

VISUAL TOOLS FOR THE SOCIO–SEMANTIC WEB

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1. OVERVIEW

Web science is about more than modeling the current Web. It is about engineering new infrastructure protocols and understanding the society that uses them, and it is about the creation of beneficial new systems. [...] Web science is about making powerful new tools for humanity, and doing it with our eyes open.

[Berners-Lee:2006]

This thesis contributes to a new discipline of science: **web science**, as introduced in [Berners-Lee:2006]. The big challenge is, that such a research area has only been recently postulated, however, does not yet exist in a coherent form. Designers, computer scientists, sociologists, cognitive scientists, psychologists etc. have individual perspectives on the complex and rapidly evolving interplay of technological and social infrastructure and human society. However, a well-defined discipline — unifying the scientific analysis of social and human factors to **understand**, but also to **shape and steer web developments** by informed design and engineering — is not established yet. I hope to contribute to an interdisciplinary dialogue between science, engineering and design with this thesis.

Future-proof interface design for information management has to take the blurring borders between content and metadata, the private and the public and the explicit and the implicit into account. The perspective on the web is gradually shifting from a collection of navigable pages, to a new understanding of a vibrant bazaar, where each participant creates, manages and feeds a variety of information channels in an ecology of services. This process roots in the explosive growth of social web applications, as well as structural changes in-

duced by the pervasiveness of networked applications and devices and has already started to redefine our understanding of information architecture, storage, retrieval and communication.

A deep understanding of the arising content formats, as well as the changing nature and role of metadata is vital for creating effective user interfaces in this domain. We can observe a trend towards a high number of subjective, loosely structured, transient contents available, creating an intersubjective, multi-faceted fabric of contents, people and metadata. New paradigms like collaborative tagging and the publication of information snippets require novel approaches in user interface design.

Accordingly, this thesis consists of three major parts:

- **ANALYSIS: THE EMERGING SOCIO-SEMANTIC WEB** gives a broad overview of recent technological, social and design trends in the world wide web, with a special focus on collaborative information structuring and the so-called socio-semantic web. Insights from cognitive psychology, microeconomics, web statistics, the analysis of open standards and emerging usage patterns lead to
- **GUIDELINES AND MAXIMES**, which derives principles for interface design based on the analysis.
- **SYNTHESIS: EXPERIMENTS, VISUAL ANALYTICS AND APPLICATION DESIGN** presents my design approach and experiments: visual explorations for analysing and revealing the shape of information, user interface prototypes for contextualized navigation, and a novel feed reader application. A discussion of perspectives for further research closes the thesis.

2. ANALYSIS: THE EMERGING SOCIO–SEMANTIC WEB

The digital turn and the explosive growth of possibilities for information access and publishing fundamentally changes our way of interaction with data, information and knowledge. This process is neither finished nor understood, but currently, generally observed phenomena are:

- an acceleration of information diffusion
- an increasing process of chunking information into small, reusable bits (micro–content)
- a shift towards a larger population of people producing and sharing information
- along with an increasing specialization of topics, interests and the according social niches
- leading overall to a massive growth of space for action, expression and attention available to every single individual

At the moment, the Web presents itself as a mess, a bazaar of wildly mixed voices, where increasingly many people share publicly on a global scale what would have been kept private only a decade ago [Weinberger:2002]. The resulting activities give rise to emergent, bottom–up, rapidly changing structures and channels for information diffusion.

In contrary, the Semantic Web, as first conceptualized by Tim Berners–Lee [Berners–Lee:1999], presents a vision of information on the web

as stored in an expressive, presentation–independent, formalized language, in order to facilitate finding, sharing and integrating information by allowing intelligent agents sophisticated analysis of the data. In other words, in this vision, the web would be a very tidy place, with an underpinning of well–formed statements made in formal languages:

“I have a dream for the Web . . . and it has two parts. In the first part, the Web becomes a much more powerful means for collaboration between people. I have always imagined the information space as something to which everyone has immediate and intuitive access, and not just to browse, but to create. [...] In the second part of the dream, collaborations extend to computers. Machines become capable of analyzing all the data on the Web - the content, links, and transactions between people and computers. A “Semantic Web,” which should make this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy, and our daily lives will be handled by machines talking to machines, leaving humans to provide the inspiration and intuition. The intelligent “agents” people have touted for ages will finally materialize.”
[Berners–Lee:1999]

Around this central idea, the semantic web comprises not only a philosophy, but also a set of design principles, collaborative working groups, and a variety of enabling technologies. It is widely believed that the key to making the abundant information on the web accessible in a better way than today is to “mash up Web 2.0 and the Semantic Web” [Ankolekar:2007]—by combining insights from the people-driven, non–authoritarian, bottom–up Web 2.0 with those about knowledge representation, reasoning and interoperability from the Semantic Web initiative.

The result might be an organic—yet structured enough—web of information **snippets and channels**, made reusable, remixable, combinable, annotated with multiple cross-references and individual perspectives, that enable everyone to produce relevant information only once, but access and share them in a variety of contexts and with individuals, groups or the general public. If information is worth storing, it is most of the time also worth sharing—it just depends with whom, and how.

Compared to Web 2.0, it will be a more local, niche- and clique-oriented web, in contrast to the broadcast-everything-to-everyone practice predominant today. Semantic Web techniques will enable the infrastructure, however, the Semantic Web vision as such will have to be refined in order to accommodate to the need for casual, subjective, participatory, ultimately user-centered structures.

Peter Morville coined the term **socio-semantic web** for a *“rich tapestry of words and code that builds on the strange connections between people and content and metadata”* in his seminal book *“Ambient Findability”* [Morville:2005], which hints at how a peaceful synergy between the two approaches, which are often perceived as rivaling and mutually exclusive, could look like. Unfortunately, he did not tell us how to get there.

The following, analytical chapter attempts to set the frame for solutions, by analyzing current developments, with a focus on novel content and metadata formats arising from collaborative, public activity on web scale and relating these to the philosophy of the Semantic Web.

If we take a close look at how Tim O'Reilly refines his own definition only a year later², it becomes apparent how the weights have shifted in the meantime:

“Web 2.0 is the business revolution in the computer industry caused by the move to the internet as platform, and an attempt to understand the rules for success on that new platform. Chief among those rules is this: Build applications that harness network effects to get better the more people use them.”

While sharing the same core elements in principle, the emphasis of the definition has moved towards the **social and economic implications** of the new technological understanding. And today, Web 2.0 is for many people associated with a simplification and democratization of publishing processes, the increasing use of the web as a medium for communication and collaboration and enriched user experience. This perspective is summarized in Eric G. Myer's tongue-in-cheek definition³ of how Web 2.0 presents itself to everyday users:

“Web 2.0: Stuff that allows users to create content or share content with a pastel palette, big fonts and rounded corners.”

The implications of this seemingly banal trend, however, were profound. Providing simple and friendly mechanisms for contribution and participation leveraged network effects: Web 2.0 services **get better, the more people use them**.

² http://radar.oreilly.com/archives/2006/12/web_20_compact.html

³ http://www.egmstrategy.com/ice/direct_link.cfm?bid=B66A59C3-EA60-C575-99771E486D2902BC

THE WEB AS A PLATFORM, SITES AS APPLICATIONS

Web 1.0 was all about hypertext and providing content — “Content is king” was an omnipresent slogan in the web of the 1990s. Basic knowledge of HTML, FTP, web hosting and other technicalities was a precondition for the creation of web pages and hence mostly left to a tech-savvy elite. Accordingly, most technical efforts went into the development of Content Management Systems, platforms that allowed enterprises to create online content or transfer existing contents into hypertext form. The web presented itself as a huge collection of hypertext documents presented in browsers, made accessible by search engines and navigable by clicking links. Consequently, the focus of research was navigation and information retrieval, under the perspective of the web as a large, global, digital library.

As outlined by Terry Winograd [Moggridge:2006], we can distinguish three basic modes of interaction with the world:

- locomotion (moving from place to place)
- conversation (communication with others)
- manipulation (using/editing/creating).

From this perspective, interaction with Web 1.0 was mainly **locomotion** understood as navigating cyberspace, but Web 2.0 triggered a new understanding of web sites as **places for conversation, contribution and interaction**. Obviously, all these concepts are not new — the internet-based bulletin board systems and newsgroups in the

1980s and 1990s shared very similar features already. The first weblogs date back to the middle of the 1990s⁴. What is new, however, is the adoption of social media by the mainstream, the shift from proprietary, closed systems to public web applications, a large degree of transparency and a much higher degree of combinability and reusability of the services.

Web 2.0 services do not only offer specific contents structured in a certain way, but primarily offer **functionality**: e.g. del.icio.us⁵ allows users to store their bookmarks across computers and with annotations, flickr⁶ to publish, organize and comment photos, backpack⁷ to collaboratively work on projects and organize files, to-dos, dates and ideas in a small group.

Services can usually not only be accessed via a central web browser interfaces, but often also via embeddable components (widgets), which can be re-used on other sites (Google maps⁸ is a prominent example), run as desktop applications or combined with other services in so-called mashups. Technically, this is enabled by open APIs (Application Programming Interfaces), which allow the access to content and functionality from third party tools or externally embedded widgets.



Figure 2: The Web 2.0 service landscape (Ludwig Gatzke)

⁴ <http://en.wikipedia.org/wiki/Blog>

⁵ <http://del.icio.us>

⁶ <http://flickr.com>

⁷ <http://backpack.com>

⁸ <http://google.com/maps>

RICH INTERACTION, CASUALTY AND USER EXPERIENCE

The mainstream adoption of these concepts was also due to richer, more seamless user interfaces, as induced by AJAX and related techniques, which allowed interaction without constantly reloading the web page. Drag-and-drop, live updates of content after e.g. filtering or search, direct feedback on form filling errors, are user interface standards for web pages by now. Additionally, a new casualty in communication and a focus on simple, friendly messages arose.

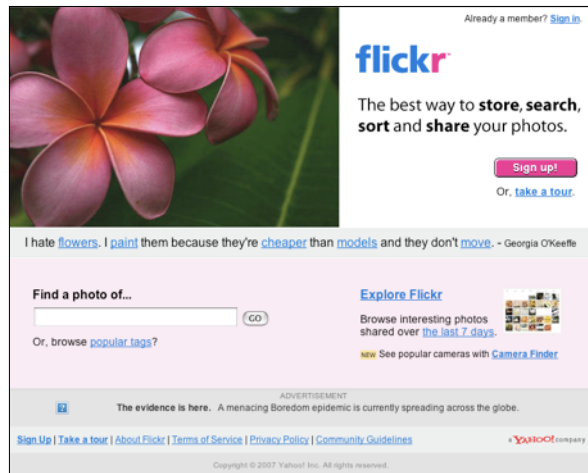


Figure 3: Flickr.com startpage

Or take flickr's start page as another example of effectively communicating, what a service is about, what the user can do with it, and providing direct access to contents via search or exploratory browsing.

⁹ http://www.poetpainter.com/thoughts/file_download/7

Mechanisms like these lead to convenient interfaces, however, this alone does not constitute rich user **experience**. Stephen P. Anderson identifies six layers of user experience in a pyramid model⁹.

