable distinguishing element of IWMs.

[3] Note: All maps were classified using one, two, or three of Engelhardt's categories. Many maps spanned categories, contributing to the assessment that the qualities of maps could be better represented with an inductive taxonomy.

| Code | Count |
|---|---|
| Structure codes | |
| Hierarchical network structure | 13 |
| Flat network structure | 28 |
| Grouping structure | 8 |
| Hierarchical list structure | 0 |
| Flat list structure | 1 |
| Comprehensive artistic structure | 1 |
| Zone Codes | |
| Self at center | 35 |
| Self at periphery | 6 |
| Self at margin | 3 |
| Self not present | 7 |

**Table 3. IWM classification using inductive taxonomy**

We therefore developed an inductive taxonomy to describe connections among, and rankings of, information-related people, places, and things, and their role in individuals' information practices. In an effort to focus on the structure of IWMs with minimal interference of interpretation or context, a researcher who had not previously worked with these IWMs nor read the accompanying transcripts initially developed this taxonomy. This researcher reviewed all IWMs, playing freely with grouping them by common structuring devices, such as lines, pointers, shapes, borders/divisions, symbols/pictures, and the placement of elements on the page. Subsequently, we named groups, highlighting difficult to categorize artifacts. Through this grouping and naming of types, we identified six overall structure types (structure codes) and four ways in which participants "placed themselves" on the map (zone codes) in relation to other

elements (see Table 3 for distribution of maps across codes; Appendix B contains code descriptions).

**Reflections on the Method.** We initially classified IWMs using a universal taxonomy, but this approach failed to help us articulate the observed patterns of the maps. Therefore, we focussed on recurring structures in the maps, designing an inductive taxonomy grounded in the data. This allowed us to: 1) reflect on the structure of elements on the page, rather than deducing what elements or structures in the IWMs mapped onto a universal taxonomy; 2) more fully encompass graphics that integrated textual and visual elements; 3) develop the language needed to talk about parts of maps and the qualities of connections between elements, enabling coders without a visual culture background to apply a form of compositional interpretation; 4) scaffold further inquiry into the meaning of the content that could be addressed using a shared (and continually negotiated) language among the coding team in subsequent analyses; and, 5) establish emerging genre conventions for IWMs and for the specific populations studied, illuminating the communicative practices and forms preferred by the artifact creators.

We conceptualized our inductive taxonomy as a set of genre conventions [52] that will need to be adapted and refined in studies based on specific IWM populations' familiarity with, and preferences for, certain communicative forms. Future work might compare genre conventions used by different populations, which may show variation across diverse communities. Compositional interpretation allowed insight into emerging IWM genre conventions, based on structure and zone types. These genre conventions can be used to probe maps created in future studies, and are flexible and extensible to adapt to production and analyses of these artifacts across different fields.

**Conceptual Analysis**

Using conceptual analysis, we asked: *Do participants' information worlds depict the conceptual models that information scientists use to visualize information behavior, practices, and worlds?* We selected the 23 vaccine-hesitant parent IWMs, which were newly collected and largely unanalyzed, with the rationale that study data that had not yet been used in the development of any models would be easier for us as researchers to explore for resonances with existing models of information behavior. We used *Theories of Information Behavior* [53] as a reference text for summaries of information behavior models, but did not limit our results to those theories/models included in that particular text. When a given model (e.g. Kuhlthau's information search process [54]) had evolved or been redrawn over time, we primarily relied on what we interpreted to be the most recent "major" version of the model (not necessarily the most recent publication, if that for example was tailored to a specific population), but aimed to maintain sensitivity to the concepts and relationships from previous versions as well (e.g., with rather substantial revisions of Wilson's model of information seeking behavior [55]).

**Analytic Process.** We hung color photographs (printed on standard letter-size paper) of the maps on a large wall in such a way that we could inspect, move, cluster, and reorganize them (Figure 2). By comparing maps with each other, and referring iteratively back to models in our reference text, we identified certain models reflected in the diagrams drawn by participants. We then printed out visual depictions of these models and hung these on the wall, clustering the IWMs around their related model(s).

**Figure 2. IWMs arrayed on wall for conceptual analysis**

At the end of this process, we found five models to be reflected in the content and composition of this set of IWMs: information practices in context [50], sense-making [56], information search process [54], everyday information practices [51], and ecological systems theory [57]. Other major models of information behavior (e.g., [55, 58]) were sought but were not strongly reflected in participants' portrayals of their information worlds. Figure 3 illustrates two maps reflecting selected models: on the left the sense-making journey over time of a mother of twins in a singleton world (as noted previously by McKenzie [59]), and on the right a map invoking an ecological systems model of an information world (previously proposed by Greyson, [60]; O'Brien & Greyson, [61]).

