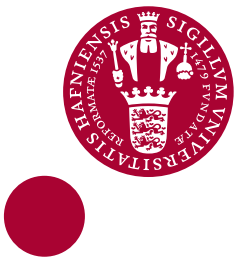


Design Dimensions Enabling Divergent Behaviour across Physical, Digital and Social Library Interfaces

Björneborn, Lennart

Published in:
Persuasive Technology

Publication date:
2010

Document version
Early version, also known as pre-print

Preprint of final version of accepted short paper
PERSUASIVE 2010 : Fifth International Conference on Persuasive Technology

Design Dimensions Enabling Divergent Behaviour across Physical, Digital, and Social Library Interfaces

Lennart Björneborn

Royal School of Library and Information Science, Copenhagen, Denmark
lb@db.dk

Abstract. What design dimensions across physical, digital, and social library interfaces may enable and trigger users to find more information resources than planned or known in advance? The paper outlines a conceptual framework with libraries as *integrative interfaces* across physical, digital, and social affordances and users that mix *convergent* (goal-directed) and *divergent* (exploratory) information behaviour. Ten design dimensions that enable and trigger divergent behaviour are outlined. Implications for persuasive design are discussed.

Keywords: interaction design, persuasive design, libraries, enabling spaces, affordances, interfaces, exploratory information behaviour, serendipity

1 Introduction

"We shape our buildings, and afterwards our buildings shape us."[1]

The design of an information space shapes the ways users can interact with this space. Traditionally, the design of digital and physical libraries supports users' goal-directed, *convergent* behaviour [3]. Tools like classification, indexing, and cataloguing help users to find information resources they have planned to find. In recent years, there has been increasing attention also on supporting library users' exploratory, *divergent* behaviour in order to create more inspiring and stimulating library spaces, circulate more information resources, and counteract *library bypass* [e.g., 21]. From a persuasive design approach, it would be interesting to identify design dimensions or *affordances*, i.e. actionable properties [14], in library spaces that may enable and trigger users to discover and explore interesting resources not planned or not known in advance among often hundreds of thousands of available resources.

In this context, the present short paper briefly outlines a conceptual framework [3] with libraries as *integrative interfaces* across physical, digital, and social affordances – and with users that mix and switch between *convergent* (goal-directed) and *divergent* (exploratory) information behaviour. Ten design dimensions that may enable and trigger divergent information behaviour as additional actions beyond preplanned findings are outlined. Implications for persuasive design are discussed.

[1] Winston Churchill cited by [12, p.194]

2 Integrative user interface

In libraries, users can interact with a multimodality of human, physical, and digital information resources. Users can read printed books, download podcasted lectures, talk with other users about music, etc., etc. The *integrative interface* (Fig. 1a+b) of a library comprises the totality of all these contact surfaces, access points and mediation flows between users and human, physical, and digital information resources [3]. The integrative interface thus comprises all affordances for user interaction in the library.

The interface is *integrative* as the multimodality of different human, physical and digital parts of the library may be looked upon as an *integrated whole*; as supplementary and supportive parts for one another. This approach thus suggests to think affordances, design, and usability across *all* contact surfaces between users and information resources – and not only such features in digital interfaces.

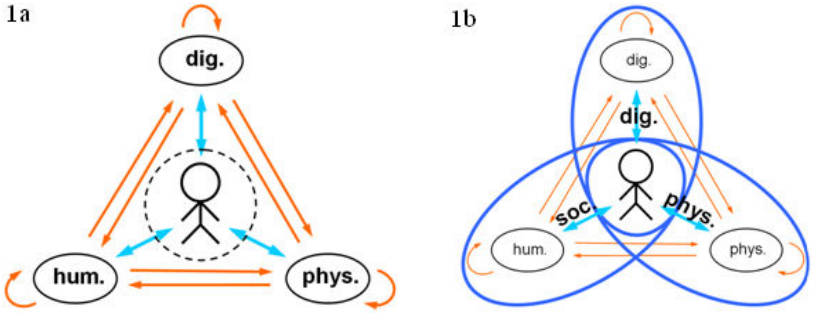


Fig. 1a. Integrative 'multimodal' interface model [3]. User within 'socio-cognitive-embodied' context (broken line circle) interacts (double arrows) with human (hum.), physical (phys.) and digital (dig.) information resources. Between resources are mediation flows (single arrows). **Fig. 1b.** Social, physical and digital information spaces in the interface model, cf. Fig. 1a.