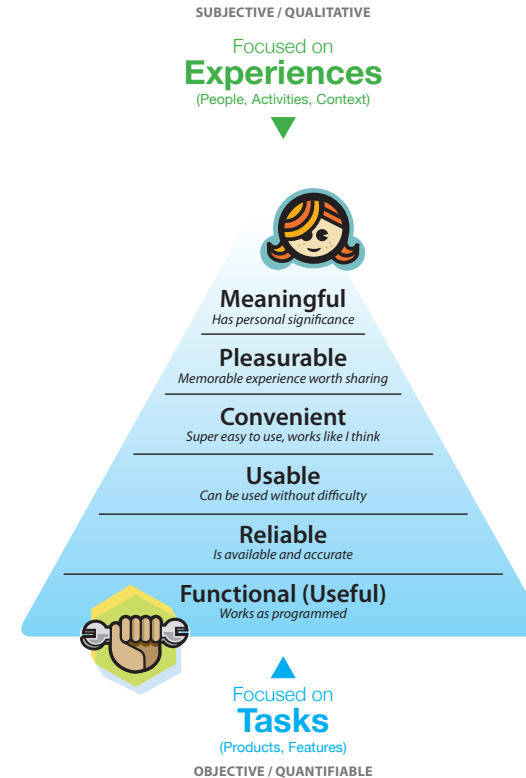


Figure 4: Stephen P. Anderson's pyramid of user experience

Functionality and reliability constitute the basis for usability, and a lot of HCI research in the past has concentrated on creating metrics and measuring empirically, how effective specific interface solutions are with respect to objective measures like effectiveness, efficiency and satisfaction. However, convenient, pleasurable and especially meaningful interaction, which Anderson locates on top of his hierarchy, require an additional personal or social transaction.

Going to the library and conveniently finding a book, because the shelves are well organized, is making our lives more comfortable. But meeting someone at the book shelf, who is interested in similar topics, chatting about books to read and exchanging thoughts with a “familiar stranger” will make the library visit a meaningful experience worth remembering. These types of interactions were enabled by the so-called Web 2.0 or the social web on a large scale — and that was the ultimate difference in user experience. AJAX could only lay the foundation by lowering the entry barriers.

THE READ–WRITE WEB

With an increasing number of services offering rich functionality, participation and social interaction, a new understanding of the web as a **read-write** medium has found its place in mainstream culture.

Accordingly, most web applications labeled Web 2.0. are

- content creation sites (blogging platforms, productivity applications, wikis)
- content aggregation sites (social news sites like digg, etc.)

- display surfaces (for showing off content like MySpace or YouTube)
- or social network sites (like Xing, LinkedIn or Friendster)

Typically, Web 2.0 sites combine two or more these features.

The canonical example for the change in media culture, and the new ease of publication, are weblogs or, for short, **blogs**. Blogs are web sites, maintained by one or more authors, where short entries (posts) are published periodically and are typically presented in temporal order. In the beginning, they were often characterized as **online diaries**, however, over time and with a variety of emerging usage practices, it became clear that blogging represents a whole new media format, which can only partially be characterized with access to pre-existing publishing formats. Danah Boyd reports a participant of her survey on blogging definitions¹⁰:

“I’ve given up on definitional questions and gone for these tautologies. Like blogging is what we do when we say, ‘We’re blogging.’ And not worried much about what’s a blog, and what’s a journal, and what’s a whatever, link log, and a photo blog, and whatever. I think that they’re not particularly meaningful categories. ... It’s a blog because a blogger’s doing it. It’s a blog because it’s caught up in the practice of blogging. It’s a blog because it’s made on blog tools. It’s a blog because it’s made up out of blog parts. It’s a blog because bloggers are engaged with it, and everyone points at it and says, ‘It’s a blog!’”

¹⁰ <http://reconstruction.eserver.org/064/boyd.shtml>

THE ANATOMY OF THE PARTICIPATORY WEB

The actual anatomy of the participatory web is hard to define due to novelty of the phenomenon and the large number of data as well as parameters to consider: While Technorati publishes staggering numbers concerning weblog growth and activity, Jakob Nielsen claims a strong inequality, with only a small number of people actually contributing versus an overwhelming majority of “lurkers” as consumers. Forrester Research presents a more differentiated picture in a recent survey, pointing out, that a more fine-grained understanding of participation is needed to understand the anatomy of the social web.

TECHNORATI: STATE OF THE BLOGOSPHERE

The popular blog search engine Technorati¹¹ reports the state of the blogosphere on a periodic basis¹². As of April 2007, a total of 70 million weblogs were tracked, about 120,000 new weblogs were created each day. 1.5 million posts per day were written, with Japanese being the top blogging language at 37%, English second at 33%, and Chinese third at 8%. These numbers definitely hint at an ongoing, strong attention to the phenomenon of blogging, do not tell us much, however, about the actual usage practices.

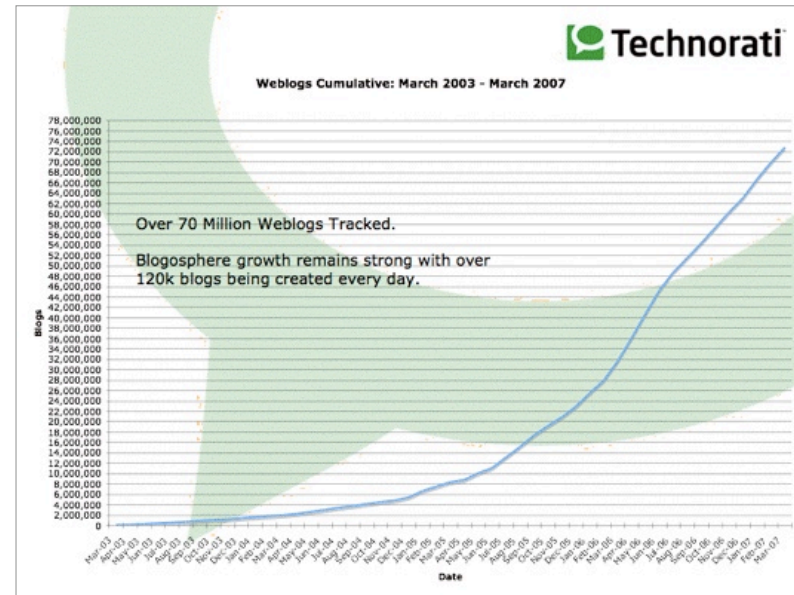


Figure 5: Technorati’s quarterly weblog statistics

¹¹ <http://technorati.com>

¹² <http://www.sifry.com/alerts/archives/000493.html>

NIELSEN: PARTICIPATION INEQUALITY

Jakob Nielsen points out that user participation often follows a power law, or the so-called 90-9-1 rule¹³:

- 90% of users are lurkers (i.e., read or observe, but don't contribute).
- 9% of users contribute from time to time, but other priorities dominate their time.
- 1% of users participate a lot and account for most contributions.

This pattern can be found in many participatory web activities. Wikipedia, for example, has an even steeper distribution; according to Nielsen *“more than 99% of users are lurkers. According to Wikipedia's 'about' page, it has only 68,000 active contributors, which is 0.2% of the 32 million unique visitors it has in the U.S. alone. Wikipedia's most active 1,000 people -- 0.003% of its users -- contribute about two-thirds of the site's edits. Wikipedia is thus even more skewed than blogs, with a 99.8-0.2-0.003 rule.”*

Accordingly, it has to be kept in mind, that the so-called read-write web is in principle open for everyone to contribute; however, only a small portion of people actively make use of that opportunity at the moment.

FORRESTER RESEARCH: SOCIAL TECHNOGRAPHICS

Unlike Technorati's statistics which mostly focus on raw blog growth numbers and structural features of the blogosphere, and Nielsen's statement, which regards participation mainly with a focus on content production, the **“Social Technographics”** study from Forrester Research [Li:2007] takes a closer look at the social and demographic structure of the social web population. The study is based on two surveys including including close to 5000 North-American individuals each.

According to the surveys, 22% of adults now read blogs at least monthly, and 19% are members of a social networking site. Even more amazingly, almost one-third of all youth publish a blog at least weekly, and 41% of youth visit a social networking site daily (see Figure 6).

Based on an analysis of online participation and consumption practices, the authors identify six (partly overlapping) segments of users, ordered by degree of participation (see Figure 7):

Creators publish blogs, maintain Web pages, or upload videos to sites like YouTube at least once per month. They include just 13% of the adult online population. Creators are generally young — the average age of adult users is 39 — but are evenly split between men and women.

Critics participate in either of two ways — commenting on blogs or posting ratings and reviews on sites like Amazon.com. They represent 19% of all adult online consumers and on average are several years older than Creators. Two-thirds of them post ratings and reviews, but

¹³ http://www.useit.com/alertbox/participation_inequality.html

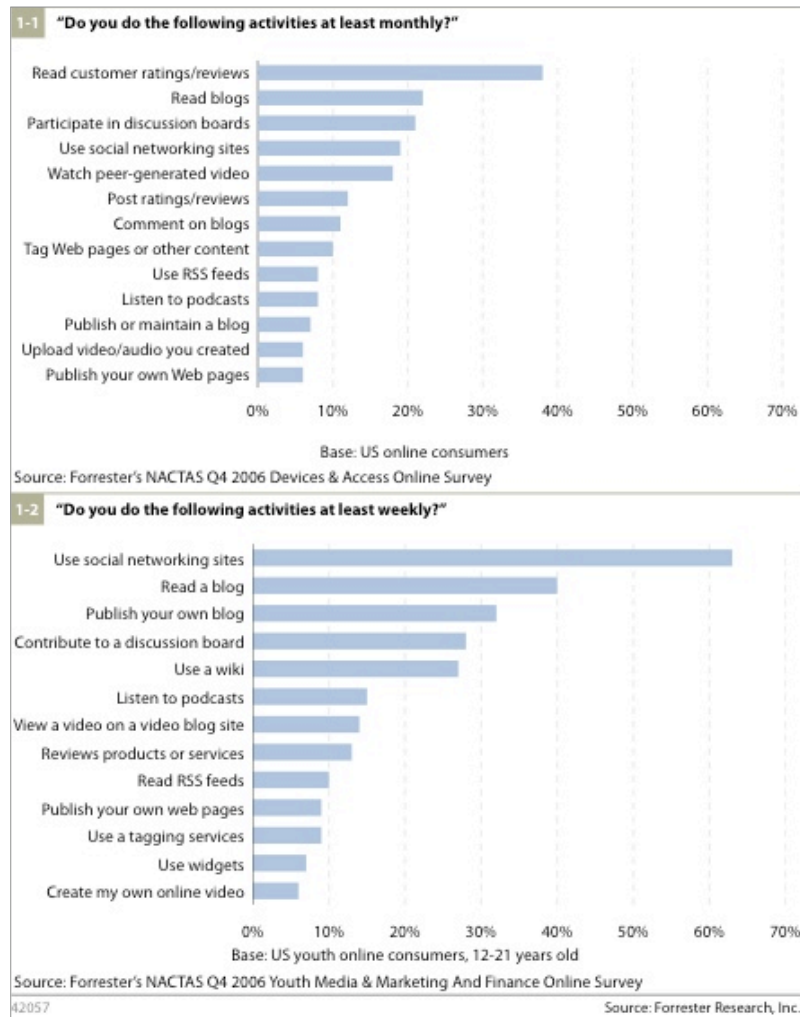


Figure 6: Social computing statistics from Forrester Research [Li:2007]