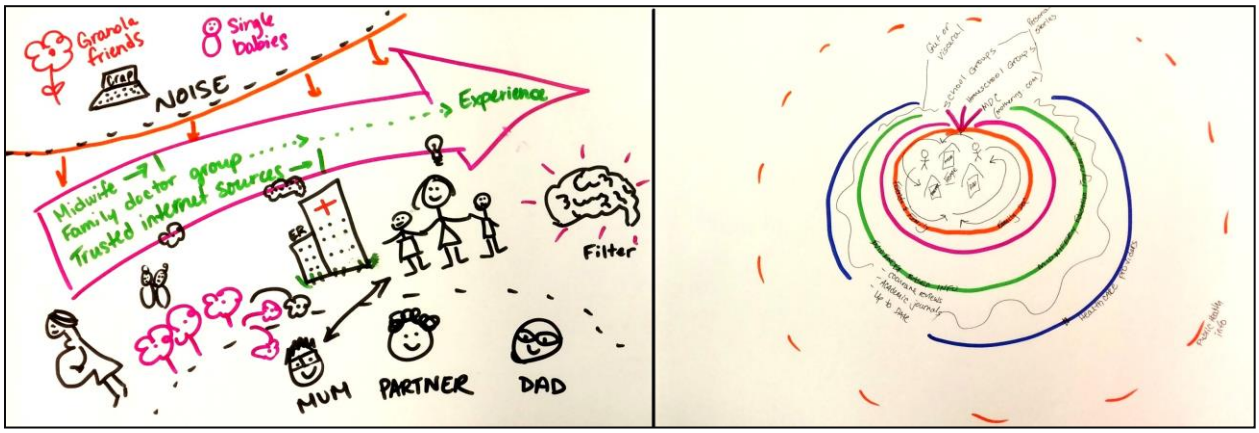


**Figure 3. Sense-making journey of a twin mother (L), Multi-level ecological world of a formerly vaccine-hesitant mother (R)**

**Reflections on the Method.** While this method seemed promising at initial results phase, upon reflection we found that the frameworks hinted at in these participant-generated IWMs reflected the *researchers'* guiding conceptual approaches more than any pre-existing mental models held by participants. We believe this is an artifact of the interview guide and study procedures, and that it cannot be assumed that the information behavior models reflected in participants' maps necessarily reflect participants' own conceptualizations of information behavior, practices, or worlds. Conceptual analysis of IWMs may be useful as part of researchers' reflexivity practices, as the reflection of the study's guiding models and theories within participant-generated visual artifacts was a validation that the researchers "kept things plumb" [62], aligning epistemology, methodology, and methods. However, we do not recommend it as a data analysis method. Our overall conclusion regarding application of conceptual analysis for interpretation of IWMs is that it may be valuable for reflexivity, but due to the risk of researchers leading participants to depict the researcher's own preferred models, is likely not useful for generating independent visual analytic findings. However, it is possible that

in a different study—perhaps one not so closely guided by information behavior and practice models—or if analyzed in conjunction with the interview transcript data, conceptual analysis could be fruitful for expanding upon or assessing the applicability of theoretical models.

**Situational Analysis**

Using Clarke's situational analysis (SA) techniques for mapping visual discourses [43], we investigated the questions: *What discourses about information are evident in these maps?* And, *How are these discourses interconnected with power dynamics?* For this intensive investigation we focused in on a subset ($n$ = 7) of the young parent IWMs that were created by teenage mothers recruited from one fieldwork site at one point in time, in order to constrain the variety of temporal, spatial, and cultural contexts. Our reasoning was that the larger analytic plan (should this pilot investigation prove fruitful) would be to analyze the IWMs in groups with a degree of shared context (as inhabiting a common context is likely to result in shared or related discourse practices), and then to compare the analyzed groups with each other for integration and collective analysis.