Mediation flows in Fig. 1a could, e.g., be staff and users communicating ('human → human')[2] or flyers in the physical library pointing to library web pages ('physical → digital'). See more examples in [3]. Mediation flows can be combined into longer chains and loops. The model includes evolving cross-modal technologies in pervasive computing, tangible interfaces, social computing, mobile interfaces, etc. [cf. 6].

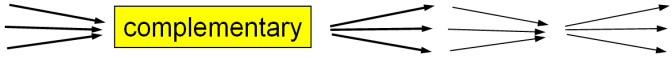
Physical aspects of persuasive design have been discussed by, e.g., [16] who refers to physical objects as "persuasive arguments in material form". Equally important, people have embodied experiences, physical mobility and spatial/tactile senses [cf. 6] that affect design across physical, digital, and social environments. For example, the embodied ability of our peripheral vision to discover/recognize new affordances can be more easily triggered if there is a 'red thread' in the design of human, physical, and digital counterparts of the library interface. It could be staff t-shirts, shelves, and web pages with similar layout signalling similar affordances across dissimilar modalities.

[2] This has Library 2.0 implications [11] when interfaces allow users to leave behavioural traces for other users to follow, cf. *social navigation* [5] and *social facilitation* [8, 15], e.g., when browsing trolleys with newly returned books or finding books left on tables by other users.

3 Convergent and divergent information behaviour

Information behaviour can be defined as "the totality of human behavior in relation to sources and channels of information, including both active and passive information seeking, and information use" [22]. On this background, library users can be seen as employing a wide range of *convergent* (goal-directed) and *divergent* (exploratory) information behaviour [3], cf. Table 1, when they look for information resources, whether human, physical, or digital. As noted in Table 1, divergent information behaviour is related to browsing [1, 4], information encountering [7], opportunistic acquisition of information [7], serendipity [10, 20], and creative thinking [2].

Table 1. Ideal-type aspects of convergent and divergent information behaviour [3]



Convergent information behaviour	**Divergent information behaviour**
- 'left brain' - goal-directed, focused, rational 'zooming in'/'narrowing vision' - e.g., known-item searches - conscious, explicit information needs - problems, work tasks, primary tasks, etc. - 'information recovery'	- 'right brain' - exploratory, impulsive, intuitive 'zooming out'/'broadening vision' - e.g., browsing, info.encountering, serendipity - subconscious, implicit information needs - interests, curiosity, creativity, secondary tasks, etc. - 'information discovery'

Convergent and divergent behaviour, handling primary tasks [cf. 15] and secondary tasks, can supplement and succeed each other as indicated by the 'behavioural pulse' at the top of Table 1. Convergent behaviour may thus identify central information that function as points of departure for exploratory and divergent information behaviour. Reversely, unplanned findings may lead to a need for more focused and convergent search strategies. Such *bit-at-a-time* activity resembling berry-picking [1] is related to task-switching and multi-tasking [18] and can be illustrated by Fig. 2.

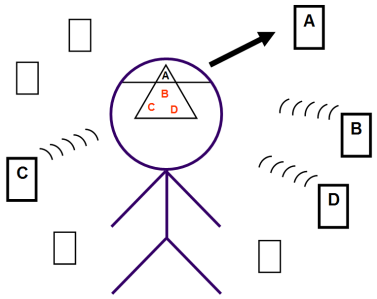


Fig. 2. Interest space model [3]. Potentially triggering items B-D matched by user's interest space ('iceberg') while user moves through information space searching for item A

When users move through an information space (e.g., library, Web, city), cf. Fig. 2, they may change directions and behaviour several times as their information needs

and interests develop or get triggered depending on affordances encountered on their way through the information space [3]. Human behaviour may be seen as a product of three factors: *motivation*, *ability*, and *triggers* [9]. All factors are implicit in Fig 2: *Motivation* includes information needs and interests. *Ability* includes information literacies to navigate with integrated body and mind through physical, digital, and social information spaces. *Triggers* include convergent and divergent design dimensions that may stimulate convergent and divergent information behaviour. The divergent design dimensions are in focus in the next section.