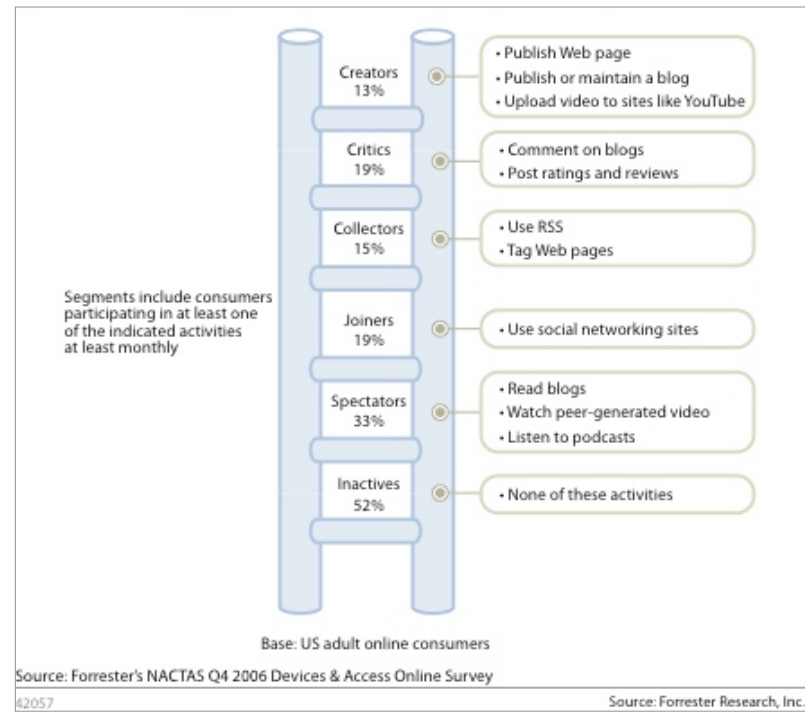


Figure 7: Participation ladder from Forrester Research [Li:2007]

only 22% comment on blogs and rate/review Web site content. Four out of 10 critics are creators as well.

Collectors create metadata that's shared with the entire community, e.g. by saving URLs on a social bookmarking service like del.icio.us or using RSS feeds on Bloglines. Collectors represent 15% of the adult online population and are the most male-dominated of all the Social Technographics groups. More than two-thirds tag pages, while more than half use RSS.

Joiners use a social networking site like MySpace.com or Facebook. They represent only 19% of the adult online population and are the youngest of the Social technographics groups. They are highly likely to engage in other Social Computing activities — 56% also read blogs, while 30% publish blogs.

Spectators represent 33% of the adult online population and are slightly more likely to be women and have the lowest household income of all the social Technographics groups. The most common activity is reading blogs, with only a small overlap with users who watch peer-generated video on sites like YouTube. 31% of do not engage in participatory activities.

Inactives: Today, 52% of online adults do not participate at all in social computing activities. These have an average age of 50, are more likely to be women, and are much less likely to consider themselves leaders or tell their friends about products that interest them.

Concerning demographic features with respect to the segments, 18 - 26 year olds have the highest percentages in almost every participating category. What stands out is the extremely high participation in social network activities (70% for 18–21 year olds). One third of teenagers is actively creating content, however these are engaging less as critics or collectors than other generations. Generation X is participating with up to 29% for Joiners, but around 40% are merely spectators or inactives. Older generations tend to participate less, but still have a spectator rate of almost one fifth for seniors.

This study is particularly interesting, since it starts to map the space between reading and writing; in fact, the social web and its services allow a variety of contribution mechanisms beyond a traditional understanding of content production.

USER GENERATED CONTENT — OR METADATA?

This sheds new light on of the buzzwords accompanying the Web 2.0: **user generated content**. Especially the explosive growth of blogs and the success of content sharing platforms like YouTube¹⁴ (with the slogan “Broadcast yourself”) seems to hint at a whole new era of amateur content made widely available.

However, as the discussed studies demonstrate, a closer look at the actually produced contents reveals, that only a small percentage of participators actually produce and publish genuine content themselves, such as writing a blog post in an article style or producing a video clip.

¹⁴ <http://YouTube.com>

A much larger percentage of the so-called “user-generated content” is actually to be understood as

- conversational and personal statements (and as such primarily relevant to a small group acquainted with the author)
- re-posting of content generated by others, such as the embedding of YouTube videos into blog posts or the excerpt-wise citation of a longer article along with a short comment or
- metadata in a wider sense of the word—such as ratings, reviews, comments, or short affirmations of interest expressed e.g. in public bookmarks enriched with user-defined keywords (so-called tags)

We can summarize that by blurring the borders between the private and the public, the formal and the casual, and consumers vs. producers, also borders between conversation, content and metadata start to get increasingly fuzzy.

2.2. THE LONG TAIL

“The theory of the Long Tail is that our culture and economy is increasingly shifting away from a focus on a relatively small number of “hits” (mainstream products and markets) at the head of the demand curve and toward a huge number of niches in the tail. [...] In an era without the constraints of physical shelf space and other bottlenecks of distribution, narrowly-targeted goods and services can be as economically attractive as mainstream fare. [...] When consumers are offered infinite choice, the true shape of demand is revealed. And it turns out to be less hit-centric than we thought. People gravitate towards niches because they satisfy narrow interests better, and in one aspect of our life or another we all have some narrow interest.”

Chris Anderson¹⁵

One of the iconic memes connected to the described developments is the so-called Long Tail. A new light on an old statistical phenomenon was shed by Chris Anderson in [Anderson:2004] and refined in [Anderson:2006]. Originally motivated by studies in micro-economics, it also applies to content generation and attention on the World Wide Web in general. This section discusses both the long-known statistical distribution bearing the same name and its significance in the light of latest web developments.

¹⁵ <http://www.thelongtail.com/about.html>

¹⁶ Depending on context, also the terms Zipf or Pareto distribution are used to describe this type of distribution.

THE STATISTICAL DISTRIBUTION

The “long tail” is the colloquial name¹⁶ for a long-known feature of a statistical distribution based on a power law [Newman:2005], i.e. having the form

$$p(x) = Cx^{-\alpha}$$

with $\alpha > 0$

The graph is a steeply declining curve, with a “long tail” to the right, approximating the x-axis, which gave the function its name (see e.g. Figure 8, left). The resulting distribution has the interesting property of being **scale-free**, which means it retains the same shape regardless of the scale of the measurements.

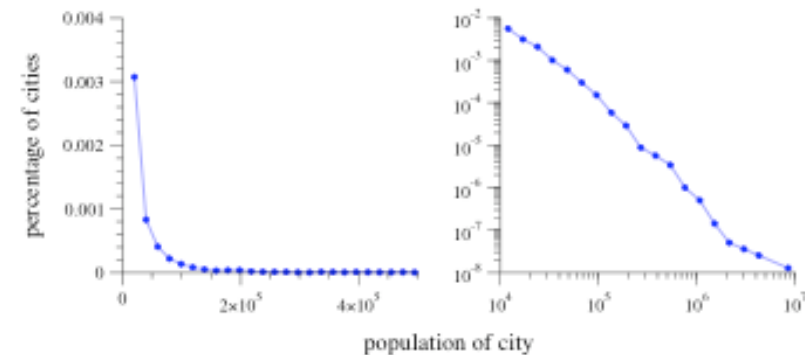


Figure 8: City populations power law [Newman:2005]

To give an example: The population of cities is known to follow a power law (see Figure 8, left): Most of the cities are pretty small, while very few cities have a large population. If now, for example, we observe that there are 20 times more cities with 100 inhabitants than with 1000, we can automatically conclude that there are also 20 times more cities with 100'000 inhabitants than with 1'000'000. Consequently, when presented in a log-log scale (see Figure 8, right), the shape of the curve approximates a straight line.

Often, the same kind of distributions is also associated with the so-called 80/20 rule, indicating e.g. that 20% of the population possess 80% of the wealth.

Besides the Gaussian normal distribution, this distribution is one of the most often observed in empirical sciences.

According to [Newman:2005],

“Power-law distributions occur in an extraordinarily diverse range of phenomena. In addition to city populations, the sizes of earthquakes, moon craters, solar flares, computer files and wars, the frequency of use of words in any human language, the frequency of occurrence of personal names in most cultures, the numbers of papers scientists write, the number of citations received by papers, the number of hits on web pages, the sales of books, music recordings and almost every other branded commodity, the numbers of species in biological taxa, people’s annual incomes and a host of other variables all follow power-law distributions.”

In general, “power law distributions tend to arise in social systems where many people express their preferences among many opportunities”¹⁷. As the number of options rises, the curve tends to get more extreme, actually increasing the distance between the number one spot and the median. Secondly, the asymmetric shape of the curve dictates that most of the values are below average, which is often perceived as counter-intuitive. Of course, one precondition for long-tail curves to arise is that there are actually systematic differences in preference to cause the skewed distribution; additionally, an important catalyst is usually feedback or transparency about other people’s choices.

THE LONG TAIL OF WEB ECONOMICS

Consequently, it is not surprising that the long tail appears around every corner in web statistics. However, there is some peculiarity concerning the right part of the curve, which was first described by Chris Anderson [Anderson:2006], and stirred quite some discussion.

Anderson comes up with a very conclusive model how web commerce and communication differ from their real-world counterparts and what effects that has. In, e.g. a traditional book store with limited storage space, the 80/20 rule dictates the inventory. It is economic just to keep the the top sellers in stock (see Figure 9, “head”), since for books which sell maybe only once a year, the inventory costs exceed the profit.