**Analytic Process.** In our discourse analysis, maps were examined, memoed individually, and then mapped collectively within a set. Memos were written at 3 levels for each image: 1) *Locating memo*s to describe the context of the study and how this image fits in as a part of the whole; 2) *Big picture memo*s to record first impressions and to describe the image via narrative description[4]; and 3) *Specification memo*s to analytically frame and view the image through a set of topics, including: selection of contents, framing, featured items, viewpoint, colour, presence/absence, composition, scale/proportions, symbols or references, situatedness, relations

[4] Clarke recommends three elements of the *big picture memos*, separating the narrative into "the big picture" and "little pictures," which we tested and deemed unnecessary due to the simplicity of the IWM images under analysis.

with visual culture(s), commonness/uniqueness, and injunctions to viewers.[5] Situational maps were then drawn for the combined set of images, first as hand-drawn "messy" maps (see example in Figure 4), and then sorted into a table for analysis as an ordered situational map using the following categories: human actors, nonhuman elements, collective human actors, implicated silent actors, political/economic elements, sociocultural/symbolic elements, temporal and spatial elements, major debates, and discursive constructions of human and nonhuman actors/elements.

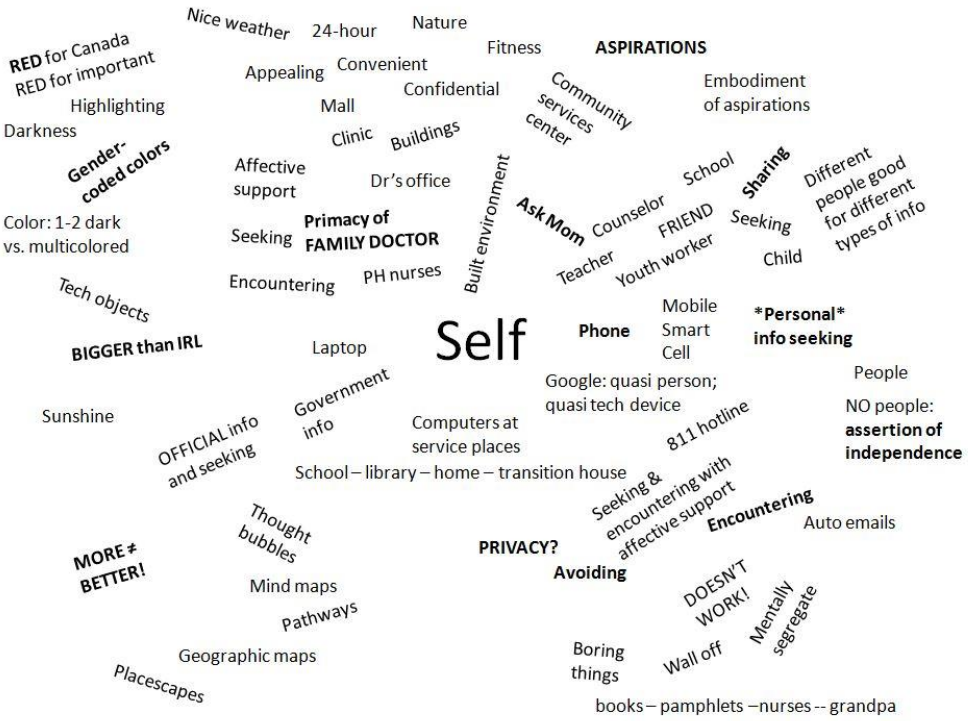


**Figure 4. Messy situational map of visual discourses**

**Reflections on the Method.** Our impression of SA for visual discourse analysis of IWMs is twofold: firstly, it is a time-consuming process; and secondly, the data generated via this process is ample and rich. Although these maps were generated within interviews whose

[5] Here also, Clarke lists additional aspects of images that were deemed non-applicable for IWMs, such as focus of image, and lighting

texts that had already been analyzed via constructivist grounded theory and SA, analysis of the maps as visual artifacts contributed new insights. For example, applying SA to just these seven IWMs highlighted the influence of the built environment on participants' information practices, and raised the complex questions of whether "aspiring" might be considered an information-related practice in certain contexts (such as when a young mother is using information to construct her vision of an ideal healthy life) and whether such aspirations may function to resist marginalization.

In this test case, we analyzed maps from studies and contexts with which we were already familiar; this would be a different process with unfamiliar maps, or with maps devoid of context. Epistemologically, SA acknowledges that researchers always bring biases and sensitivities, and thus removing or controlling for context is not seen as an asset. Overall, we believe that visual discourse analysis of IWMs is a worthwhile endeavor, and that SA should be a recommended method. SA is time consuming, but if done diligently, surfaces a substantial amount of information from the maps considered in the context of the interviews. Caution should be exercised by a researcher lacking familiarity with the overall study and population, and methods of verifying preliminary analysis of these discourses with study populations—particularly those subject to stigma and marginalization—should be considered.