4 Design dimensions enabling divergent behaviour

The ten design dimensions in Table 2 for enabling and triggering divergent behaviour were identified in a study at two Danish public libraries [3]. Naturalistic observation of users' information behaviour when they moved through the physical library was combined with qualitative interviews with 113 users: *What did they intend to find? What did they actually find? How did they find it?* Additional think-aloud sessions with eleven of the interviewees that walked through the library together with one of the researchers provided reflective comments on what design dimensions triggered the users' attention and might change their information behaviour.

The identified dimensions can influence users' behaviour across all contact surfaces and mediation flows in the interface model in Fig. 1a.

Table 2. Design dimensions enabling divergent behaviour across integrative interfaces [3]

Design dimensions	**Explanation**
Accessibility	Unhampered direct access to human, physical, digital information resources
Diversity	Rich and dense variety of topics, genres, media, activities, modalities, etc.
Display	Curiosity-teasing mediation and exposure of information resources
Contrasts	Eye-catching differentiation including quiet zones and display zones
Pointers	Signage, maps, markers, cues, references, etc., may trigger users' interests
Imperfection	Imperfect 'cracks' in interfaces may lead to unplanned findings
Cross-contacts	Contact surfaces across dissimilar topics, genres, activities, modalities, etc.
Multi-reachability	Many different access routes can be chosen through and across interfaces
Explorability	Interfaces invite users to move, look around, explore and browse
Stopability	Interfaces invite users to stop, look closer and assess found resources

The dimensions overlap and the list is not exhaustive as there may be additional dimensions that more extensive studies may identify. See [3] for more details and examples of the dimensions that are not possible to give in this short paper.

Facilitating divergent information behaviour and secondary tasks (cf. Table 1), the dimensions are mostly concerned with an *enabling* approach, and to some degree a *motivating* approach; the least interventionary of the persuasive approaches *enabling*, *motivating* and *constraining* [13]. Several dimensions thus deal with the very structure, architecture and connectedness of information spaces that may enable

divergent behaviour, e.g., *accessibility*, *multi-reachability*, *explorability*, and *stopability*. These dimensions influence how users can move through and explore an information space, cf. Fig. 2. For example, before open shelves were introduced in libraries in the late 19th century, closed stacks provided no direct access to information resources, and thus no affordances for divergent behaviour, browsing and serendipitous findings. There are parallels to impulse-driven shopping and retail interior design triggering customers to choose new routes, shelves, products, etc. [19].

Stopability complements *explorability* and denotes how the library interface invites users to stop and assess information resources. It could be seating affordances close to shelves or free space on shelves etc., enabling users to put down carried things and get free hands to touch and examine found resources including unplanned findings. This design dimension may help users decide whether to make use of found resources.

Some of the dimensions may enable both divergent and convergent behaviour, e.g., *accessibility*, *stopability*, *display*, and *pointers*. The latter two dimensions are covered by Fogg's persuasive tool 'suggestion' [8]. Displays (e.g., exhibitions) and pointers (e.g., signage) in the library may hence motivate users to change information behaviour and switch from convergent mode to divergent mode, or vice versa.

Other dimensions deal with eye-catching, differentiating qualities of information resources, e.g., *diversity*, *contrasts*, *imperfection* and *cross-contacts*. The abovementioned behavioural traces left behind by users are examples of imperfect 'cracks' in the library interface that may enable and trigger unplanned findings. Users may thus perceive useful affordances not necessarily intended by designers [cf. 17].

The table outlines *extrinsic* triggers. Of course, *intrinsic* factors like abilities and motivation [cf. 9] influence how users perceive and utilize affordances for divergent behaviour. Intrinsic factors include intentions, attention, physical mobility, energy, past experiences, personality, interests, needs, etc. As a result, users have different receptiveness to discovering and encountering information resources not planned or not known in advance; ranging from 'non-encounterers' to 'super encounterers' [7].

5 Conclusion

Persuasive design may bridge *'affordance gaps'* [17] between users' *perceived* affordances and designers' *intended* affordances; thus helping users to grasp usage potentials provided by the design dimensions of a given technology or interface.