In contrast, Anderson discovered that successful online shops make most of their money with niche products, each sold very rarely. But

¹⁷ http://shirky.com/writings/powerlaw_weblog.html

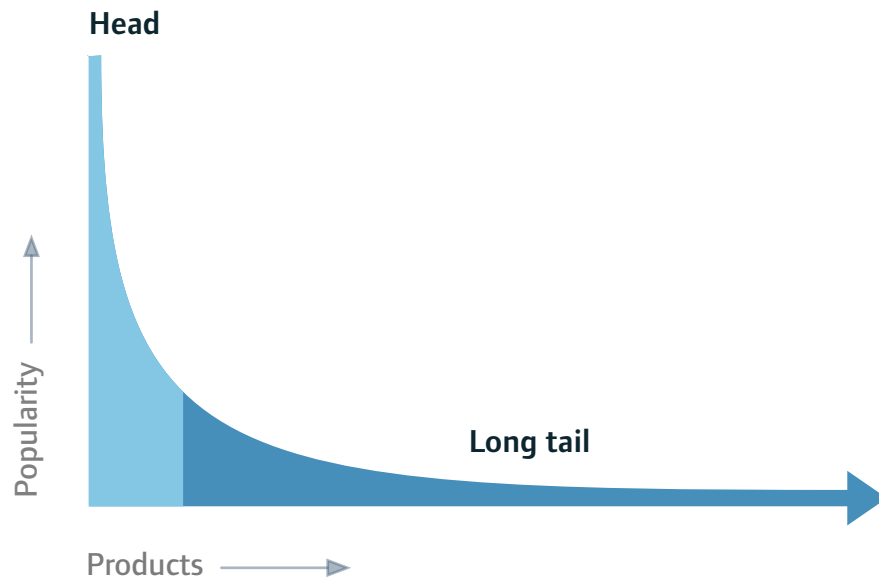


Figure 9: The long tail of web economics (reproduced from [Anderson:2006])

there is literally millions of them — together with the cheapness of storage and distribution, outsiders are suddenly profitable. In the same sense, the user-edited internet encyclopedia Wikipedia¹⁸ has many low popularity articles that, collectively, create a higher quantity of demand than a limited number of mainstream articles found in a conventional encyclopedia such as the Encyclopedia Britannica.

This sets the agenda for a whole new way of thinking about **navigation and interaction with information**: If everybody is puzzling together his personal taste made up of widely obscure stuff, this re-

quires fundamentally different paradigms for browsing, storing and discovery of information. The items in the long tail are hard to classify, cluster and group, due to their sheer abundance and diversity. They deviate so much from the “normal”, the common ground everybody is aware of, and which is contained in the head of the curve, that classical approaches to categorization and ordering are not feasible anymore.

One of the most interesting features of the distribution is its **self-similarity**: When looking at movies sales, for instance, a typical long-tail distribution will arise, with few blockbusters at top and a large number of semi-successful movies in the tail. However, the same distribution, in principle, will arise, when looking only at horror movies or Czech documentaries. This makes it clear, that the long tail for movie sales is in fact a superposition of a plethora of smaller long-tails, which can in turn be split again. On the one hand, untangling this composition is the key to making these structures manageable and navigable; on the other hand, this shifts the problem only to a lower scale.

¹⁸ <http://wikipedia.com>

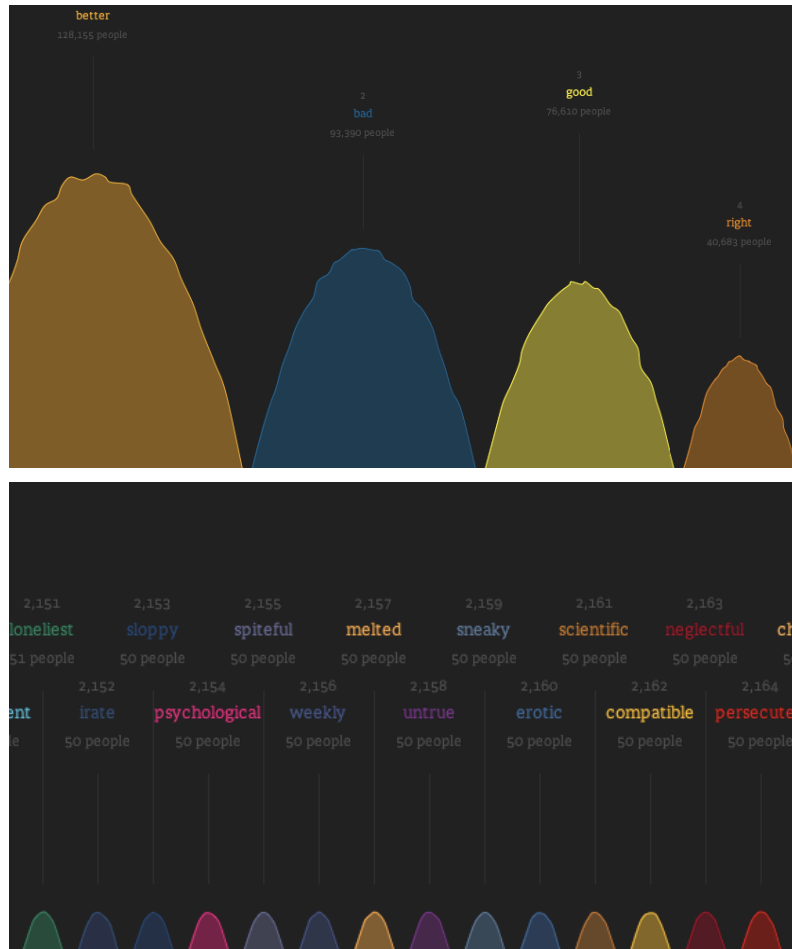


Figure 10: We feel fine: the long tail of moods and emotions

An illustration of the dramatic shift towards the long tail in web culture is the web art project “we feel fine” launched in 2005 by Jonathan Harris & Sepandar Kamvar¹⁹.

It is based on a periodic scan of the web for sentences like “I feel...” or “I am feeling...” and the extraction of the contained adverbs and adjectives the authors use to describe their mood. The resulting collection of moods and feelings is visualized in a variety of ways, one of them being heaps scaled and sorted by frequency.

Expectedly, the four top adjectives “better”, “bad”, “good” and “right”, are rather general and occur very often. However, only one tenth in to the whole curve, we find much more specialized, informative descriptions, such as “sneaky”, “cherished”, “neglectful” etc. The interesting thing is, that in terms of global popularity, the whole rest of the curve is almost indistinguishable: The very end of the curve looks almost the same as the beginning.

¹⁹ <http://www.wefeelfine.org/>

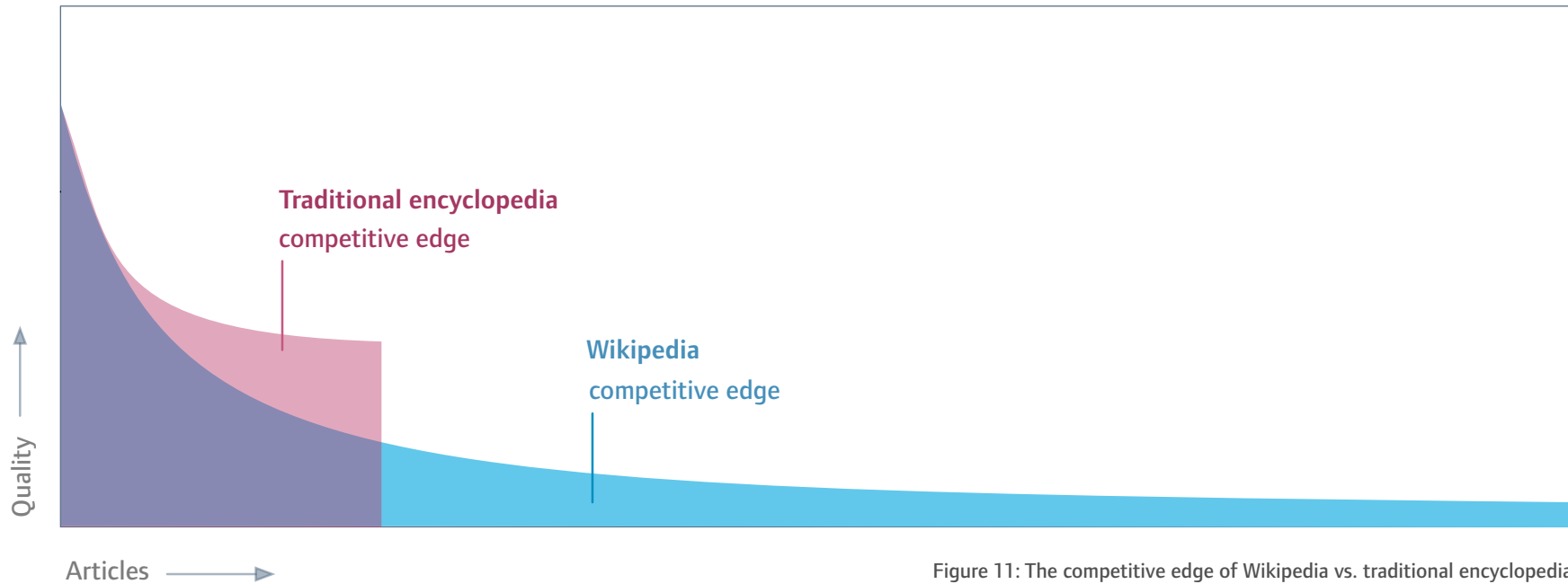


Figure 11: The competitive edge of Wikipedia vs. traditional encyclopedias

The relevance of the described phenomenon for information structuring and communication on the world wide web can further be illustrated with an exemplaric comparison of Wikipedia and traditional encyclopedias:

While the latter, with employed experts, strict quality control and age-old tradition manages a high quality level for virtually all their articles, there is a natural limit to the number of articles that can be published on that level. Wikipedia articles, written mostly by amateurs in a loosely organized, democratic peer-review process, will **in average** be not as well researched, complete or might be even subjective in nature, intentionally leaving out important facts or presenting

wrong facts. However, the important competitive edge is that Wikipedia offers a “better-than-nothing” article on virtually **any** topic that somebody finds interesting enough to compile a short page about it. For people interested in that very specific topic (say a chess variant like “Capablanca random chess”), with traditional encyclopedias offering no information, Wikipedia’s page is of infinitely higher utility to the potential user. The argument, that for a single user 99.999% percent of these pages are rather worthless, and that most of them might be of disputable quality, misses the point: for some of the users, they will make a huge difference—and these continue to sum up, as the long tail is virtually unbounded to the right side.

2.3. MICROCONTENT

Is the second paragraph dead?
[Beale:2005]



The described trends profoundly changed the formats in which information is published. It has been mentioned above, that the increased casualty and informality of lead to an increasing number of **personal, subjective, often conversational** statements available online. Second, much of the published content is **referential**, in a sense that it can only be interpreted with reference to another information item — such as a review, a comment to a

blog post or automatically published bookmarks. A third trend is especially remarkable: Single information items tend to get much **shorter**. This is not only an effect of the technologies used to publish and communicate information (such as blogging software, cell phones, email clients) [Beale:2005] but also the consumption behavior of the users and the according social practices.

This is taken to the extreme at twitter.com, where users answer the question “What are you doing right now?” on a frequent basis to keep their friends updated of their activities. Twitter entries are limited to 140 characters; a limit well known from text messaging on mobile phones. Consequently, twitter posts can not only be submitted on the web page, but also from cell phones or instant messaging clients. Per

default, posts are also published on the public timeline, which displays a world-wide cut through the activities of twitter users at a given time. Due to the miniaturized format of publishing, “twittering” is also referred to as micro-blogging.