## Concluding Remarks

IWMs are unique participant-generated visual artifacts for investigating information worlds, behaviors and practices. IWMs are less consistent in format and more pictorial than those generated from the information horizons [15] method, and yet more textual in nature than Photovoice [14, 63] or iSquares [5]. Our findings thus differed from those of other explorations of information research artifacts using visual analysis. Overall, due to the diversity of format and

content in the IWMs, which we believe is a result of the participant-centered nature of the method itself, inductive or hybrid analytic methods proved more fruitful than deductive schemes that attempted to apply pre-existing taxonomies or models to the maps.

Applying an existing "universal" taxonomy was not fruitful in our compositional interpretation, though Hartel used Engelhardt's taxonomy effectively in her iSquares analysis [34]. However, our inductive taxonomy allowed us to identify genre conventions for classifying IWMs. In future work, it would be generative to compare these genre conventions to IWMs gathered in the study of other social worlds and phenomena. Also in contrast with Hartel's work, our application of conceptual analysis ultimately resulted in a reflection of the research procedures and epistemology, rather than providing insight into participants' own conceptual models. Rather than dismiss this method as unproductive for study findings, we find it productive in that it offers a contribution to researcher reflexivity pertaining to the researcher's own beliefs, paradigm, and conceptual biases regarding the intangible construct of information.

We took a directed approach to QCA, developing our coding scheme based on key concepts inherent in the frameworks used to create the IWM mapping technique. QCA provided an overview of participants' information worlds and practices, and enabled comparisons across maps from different studies and domains. However, challenges in interpreting some map elements raised concerns about introducing systematic bias. For this reason, we would recommend using the maps to triangulate the interview data. SA, while time consuming, generated a large amount of rich data, including discourses and power relations not identified in previous analysis of the textual data. While SA has previously been used on a limited basis in information research (i.e., to visualize codes and themes within textual data), we assert that it may also be used for analysis of arts-based research artifacts, including IWMs.

Given the participant-centered nature of IWM and its emphasis on empowering marginalized perspectives, ethical considerations with visual analysis of IWMs are important. For example, the question of what to do with emergent findings with which participants might disagree or be unhappy is ever-present (and not limited to visual data). More specific to visual data analysis of participant-generated images are concerns regarding researchers inferring intentionality or misinterpreting participant intentions with an image. Our analyses here consisted of researchers' interpretations of IWM images, rather than assumptions about participants' intentions, psyches, or inner thoughts. However, the question of researcher/analytic bias was one to which we gave a great deal of consideration, as it is important to acknowledge the potential biases in our analytic processes and coding schemes [28]. While methods such as compositional interpretation might largely be conducted without researcher familiarity with the participant population or study setting, more in-depth approaches such as discourse analysis of IWMs should not be conducted stripped of context. This is particularly important when artifacts are created by members of cultural groups different from the researcher's own, or by members of socially marginalized populations. In such cases, it might be more ethically acceptable to return again to a participant population to validate interpretations, or even to co-interpret IWMs. When considering analysis of IWMs either with or without participant assistance, it is important to bear in mind Rose's assertion that interpreting images is just that, interpretation, not the discovery of their inherent "truth."

It is noteworthy that we elected to pursue different research questions (see Figure 1) for each of the analytic approaches we used. Exploring each analytic approach, QCA allowed us to extract the "aboutness" of the objects depicted in the IWM, while compositional interpretation focused on elements (graphics, text) inherent in the maps, and ultimately to delve into emerging

genre conventions for IWMs. Conceptual analysis allowed us to consider whether the information worlds of participants reflected LIS models used to depict people's information seeking, behaviours and use, and situational analysis brought to bear the broader social discourses evidenced in young parents' IWMs. What we were able to "ask" of the data reflected the epistemological and ontological underpinning of each analytic approach, and influenced the overall purpose of the analysis, e.g., establishing a taxonomy to describe IWM's visually, describing information sources utilized by study participants, or probing ideas of selfhood in a culture of surveillance for young mothers. Thus, researchers adopting IWM should be mindful of their own worldviews and the kind of inquiry they wish to undertake. This may impact how they adopt IWM, i.e., whether they adapt the interview guide to bring in more of participants' contexts, as well as how they analyze the data.