As stated in the introduction, traditional focus in libraries has been on design dimensions supporting convergent information behaviour. This paper has briefly outlined ten design dimensions that may be used to better enable and trigger divergent information behaviour in order to discover and explore interesting resources not planned or not known in advance. It would be interesting further to investigate these divergent design dimensions in relation to existing persuasive design frameworks and incorporate the outlined conceptual framework with its holistic approach to information spaces and interfaces across physical, digital, and social affordances.

In the presented approach, libraries can be seen as *enabling spaces* with design dimensions that should facilitate *both* convergent and divergent behaviour when users interact with human, physical, and digital information resources. Ultimately, it is up

to the users how to explore and exploit – and perhaps even expand (in Library 2.0 settings) – these affordances and design dimensions. Persuasive design may thus be successful – at least in an *enabling* approach – even if users' perceived affordances go beyond designers' intended affordances. The more enabling affordances, convergent *and* divergent, that are designed and allowed across information spaces, the more stimulating and rewarding interactions, hopefully, the users will experience. Rephrasing the introductory quote: *The ways we shape our environments shape us*.

References

1. Bates, M.J.: The design of browsing and berrypicking techniques for the online search interface. Online Review 13(5), 407-424 (1989)
2. Bawden, D.: Information systems and the stimulation of creativity. Journal of Information Science 12, 203-216 (1986)
3. Björneborn, L.: Serendipity dimensions and users' information behaviour in the physical library interface. Information Research 13(4), paper 370 (2008) http://InformationR.net/ir/13-4/paper370.html
4. Chang, S.J., Rice, R.E.: Browsing: a multidimensional framework. Annual Review of Information Science and Technology 28, 231-276 (1993)
5. Dieberger, A., Dourish, P., Höök, K. et al.: Social navigation : techniques for building more usable systems. Interactions 7(6), 36-45 (2000)
6. Dourish, P: Where the action is: the foundations of embodied interaction. MIT Press (2001)
7. Erdelez, S.: Information encountering. In: Fisher, K.E. et al. (eds.). Theories of Information Behavior: A Researcher's Guide. pp. 179-184. Medford, NJ: Information Today (2005)
8. Fogg, B.J.: Persuasive technology : using computers to change what we think and do. Morgan Kaufmann (2003)
9. Fogg, B.J.: A behavior model for persuasive design. PERSUASIVE 2009. ACM (2009)
10 Foster, A., Ford, N.: Serendipity and information seeking: an empirical study. Journal of Documentation 59(3), 321-340 (2003)
11. Holmberg, K., Huvila, I., Kronqvist-Berg, M. et al.: What is Library 2.0? Journal of Documentation 65(4), 668-681 (2009)
12. Lawson, B.: The Language of Space. Oxford: Architectural Press (2001)
13. Lockton, D., Harrison, D., Stanton, N.: Design with intent: persuasive technology in a wider context. PERSUASIVE 2008: LNCS 5033, pp. 274-278. Springer (2008)
14. Norman, D.: Affordance, conventions and design. Interactions 6(3), 38-42 (1999)
15. Oinas-Kukkonen, H., Harjumaa, M.: A systematic framework for designing and evaluating persuasive systems. PERSUASIVE 2008: LNCS 5033, pp. 164-176. Springer (2008)
16. Redström, J.: Persuasive design: fringes and foundations. PERSUASIVE 2006: LNCS 3962, pp. 112-122. Springer (2006)
17. Sadler, E., Given, L.M.: Affordance theory: a framework for graduate students' information behaviour. Journal of Documentation 63(1), 115-141 (2007)
18. Spink, A.: Multitasking information behaviour and information task switching: an exploratory study. Journal of Documentation 60(4), 336-351 (2004)
19. Underhill, P.: Why we buy: the science of shopping. New York: Simon & Schuster (1999)
20. Van Andel, P.: Anatomy of the unsought finding: serendipity: origin, history, domains, traditions, appearances, patterns and programmability. British Journal for the Philosophy of Science 45(2), 631-648 (1994)
21. Van Riel, R. et al.: The reader-friendly library service. Society of Chief Librarians (2008)
22. Wilson, T.D.: Human information behaviour. Informing Science 3(2), 49-56 (2000)