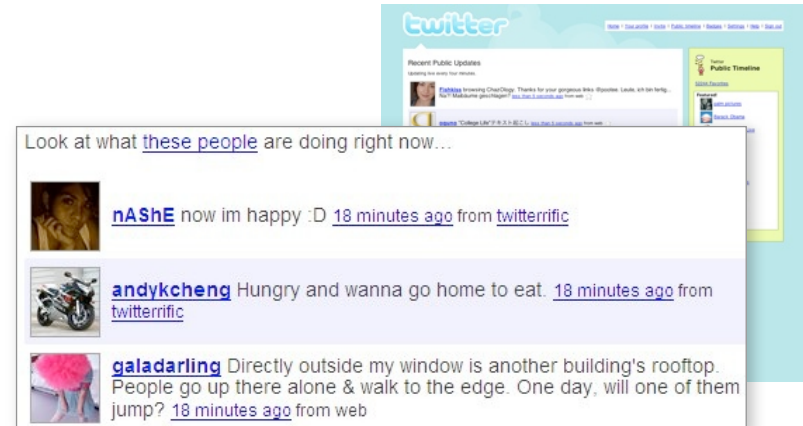


Figure 12: Micro-blogging on twitter.com

CHUNKS, SNIPPETS, MICROCONTENT

The extreme, yet illustrative example of twitter hints at the fact that the phenomenon of **chunking information into the smallest potentially useful unit** is an emerging trend and its significance not researched deeply enough.

Currently, these minimal information items are, depending on context referred to as **snippets**, **chunks** or **microcontent**²⁰.

Microcontent is a vaguely defined term. Dr. Arnaud Leene comes closest to a workable definition by postulating several properties qualifying a digital information item as microcontent [Leene:2006]:

- **Focussed.** The piece of information has recognizable focus: it has a single subject. Examples are a business card, a cooking recipe, a book review.
- **Self-contained.** Microcontent items contain both all of their content as well as embedded metadata. This makes it possible to pass microcontent around between persons of digital tools via e.g. RSS
- **Indivisible.** A microcontent item contains all and only its characteristic components. If one of them is left out or used out of context, the result is not an identical piece of microcontent.
- **Structured.** The information in a piece of micro-content is structured, such that content, markup and metadata can be separated and consumed in a meaningful and efficient manner by different applications.
- **Addressable.** Each piece of microcontent has its unique URI and can thus be referred to in an unambiguous manner.

This definition of micro-content is descriptive in a sense, that most of contents published in e.g. weblogs matches some of the criteria. On the other hand, it is normative in its requirement to fulfill all attrib-

utes. Especially, the requirements of being focussed, indivisible and structured are often not met, which makes a unified treatment of arbitrary micro-content in end-user applications a difficult task. However, the more applications are built around these paradigms, the more authors will adjust to the formats. In the following, some of the new content formats shall be discussed with respect to this microcontent definition:

TWITTERING: NANOCONTENT

It is disputable if the average twitter post should be regarded as **micro-content** or just an **utterance**, due to the spontaneous, ad-hoc nature of its production and the strong context-dependency of its meaning and significance. Perhaps, nano-content is the appropriate word.

PUBLIC BOOKMARKS: REFERENTIAL MICROCONTENT

Public bookmarking systems allow users to share their bookmarks publicly, along with a list of freely chosen descriptive or operational keywords (so-called "tags", see section 2.5). A stream of bookmarks from one user, associated with one tag or referring to one resource is typically available at the services site. Accordingly, each of these shared bookmarks constitutes one peice of micro-content, with the specialty, that the contained statement (user X bookmarked site Y, using keywords Z) is ultimately referential, in a sense that the referee of the statement is only contained as a link.

²⁰ In this thesis, the neologism microcontent first introduced by Anil Dash (http://www.anildash.com/magazine/2002/11/introducing_the.html) will be used, since it hints at the definition of a new format; snippet and chunk are pre-existing terms and as such potentially loaded with wrong preassumptions.

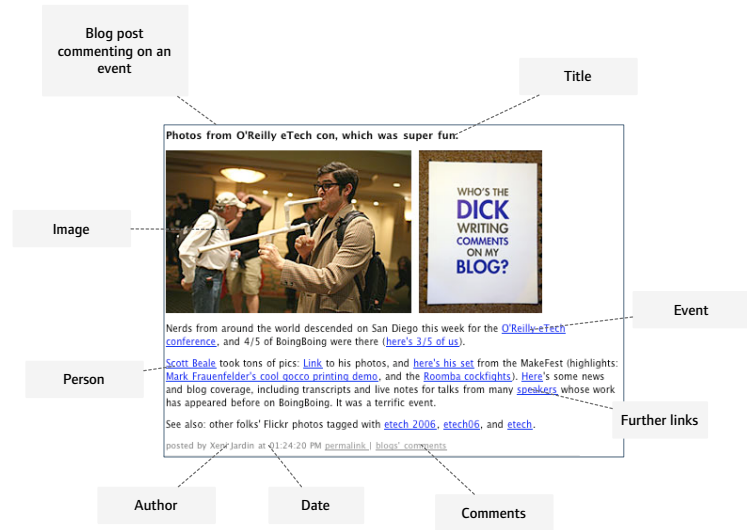


Figure 13: Blog post context, content and metadata

STORY TEASERS: REFERENTIAL, SUMMARIZED MICRO-CONTENT

New sites usually present previews to larger stories in micro-content format, containing date, author, headline and a short summary of the contents. Although the piece of micro-content clearly fulfills the conditions, the dominating relation to the actual content makes it less self-content than sometimes desirable and again **referential** in nature.

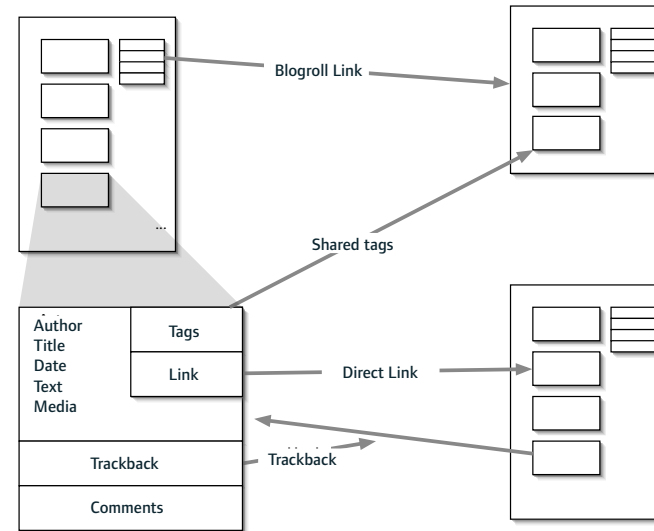


Figure 14: The intertwingularity of blog posts

BLOG POSTS: INTERTWINGLED MICRO-CONTENT

Today, blogs are the premier source and distribution channels for micro-content. There are many different types of blog entries, ranging from pointers to interesting link along with a short comment over personal statements and experience reports to small essays about topics of interest. An increasing amount of blog posts is also automatically generated by other services, such as a digest of recently bookmarked sites at an online bookmarking service or a re-post of other micro-content, facilitated e.g. by software such as ReBlog.

The context of blog entries is of special importance in understanding their content: Other than in a newsgroup or forum, where entries refer to immediately preceding entries, blog entries typically exhibit a stronger degree of linkage or “**intertwingularity**”²¹: The whole blog is typically associated with a “blog roll”, where the author points to his sources of information and his favorite blogs. The whole blog and individual blog entries can be characterized by tags (free-form keywords). These can be used to navigate, filter, search or discover related items across blogs. Often, a reference is established to ongoing discussions or external resources by linking directly from the blog entry’s content. For one entry, it can be determined, which other blog entries link to it (*trackback*)²².

This form of backwards-linking makes a larger discourse–context and meta–information on the post or its topic directly accessible. Additionally, blog visitors can leave comments, which, when containing a larger statement, point to other blog posts as well.

All these mechanisms embed pieces of micro–content into a larger **discourse or reference context**, which is also vital to understanding its context. As mentioned above, many blog posts are referential and subjective, accordingly, responses to the post, the author’s reputation, other posts about the same topic, are not merely additional information, but essential to judging the personal relevance of the statement made. The lack of quality control in a broadcast–everything publishing scene can only be compensated by the reader—by aggregating the many different voices into a coherent picture.

²¹ a term coined by Ted Nelson to express the complexity of interrelations in human knowledge.

²² http://www.sixapart.com/pronet/docs/trackback_spec

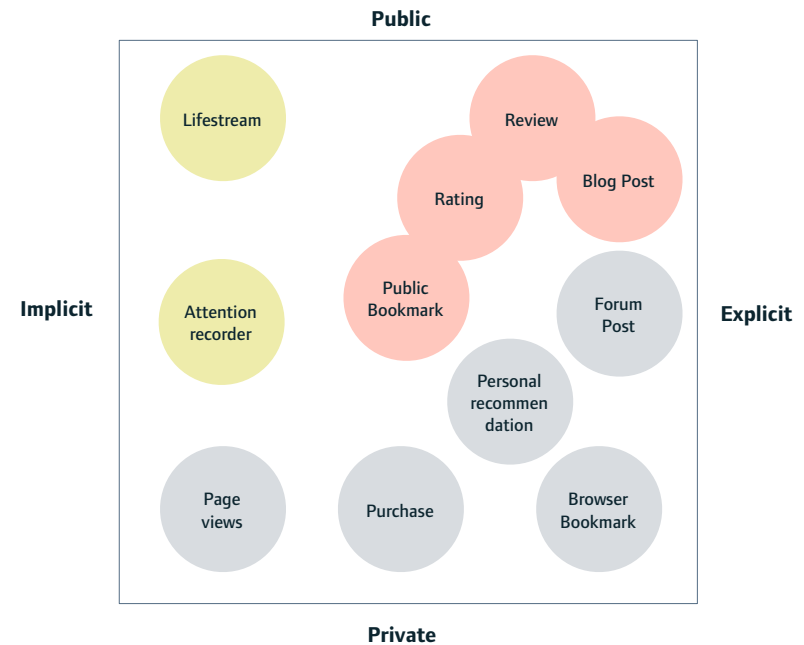


Figure 15: Record and publish everything: Established mechanisms (blue), typical Web2.0 applications (red), upcoming trends (yellow)

PUBLISHING IMPLICIT INFORMATION

In addition, we can also observe a trend towards **publishing implicitly created information**²³.