Cox and Benson [12] suggest that, "Greater understanding of methods of visual analysis in the information behavior research community is needed, at least if visual material is to be itself analyzed, not merely be used to elicit more familiar interview data." In this paper, we have demonstrated our attempts to analyze IWMs independent of the interviews within which they were embedded, demonstrating the opportunities and constraints inherent in our process. We encourage others using IWM to consider applying QCA, compositional interpretation, or SA to summarize and compare the content of IWMs, test and extend our taxonomy for IWM classification, and discover discourses embedded in participant-generated maps. Additionally, researchers may apply conceptual analysis as part of a reflexive process examining study design and implementation. Future work that applies visual analysis to IWMs (rather than adding it as a secondary analysis) should explore the potential to conduct such analysis collaboratively with participants or to engage in triangulation and verification exercises with study populations, in

order to ensure that researcher biases do not erase participant perspectives. In a reversal of our previous stance, we would now encourage other researchers using IWM to consider integrated or secondary visual analysis of the resulting participant-generated maps, as long as they are mindful of ethical considerations including biases in researcher interpretations, significance of study context, and participant perspectives on data use.

References

[1] Pauwels L. Visual Sociology Reframed: An Analytical Synthesis and Discussion of Visual Methods in Social and Cultural Research. *Sociol Methods Res* 2010; 38: 545–581.

[2] Rose G. *Visual Methodologies: An Introduction to Researching with Visual Materials*. 3rd ed. Thousand Oaks, CA: SAGE, 2012.

[3] Given LM, O'Brien H, Absar R, et al. Exploring the complexities of information practices through arts-based research. *Proc Am Soc Inf Sci Technol* 2013; 50: 1–4.

[4] Hartel J, Lundh A, Sonnenwald D, et al. State of the art/science: Visual methods and information behavior research. *Proc Am Soc Inf Sci Technol* 2012; 49: 1–4.

[5] Hartel J. An arts-informed study of information using the draw-and-write technique. *J Assoc Inf Sci Technol* 2014; 65: 1349–1397.

[6] Wildemuth BM. Visual data collection methods. In: *Applications of social research methods to questions in information and library science.* Santa Barbara, CA: Libraries Unlimited, 2016, pp. 173–184.

[7] Banks M. Approaches to studying the visual. In: *Using visual data in qualitative research*. London, UK: SAGE Publications Ltd, 2007, pp. 36–56.

[8] Greyson D, O'Brien H, Shoveller J. Information world mapping: A participatory arts-based elicitation method for information behavior interviews. *Libr Inf Sci Res* 2017; 39: 149–157.

[9] Barriage S, Li X, Lopatovska I, et al. Visual research methods with children and youth: Opportunities & challenges. *Proc Assoc Inf Sci Technol* 2017; 54: 619–620.

[10] Julien H, Given LM, Opryshko A. Photovoice: A promising method for studies of individuals' information practices. *Libr Inf Sci Res* 2013; 35: 257–263.

[11] Lingel J. Information tactics of immigrants in urban environments. *Inf Res* 2011; 16: article 6.

[12] Cox A, Benson M. Visual Methods and Quality in Information Behaviour Research: The Cases of Photovoice and Mental Mapping. *Inf Res Int Electron J*; 22, https://eric.ed.gov/?id=EJ1144766 (2017, accessed 27 October 2018).

[13] Pollak A. Visual research in LIS: Complementary and alternative methods. *Libr Inf Sci Res* 2017; 39: 98–106.

[14] Wang C, Burris MA. Photovoice: concept, methodology, and use for participatory needs assessment. *Health Educ Behav* 1997; 24: 369–387.

[15] Sonnenwald DH, Wildemuth BM, Harmon GL. A Research Method to Investigate Information Seeking Using the Concept of Information Horizons: An Example from a Study of Lower Socio-economic Students' Information Seeking Behaviour. *New Rev Inf Behav Res* 2001; 2: 65–86.

[16] Radford J, Neke J. *Relational mapping*. Special Paper, Royal Roads University, http://www.conflictresolutionsk.ca/RelationalMapping-JohnRadford.pdf (October 2000).

[17] Greyson D. Health information practices of young parents. *J Doc*; 73.

[18] Shankar S, O'Brien HL, How E, et al. The role of information in the settlement experiences of refugee students. *Proc Assoc Inf Sci Technol* 2016; 53: 1–6.

[19] Martzoukou K, Burnett S. Syrian new Scots information literacy way-finding practices: Phase 1 research findings. Swansea, Wales, https://www.slideshare.net/martzoukou/syrian-new-scots-phase-1-lilac-conference (2017).

[20] Greyson D, Bettinger J. Health information assessment by vaccine hesitant mothers. In: *Proceedings of the Association for Information Science & Technology*. Washington, DC, 2017.