Usually, things attended to, purchased or bookmarked stay available for private access or for a small group of people. Web2.0 applications made the publication of personal opinions, ratings, reviews and noteworthy web sites easy and popular. These do not necessarily represent content themselves, but rather add little pieces of meta-information to things, users or other contents. As such, they only make sense when aggregated, evaluated and combined. Currently, a new web services make the results from constant tracking of activities and attention widely available: last.fm²⁴ lets users track the music they listen to, plazes²⁵ streams user's locations, attention trust's attention recorder²⁶ saves complete clickstreams, browsing histories (but let's the user decide on his own how and what to publish of it), while services like cluztr²⁷ let users continuously share every single webpage they browse to. Another class of online services, such as iStalkr²⁸ combined these information bits into a constant stream of metadata, attention and opinions around a person.²⁹

²³ http://wanderingstan.com/2007-04-19/microblogging_to_implicit_blogging

²⁴ <http://last.fm>

²⁵ <http://plazes.com>

²⁶ <http://attentiontrust.org>

²⁷ <http://cluztr.com>

²⁸ <http://istalkr.com>

²⁹ A phenomenon that has received the name "lifestreams", not to be confused with David Gelernter's project in the 1990s. More information on this recent phenomenon can be found at <http://lifestreamblog.com/>

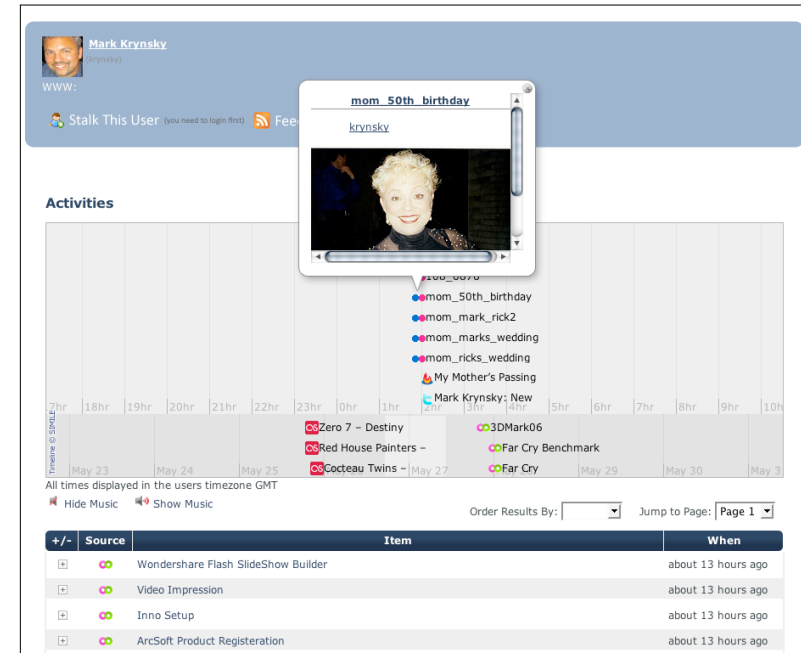


Figure 16: iStalkr.com lifestream for a user, displaying recently viewed pictures, web pages, music listened to, twitter messages, blog posts, etc.

2.4. WEB FEEDS

RSS is an extremely important standard. It's the HTML of the next generation of the Web, or some people might refer to it as the Unix pipe of the Internet. It's a way of channeling data from one application to another in very interesting and robust fashion. [O'Hanlon:2005]

GO GET VS. COME TO ME

The world wide web is still widely perceived as an asynchronous “pull” medium — users navigate to sites to get information (locomotion). To read your daily news, you navigated to your favorite news site and checked if there were new articles. To find information about a topic, you type keywords into a search engine and navigate to the results. This represents a classical request-response schema. In contrast, synchronous “push” channels like telephone, instant messaging or mobile text messaging proactively communicate updates or pieces of conversations to the user. Obviously, due to attention-economical reasons, only a limited number of push channels is beneficial, before information overload sets in.

In this context, **web feeds** introduced an interesting and powerful information delivery paradigm to the Web: Web feeds allow users to subscribe to frequently updated contents. To consume web feeds, usually, a dedicated feed reader application is needed, but recent browser versions also support direct display and subscription of feeds. Instead of actively accessing web pages of interest on a regular basis, web feeds let the user **attract** the information he is interested in. Usually users subscribe to multiple feeds; the resulting news mixture is a

highly personalized, constant influx of information items from various sources — be it news stories from the big players, upcoming events from the region or the latest progress on a friend's project.

WHAT ARE WEB FEEDS?



Figure 16: Vienna — a typical desktop news reader

Feeds and feed items are made accessible with the help of desktop or web applications. Typically, the application periodically scans all subscribed sources for new items, which are then marked as unread. Users scan unread items, click some of them to read consume the full content or go to the web page associated with the news item and then occasionally mark them as interesting (e.g. by assigning them a “star”, which amounts to bookmarking an item), file them in folders or tag

structures, annotate the item for personal or public use or republish the item itself on e.g. a blog. This might be done in the feed reader itself or the web browser, e.g. via public bookmarking applications like del.icio.us, which support a large subset of these actions. However, newsreading is a quick scanning activity, where only a small subset of the available contents is actually inspected closer or annotated.

Technically, web feed is an XML formatted file, containing a limited number of structured entries, sorted by the date of creation or update. Once a new information item is available, it is put on top of the list and the feed is updated. Depending on implementation, the feed either contains a fixed number of items or all items from a given time range. In either case, it provides only a small window perspective on the most recent items of a dynamic information collection.

The most popular feed formats are RSS (in various versions) and Atom. Without going into the details of the specifications, we can identify a shared least common denominator for all these implementations [Brandt:2006]:

Feeds are located at a unique URI³⁰, allowing the retrieval of its contents via HTTP and external references for linking or making machine-readable statements about that particular feed. The feed and its contained items are described by at least the elements title, link and description, but they can also contain additional metadata. The central element is the link, which is the subject that the item refers to. In every feed format one is obliged to use a URI as an item identifier. The title is supposed to be used as the human readable form of the link. Thus these three elements build the core of each feed and of each in-

formation object that is included. The feed items can contain various other descriptive elements depending on the format. Furthermore, all popular web feed formats can be extended by new tags. It is both possible to use the feed items only as short summarizing pointers to content contained on a web page or to include all the information into the feed document itself. In the latter case, the feed item is self-contained and usually matches the definition of micro-content as introduced above quite well.

USAGE PRACTICES

As noted above, web feeds provide three major benefits in a variety of scenarios [feedburner:2005]:

- Notification about updates to a specific channel of content.
- Subscription, establishing a persistent one-way link between publisher and subscriber.
- Semi-structured content, allowing the consumption and presentation of microcontent with a variety of applications and tools.

Originally used for news teasers pointing to the original stories, web feeds are increasingly used to

- deliver structured microcontent; e.g. weather information, blog posts, or media files (so called podcasts for audio files or vodcasts for video files).

³⁰ Unique Resource Identifier, identical to URLs in format, however, a URI should provide a fixed name for identifying a resource

Figure 17: Newsticker



Figure 18: Google reader—a web based–feed aggregator

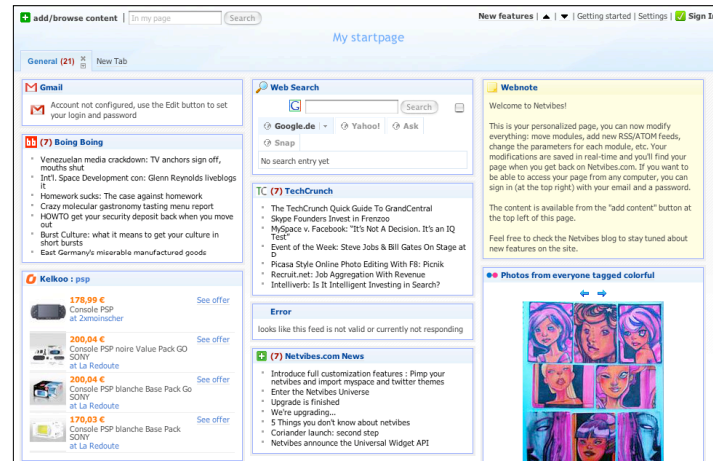


Figure 19: Netvibes: personalized browser start page



Figure 20: Democracy—video subscriptions via RSS

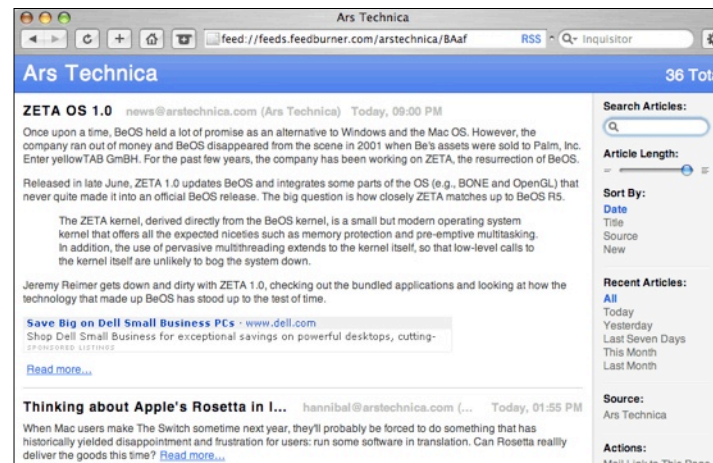


Figure 21: Safari's built-in newsreader

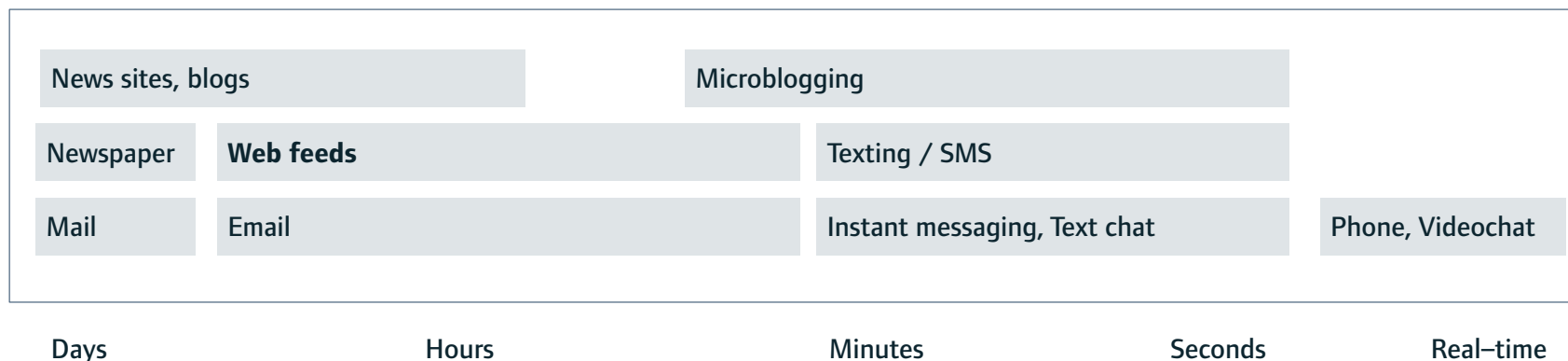


Figure 22: Feeds as a continuously updated, but asynchronous medium

- embed information from external sources into web pages or applications
- subscribe to queries on web applications (such as a subscription to a specific user’s public bookmarks or photos taken at a specific place)
- transfer information between different devices, applications or web pages.

Using an automated a periodic pull mechanism (to check if there are new updates on the feed) results in an almost-synchronous “real time” update for the recipient. In principle, the principle is very similar to email, with the crucial difference, however, that web feeds are a one-way medium: there is no “respond” button in feed readers. This also induces a higher variety in usage practices for feed readers: the general expectation of a timely response for emails dictates high, continuous attention to updates. In contrary, the lack of a back channel for feed readers makes the time and frequency of checking for up-

dates a completely private issue. As such, feeds present an unobtrusive medium for subscriptions and awareness information.

Nevertheless, despite this interesting in-between nature of feeds regarding their temporal nature, there are only two major patterns to be observed in interface design and feed content presentation, which closely resemble traditionally media and communication patterns:

- **The stream:** News are updated continuously in the background and displayed in real time. These interfaces are “now-machines” in a sense that they display only the current state of affairs without access to past events. Analogy: Radio, TV, Billboards.
- **The mailbox:** News are updated continuously and typically organized by feed or smart folders (“today’s items”). Freshly arriving news are marked as unread. Old news are archived, until deleted or a fixed deletion date is reached. Analogy: Email

In the light of the previous chapters, it becomes clear how feeds can play an important role in making a large amount of background and awareness information available: constituting a one-way, self-paced, hence unobtrusive communication medium, filled with information snippets along with descriptive metadata, they can be used in variety of applications and also consumed offline or passed on. They can replace push media notification, subscription to email newsletters, but also active surfing to web pages in many instances.

Despite all these advantages, adoption of RSS feeds is still rather low. On the one hand, this can be contributed to the technical appeal RSS still has; accordingly, many people don't understand what it might be good for. On the other hand, when working with feeds one faces a difficult situation in interface design: the separation of content and presentation, and the variety of use cases often results in a very generic presentation form, which is often not attractive or comfortable to consume. An often chosen alternative is to produce dedicated, compact applications (so-called "widgets") to present specific types of contents (such as e.g. a weather widget, a stock-chart widget etc.); this however, leaves the user with a lot of different mini-applications to manage.

PERSPECTIVES

It is worthwhile to note, that the items contained in a news feed are not web "pages". Rather, they constitute snippets of information, enriched with metadata about their source, author, context and life-cycle; sometimes also author-defined tags are added. Content-wise, they

usually they contain short HTML passages, but also sound (podcasts) or video (vodcasts) files can be included and automatically downloaded. These snippets are passed on, used in a variety of applications and devices, republished, filtered and remixed.

Tools like Yahoo Pipes (see Figure 23) facilitate the construction of novel feeds by combining various sources by logical criteria, such as e.g. creating a personalized feed of music videos from YouTube that match the user's personal listening profile from last.fm.

Microformats³¹ allow to mark-up the HTML content of feed items in a structured and semantically well-defined manner. If these are used, the type of microcontent (review, business card, calendar event, etc.)

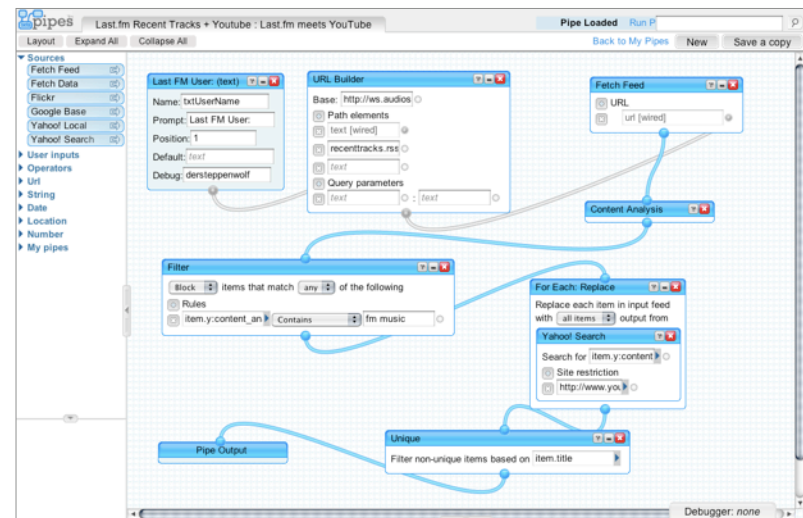


Figure 23: Yahoo pipes

³¹ <http://microformats.org>

and additional metadata (such as author-defined tags) can be identified and used in microcontent presentation.

In order to reuse and recombine contents based on their content or context, it would be ideal to reverse the roles of blogs and feeds: Right now, substantial content is available on blogs, which also offer a web feed. If authors marked-up explicitly, what type of item they are publishing (such as e.g. a review, an essay, or a personal story) along with some metadata fields (such as e.g. an explicit rating like “3 out of 5”), then the own blog might be one place, where the content is published, but at the same time, a reuse of the same content in different context (such as e.g. a user visiting the page of the movie someone commented about) would be effortlessly possible. In a similar vein, users could add event descriptions to a calendar software, or contact data to address management applications, etc. If you were only interested in a portion of the authors content, you could subscribe to a dynamic query only delivering e.g. new book reviews by the author, but leaving personal stories aside.

Of course, this mark-up does not have to be done by hand; rather, blogging software plug-ins like structured blogging³² provide interfaces for conveniently structuring blog posts. This publishing of marked-up microcontent could be a realistic first step towards a semantic web vision; however, microformats are not widely spread yet, which hints at a **chicken-and-egg** problem: without immediate benefit for the author, there is not enough incentive to do the extra work; on the other hand, immediate benefit like improved findability, or better organization of the own information, can only be demonstrated, once a critical mass of structured contents is available.

³² <http://structuredblogging.org/>

Dimension	Values	Explanation	Example
Tagging rights	Self-tagging Permission-based Free-for-all	Users tag only self-created resources Users can tag some resources Users can tag all available resources	Technorati.com Flickr.com (friends, family, contacts) bibsonomy.org, del.icio.us
Source of resources	User-generated content Provided content External resources	Users tag self-generated content Users tag content provided by the service Users tag resources not hosted by service	Flickr.com, YouTube.com ESP game del.icio.us, last.fm
Tagging feedback	Blind Viewable Suggested	No awareness of community or own tags Previously applied tags are presented The system selects tag suggestions	Technorati.com, ESP game ma.gnolia.com del.icio.us
Tag aggregation	Set Bag	Each distinct tag is only stored once Multiple applications of the same tag are counted	YouTube.com, Flickr.com del.icio.us
Vocabulary control	Unrestricted vocabulary Managed vocabulary Fixed vocabulary	Free-form annotation Restricted vocabulary with regular updates Standardized classification	all of the above Wikipedia categories, Wordpress categories –
Vocabulary connectivity	Unrelated tags Associative Hierarchical Multi-hierarchical Typed	Keywords Authority file Taxonomy/Classification Thesaurus/Faceted Classification Ontology	del.icious, magnolia.com, ESP game bibsonomy.org Wikipedia categories
Resource connectivity	None Links Groups	No explicit relation between resources Links between resources (e.g. web pages) Grouped resources (e.g. foto albums)	Upcoming.org del.icio.us Flickr.com
Automatic tagging	None Auto-tags Automatic tag expansion	Only user-defined tags Automatically applied tags based on resource analysis Automatically applied tags based on user-defined tags	

Table 1: Classification of tagging systems, based on [Marlow:2006] and [Voss:2007]

ry—with the important difference to e.g. folder structures, that each item can be stored in an arbitrary number of containers at the same time. In a third view, tags can be seen as **concepts**, which are short-handedly denoted by their identifying name and explicated by their extensions (the set of items associated with that tag). However, relations to other concepts in tags space are only implicitly encoded by the overlap of tagged items.

In principle, the idea of free-form annotation is not new; photo-organizing tools have had this for years, and HTML offered the option to use free-form META keywords to describe a document since HTML 2.0 in 1996.³⁵ Also, free-form annotation of resources with keywords is a century-old means of indexing in library science.

However, the crucial point, which made tagging the success it has been up to now, is the fact that **collaborative tagging systems** allow users to **share** their annotations in a tagging community. These web application allow not only the convenient storage and mark-up of resources for later re-finding, but make the produced information at the same time available to all users, enabling multiple semantic as well social navigation paths through the contents.

Adding the social dimension and applying it on a large, public scale made tagging a shooting star in information architecture. The success of tagging is overwhelming: As of April 2007, the online weblog search engine Technorati counted “230 million posts with tags or categories, 35% of all February 2007 posts used tags and 2.5 million blogs posted at least one tagged post in February”³⁶.

³⁵ http://www.w3.org/MarkUp/html-spec/html-spec_toc.html

³⁶ <http://www.sifry.com/alerts/archives/000493.html>

TAGGING SYSTEM DESIGN FEATURES

Based on Marlow’s classification of tagging systems [Marlow:2006] and a revised version presented in [Voss:2007], we can distinguish a variety of tagging systems by the dimensions presented in Table 1. Given the high number of different options of designing and using tagging systems, one has to be cautious when generalizing about “tagging as such”. In the following, if not noted otherwise, the paradigmatic case of **free-for-all**, **suggestion-feedback**, **bag-model** approach with **unrestricted vocabulary** and **unrelated tags**, as e.g. used by del.icio.us, is discussed.

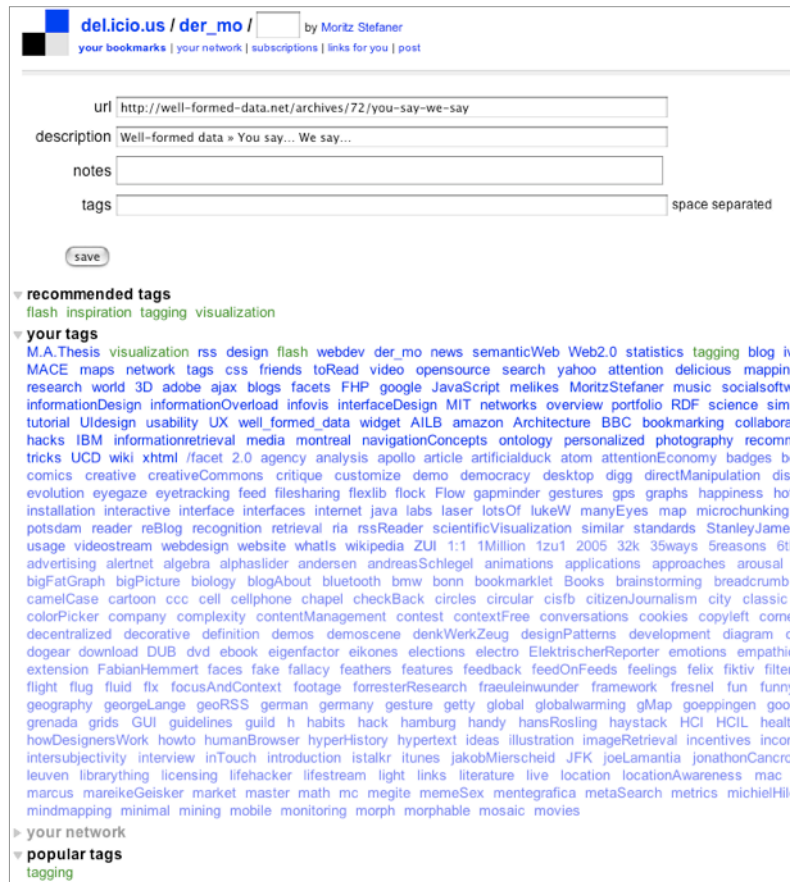


Figure 25: Interface for tagging a web page; note the high number of previously applied tags

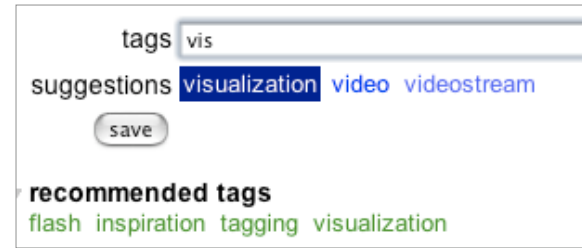


Figure 26: Auto-completion/suggestion

A typical workflow using these types of systems usually involves the following steps:

The user discovers a resource of interest and decides to mark it for later retrieval by using the tagging service. Often, this is done via browser extensions or bookmarklets to have direct, uncomplicated access to the service. The system presents fields for annotating the resource with a comment as well as a free-text field for adding tags. (see Figure 25) Recommended tags, own previously applied tags as well as popular tags for the resource are displayed and can be added via click selection.