[21] Burck C. Comparing qualitative research methodologies for systemic research: the use of grounded theory, discourse analysis and narrative analysis. *J Fam Ther* 2005; 27: 237–262.

[22] Guo B, Yuan Y. A comparative review of methods for comparing means using partially paired data. *Stat Methods Med Res* 2017; 26: 1323–1340.

[23] Clark BA. Ethics in child and youth care practice with transgender youth. *Int J Child Youth Fam Stud* 2017; 8: 74–96.

[24] Hartel J. Visual Analysis Through Four Lenses, https://works.bepress.com/jenna_hartel/42/ (2015, accessed 26 August 2016).

[25] Hartel J. Adventures in Visual Analysis. *Vis Methodol* 2017; 5: 80–91.

[26] Hartel J, Noone R. Analyzing visual data (workshop). Philadelphia, PA, 2016. Epub ahead of print 20 March 2016. DOI: 10.9776/16348.

[27] Drisko J, Maschi T. *Content Analysis*. Oxford, UK: Oxford University Press, 2015.

[28] Hsieh H-F, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res* 2005; 15: 1277–1288.

[29] Schreier M. *Qualitative content analysis in practice*. Thousand Oaks, CA: SAGE Publications, 2012.

[30] Li X, Cox A, Ford N. Knowledge construction by users: A content analysis framework and a knowledge construction process model for virtual product user communities. *J Doc* 2017; 73: 284–304.

[31] Hara N, Sanfilippo MR. Analysis of roles in engaging contentious online discussions in science. *J Assoc Inf Sci Technol* 2017; 68: 1953–1966.

[32] Kress GR, Leeuwen TV. *Reading images: The grammar of visual design*. London, UK: Routledge, 2006.

[33] Engelhardt Y. *The language of graphics: A framework for the analysis of syntax and meaning in maps, charts and diagrams*. Doctoral Dissertation, University of Amsterdam, Institute for Logic, Language and Computation, 2002.

[34] Matusiak K, Hartel J, Thomson L. Visual research methods workshop. Copenhagen, Denmark, 2016.

[35] Furner J. Conceptual Analysis: A Method for Understanding Information as Evidence, and Evidence as Information. *Arch Sci* 2004; 4: 233–265.

[36] Pidgeon NF, Turner BA, Blockley DI. The use of grounded theory for conceptual analysis in knowledge elicitation. *Int J Man-Mach Stud* 1991; 35: 151–173.

[37] Guarino N. Formal ontology, conceptual analysis and knowledge representation. *Int J Hum-Comput Stud* 1995; 43: 625–640.

[38] Neumann R, Parry S, Becher T. Teaching and learning in their disciplinary contexts: A conceptual analysis. *Stud High Educ* 2002; 27: 405–417.

[39] Jackson F. *From metaphysics to ethics: A defence of conceptual analysis*. New York: Oxford University Press, Incorporated, 2000.

[40] Haider J, Bawden D. Conceptions of "information poverty" in LIS: A discourse analysis. *J Doc* 2007; 63: 534–557.

[41] Madsen D. Liberating interdisciplinarity from myth. An exploration of the discursive construction of identities in information studies. *J Assoc Inf Sci Technol* 2016; 67: 2697–2709.

[42] Budd JM, Raber D. *Discourse Analysis: Method and Application in the Study of Information*. 0306–4573, Information Processing & Management, 1 January 1996.

[43] Clarke A. *Situational analysis: Grounded theory after the postmodern turn*. Thousand Oaks, CA: SAGE, 2005.

[44] Greyson D, O'Brien H, Shoveller J. Constructing knowledge and ignorance in the social information worlds of young mothers. *Proc Assoc Inf Sci Technol* 2017; 54: 139–149.

[45] Mulvey L. Visual pleasure and narrative cinema. *Screen* 1975; 16: 6–18.

[46] Foucault M. *The birth of the clinic: an archaeology of medical perception*. 1st American ed. New York: Pantheon Books, 1973.

[47] Fisher KE, Naumer CM. Information grounds: Theoretical basis and empirical findings on information flow in social settings. In: *New Directions in Human Information Behavior*. Dordrecht, NL: Springer, pp. 93–111.

[48] Nardi BA, O'Day V. *Information ecologies: Using technology with heart*. Cambridge, Mass: MIT Press, 1999.

[49] Jaeger PT, Burnett G. *Information worlds: Social context, technology, and information behavior in the age of the Internet*. London, UK: Routledge, 2010.

[50] McKenzie PJ. A model of information practices in accounts of everyday-life information seeking. *J Doc* 2003; 59: 19–40.

[51] Savolainen R. *Everyday information practices: A social phenomenological perspective*. Lanham, MD: Scarecrow Press, 2008.

[52] Andersen J. The concept of genre in information studies. *Annu Rev Inf Sci Technol* 2008; 42: 339–367.

[53] Fisher KE, Erdelez S, McKechnie L. *Theories of information behavior*. Medford, NJ: Information Today, Inc., 2005.

[54] Kuhlthau CC. Inside the search process: Information seeking from the user's perspective. *J Am Soc Inf Sci* 1991; 42: 361–371.

[55] Wilson TD. Evolution in information behavior modeling: Wilson's model. In: *In, K. Fisher, S. Erdelez & L. McKechnie, (Eds.). Theories of information behavior*. Medford, NJ: Information Today, 2006, pp. 31–36.

[56] Dervin B. From the mind's eye of the 'user': The sense-making qualitative-quantitative methodology. In: Glazier JD (ed) *Qualitative Research in Information Management*. Westport, CT: Libraries Unlimited, pp. 61–84.

[57] Bronfenbrenner U. *The ecology of human development: experiments by nature and design*. Cambridge, MA: Harvard University Press, 1979.

[58] Ellis D. A behavioural model for information retrieval system design. *J Inf Sci* 1989; 15: 237–247.

[59] McKenzie PJ. The seeking of baby-feeding information by Canadian women pregnant with twins. *Midwifery* 2006; 22: 218–227.

[60] Greyson DL. Ecological systems modelling of information behaviour: Theory to increase research impact. Waterloo, ON, www.cahttp://www.cais-acsi.ca/ojs/index.php/cais/article/viewFile/634/393 (2012).

[61] O'Brien H, Greyson D. Information needs: Understanding and responding to today's information user. In: Hirsch S (ed) *Information services today: An introduction*. Lanham, MD: Rowman & Littlefield, 2015, pp. 119–129.

[62] Chenail R. Keeping Things Plumb in Qualitative Research. *Qual Rep* 1997; 3: 1–8.

[63] Given LM, Opryshko A, Julien H, et al. Photovoice: A participatory method for information science. *Proc Am Soc Inf Sci Technol* 2011; 48: 1–3.

## Appendix A.

| Model or Theory | Overview of framework | Tenets or Propositions | Key concepts |
|---|---|---|---|
| *Information grounds* | "Synergistic environments temporarily created when people come together for a singular purpose but from whose behavior emerges a social atmosphere that fosters the spontaneous and serendipitous sharing of information" (Fisher, 2005) | • May occur in any temporal setting<br>• Information sharing is not the primary reason for gathering; information flow is a by-product of social interaction<br>• Grounds contain different social types. These actors play different roles in information flow<br>• Information sharing is formal and informal<br>• Information obtained is used in alternative ways<br>• Depending on physical or individual factors, sub-contexts may exist that form a "grand context"<br>• Grounds may vary based on motivation, membership type and size, and focal activities | • Information sharing (informal/formal or incidental)<br>• Actors or social types<br>• Temporal space or grounds: focal activity, membership size and type, purpose<br>• Social interaction<br>• Sub-contexts formed apart from the main or grand context |
| *Information horizons* | A theoretical and methodological framework to explain information-seeking and use behavior in context (Sonnenwald, 2005) | • Information behavior influences/is influenced by people, social networks, situations and contexts<br>• In a specific context, people or systems may perceive, reflect, and evaluate change in themselves, or their environment<br>• An information horizon consists of different information resources and relationships among these resources<br>• Information seeking is a collaboration between people and information resources<br>• Information horizons are densely populated spaces of information resources that may or may not have an awareness of each other | • Social networks and social situations or contexts<br>• Change in self, others or environment<br>• Information sources and their relationships<br>• Collaboration |

| | | | |
|---|---|---|---|
| | | in the space | |
| *Information ecologies* | "A system of people, practices, values, and technologies in a particular local environment" (Nardi & O′Day, 1999, p. 49). | • Systems: different, yet highly interrelated and dependent parts of the whole<br>• Diversity of people and tools<br>• Keystone species or skilled people that support the use of tools<br>• Locality or sphere of influence and commitment | • Systems comprised of diverse people and tools<br>• Social types or roles<br>• Context or locality<br>• Meaningfulness of technology determined by people in the ecosystem |
| *Information worlds* | "A space-time-intellect delimited life sphere in which information or knowledge afforded by [philosopher Karl] Popper's worlds 1 [physical], 2 [mental] and 3 [objective knowledge] is converted into personal information assets through intentional, conscious and involuntary information practices that are performed by the individual as an information creator, provider, transmitter, seeker, receiver, and user" (Yu, 2012, p. 15) | • Space: the physical locations where the individual actually performs information practices<br>• Time: the proportion of one's time (both during work and off work) spent on obtaining information utilities from the three world components on daily and regular basis.<br>• Intellectual sophistication: the sophistication of mind, general cognitive skills, language skills, and information skills that an individual can apply in the process of interacting with the three worlds and obtaining information utilities from them | • Accessibility, based on the boundaries of the three worlds |
| *Information practices* | "These varieties of information behaviour encompass a range of practices that can be as premeditated as actively browsing for information to meet a | People connect to and interact with information in four specific modes:<br>• Active seeking<br>• Active scanning, e.g., semi-directed browsing<br>• Non-directed monitoring, e.g. serendipitous | • Seeking, searching, activating or re-connecting with a source<br>• Browsing<br>• Placing oneself |

| | | | |
|---|---|---|---|
| | known need or as serendipitous as encountering an unexpected source, miscellaneous fact, or familiar situation that may be of some assistance in meeting some present or future need." (McKenzie, 2003, p.19) | encountering or general monitoring<br>• By proxy, e.g., information is obtained through intermediaries | in an information rich setting<br>• Asking questions<br>• Observing or listening<br>• Recognizing<br>• List making<br>• Conversing<br>• Monitoring<br>• Encountering<br>• Being told<br>• Being referred |

**Appendix B. Codes, definitions, code creation and illustrative example from the data**

| Codes | Definition | Code creation |
|---|---|---|
| Information practices | Activities that occur as a consequence of seeking, avoiding, interacting with or using information, e.g., sharing, searching, browsing, asking questions, observing, conversing, monitoring, etc. | Before analysis |
| Social types | People in the participant's information world that give information to or receive information from the mapper, whether solicited or not; includes friends, family members, librarians, "knowledge experts," e.g., physicians, teachers | Before analysis |
| Spaces | Physical and virtual spaces where information is encountered, gathered, interacted with, used, etc. | Before analysis |
| Information resources | Non-interpersonal sources, channels and tools that contain information; may be digital, e.g., apps, websites, databases, or non-digital, e.g., books, pamphlets, signs | Before analysis |
| Relationships | The nature of the associations among people, places, information resources, etc. in the IWM | Before analysis |
| Values | The participant's assessment of the meaningfulness, utility, influence, etc. of information, people, places and sources in their information world | Before analysis |
| Constraints & enablers | Factors, such as accessibility, stigma, or personal issues that deter or inhibit information practices | Before analysis; modified during IWM analysis |
| Specific topics | Participants identify specific topics about which they seek or share information | During IWM analysis |

## Appendix C. Inductive taxonomy structure codes

| Code | Definition |
|---|---|
| Hierarchical network structure | Elements are joined by one or more connectors (e.g., lines, overlapping clusters, etc) to signify a network. Order is communicated through a ranking of elements by numbering, color scheme, or some other notation for showing preference between elements (e.g., plus marks). Not all elements need to be connected. |
| Flat network structure | Elements are joined by one or more connectors (e.g., lines, overlapping clusters, etc) to signify a network. There is no discernible ranking of elements within the network. Not all elements need to be connected. |
| Grouping structure | Two or more groups (with at least one element in each group) are present. Groups may be indicated by labels, dividing lines, or clustering. There are no connectors between groups (if connectors are present the structure is a network). |
| Hierarchical list structure | Composed of text only, ordered by a ranking scheme (e.g., numbering, color scheme, etc). |
| Flat list structure | Composed of text only, not ordered by a ranking scheme. No preference or level of importance for different elements is shown through numbering, color scheme, etc. |
| Comprehensive artistic structure | This type encompasses maps that are purely visual with no text. This type of map may include metaphor and symbolic illustration in an overall picture in which discernible groups are not present (e.g., no dividing lines or clusters). |
| Self at centre | Visual or texual representation of the self at the centre in relation to the other elements in the space. That is, there appears to be a drawn or written “me” between all other elements in the space. |
| Self at periphery | A visual or textual representation of the self on the left, the right, the top, or the bottom of the space in relation to the other elements in the space. |
| Self at margin | A visual or textual representation of the self on the edge of the page in any zone (left, |

| | |
|---|---|
| | right, top, or bottom). |
| Self not present | A visual or textual representation of the self is not present in the space. |