When typing to add tags, the system provides auto-completion suggestions from preexisting tags. This feedback loop is crucial for fostering the stabilization of community-wide agreement on using specific tags for shared concepts, as well as the avoidance of spelling or typing mistakes (see Figure 26).

Later, resources and tags can be retrieved with relation to the user (all items tagged by “der_mo”), the resource (who has bookmarked this resource and what tags have they used?) or a tag (What resources are available tagged with “visualization”?)

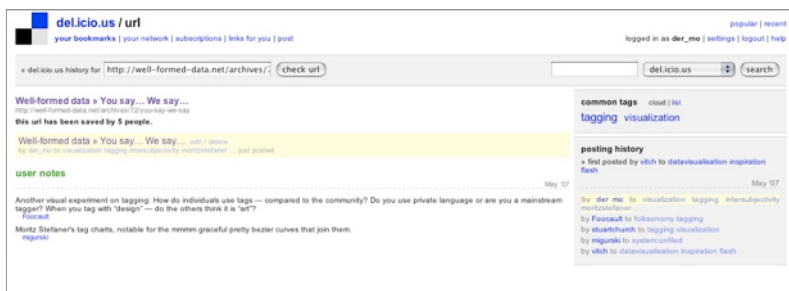


Figure 27: Tags and comments for a specific URL



Figure 28: Bookmarked pages per user

A COGNITIVE PERSPECTIVE ON TAGGING

Understanding the success of tagging has almost as many dimensions as understanding the revival of the social web in general. It has been the source of heated discussions in the scene of information architecture³⁷, often used as a means to discard information science and its principles much older than the web, along with more recent, but more formalized approaches from the Semantic Web scene altogether. This makes it worthwhile to set the frame by finely differentiating different tagging systems, shed some light on the processes of categorization and classification from a cognitive and information architecture point of view, before going into the specifics of and lessons to be learned from the success of tagging.

CATEGORIZATION

The fundamental cognitive tool for understanding the world is **categorization**. According to [Jacob:2004], “*categorization divides the world of experience into groups or categories whose members share some perceptible similarity within a given context.*” Defining meaningful groups of things that “belong together” lies at the heart of cognition and communication. Classically, categories are defined by their **intension** (the union of the essential, defining **properties** that members of the category share), their **extension** (the set of all entities belonging to that category) and their **relation** to other categories. In information architecture, categorization can be used to assign subject or index terms to resources (either freely or with a restricted vocabulary).

³⁷ see e.g. http://www.shirky.com/writings/ontology_overrated.html

Categorization is not only a process of recognition, but also an active creative process. We are able to rapidly construct ad-hoc categories, such as (“10 things to take on a lonely island”) [Barsalou:1983]. Moreover, categories do not necessarily have sharp borders or explicitly defined inclusion relations: modern cognitive psychology suggests a graded structure based on typicality or family resemblance, with unclear membership cases (see e.g. [Barsalou:1983, Lakoff:1987]), also for everyday concepts. Moreover, it has been shown in seminal studies by Rosch et al [Rosch:1976], that there is a clear and widely shared preference for categorization on a **basic level**, which optimizes the trade-off between informativeness and distinctiveness: When confronted with the picture of a bulldog, people usually assign the category “dog”, but not “animal” or “mammal” (superordinate concepts — not informative) or “bulldog”, “brown bulldog” (subordinate concepts — not distinctive enough). In short, the conceptual system “works best with a few fairly informative concepts than with a very large number of extremely informative concepts” [Murphy:2002] However, the basic level is also subject to the variation depending on the degree of expertise in the given domain or contextual factors [Murphy:2002].

CLASSIFICATION

Classification builds on categorization, but introduces additional tools and constraints: it “involves the orderly and systematic assignment of each entity to one and only one class within a system of mutually exclusive and non-overlapping classes.” [Jacob:2004] While categorization is an everyday mental process, classification is its explication under tough circumstances: To conceptually tidy up a very messy world, based on only slightly less messy categories, is a process that naturally causes a lot of friction, debate and trade-offs. The transition from loosely and often only implicitly defined, potentially subjective categories to ex-

plicitly formulated information architectures has to cause losses at a certain point. What is gained, however, is a clear conceptualization of a domain, where everything has its place and also future, unseen items can be fit in. This is an indispensable asset not only for conceptualization of a domain or the re-findability of resources, but also often a necessary basis for collaboration and communication.

Library and information science has a long tradition of organizing resources in a variety of classification structures. In principle, there are two complementary strategies to generate the relations between classes [Quintarelli:2005, Jacob:2004]:

The **hierarchical-enumerative** approach (top-down) arranges the totality of all classes in progressively more specific classes of classes. The canonical example is e.g. the classification of living organisms into species dating back to Aristotle. Typically, classes sharing the same parent are mutually exclusive and a transitive, directed relation between classes A and B denotes the logical implication “all A are B”, effectively leading to inheritance of properties from top to bottom.

Faceted (analytico-synthetic) classification approaches are inductive, bottom-up schemes of **properties** generated through a process of analysis and synthesis. The construction of these structures begins at the fundamental level of entities and their properties. These features are then organized into mutually exclusive groups on the basis of conceptual similarity, and these groups are, in turn, arranged in successively larger groupings to form **facets or aspects**. E.g., a faceted vocabulary for classifying cars might include mutually exclusive facets for “color” (red, blue, black), “body style” (sedan, convertible, minivan), and “transmission” (manual, automatic) [Jacob:2004].

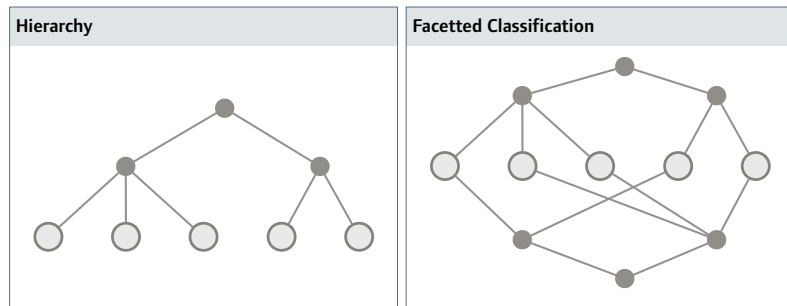


Figure 23: Hierarchical vs. faceted classification. Resources are drawn light grey, structural elements in dark.

In principle, both types of classification can be transformed into each other. The conceptual difference, however, is that hierarchical approaches result in one specific order of classes and entities, where more important, general distinctive features are located at the top of the hierarchy and more specific features closer to the bottom. Faceted structures allow parallel examination of entities with respect to independent feature groups, which do not need to be put in relation to each other.

THE TROUBLE WITH FILE-FOLDER STRUCTURES

The first thing most users learn when working with computers is the ubiquitous file-folder metaphor, used to organize the computer hard disk, browser bookmarks or email. While it facilitates the start into the digital world by means of analogous reference to real world objects, on the long run, it is often a source of frustration. Among others, this can be attributed to two major reasons:

Taxonomical structures as such require not only a lot of effort to construct, but especially to re-organize. They work best for a relatively restricted corpus, pre-defined categories, stable and restricted items with clear edges between classes [Quintarelli:2005]. In such a situation, they provide a sound and efficient framework for retrieval and findability. The problem is that the digital information we interact with is constantly subject to change and re-priorization. Additionally, given the fact, that people retain in general retain more information than they discard [Whittaker:2001], this results in an on-the-go construction of taxonomies for growing data collections, which is a difficult task.

Moreover, even if perfect classification would work, depending on context, there are a number of attributes that might be relevant for retrieving a set of documents. [Ravasio:2004] identify three separate perspectives on information, which can be of different priorities in different situations:

- **Task-oriented:** the task within which the file is defined
- **Context-oriented:** other documents, programs and tasks related to the file
- **Content-oriented:** the actual contents of the file

In fact, experience shows that many folder names rather denote properties ("Pictures", "2005", "Private" etc.) than nested concepts or classes. The desktop metaphor allows us to use folders this way, since the directed ordering relation merely denotes "A contains B", without restricting the semantics of the involved concepts. This introduces a large degree of freedom in utilizing these structural elements. However, if used in this way, the hierarchical order forces a decision on important distinctive attributes to be put on top of the hierarchy (e.g.

“Private -> Pictures -> 2005” vs. “2005 -> Pictures -> Private”). This prioritization has to be done before-hand and cannot easily be changed later, if needs or perspectives change.

WHY TAGGING WORKS

Tagging solves a lot of the problems mentioned above, by using the almost weakest form of information architecture conceivable—free association of words with resources—and combining it with social and personal feedback processes. Despite its structural shortcomings, social tagging works, due to its cognitive and social economics and its aptness to the specifics of web and its culture. Cognitively, it captures associations with **categories and properties on a subjective level**, rather than constant reconsideration of the “larger scheme” or agreement on a specific way of organizing information in collaborative situations.

ON-THE-FLY, BOTTOM-UP INFORMATION ARCHITECTURE

According to [Sinha:2005], the strength of tagging is that it taps into an existing cognitive process without adding much cognitive cost. Any object we come across automatically activates related concepts and categories. Writing down the first categories that come to mind, without the constraint of uniqueness, precise wording or the choice of a single “right” class, is effortlessly possible. Classification, on the other hand, needs a difficult second step of choosing the relevant properties of an object in relation to the pre-existing, external conceptualization. The larger and more well-defined (hence “stronger”) this conceptuali-

zation is, the more difficult is this decision; a phenomenon that Sinha refers to as “post-activation analysis paralysis”.

Secondly, tags are only created **when needed**. Per definition, there is no such thing as an “empty tag”. Successively, quickly associating concepts with objects ensures that only labels are used that will later be actually valuable. This makes tagging an inherent bottom-up process based on the actually relevant properties of resources, under the perspective of the tagging person. Or put in other words, *“the best way to obtain a user-centric indexing is through user-generated indexing”* [Montero:2006].

Moreover, tagging can be seen as **inverted search**. The predominant paradigm for information access on the web is free-form keyword search. Again, free-form search is mostly a quick, associative process. Assigning tags follows the complementary principle: choose a combination of keywords that are specific enough to distinguish the resource in comparison to its context, but general enough to economically re-find it later.

Tag structures are **hackable**: The simple, transparent mechanism allows users to attach virtually any kind of information to resources, if it can be expressed in a short string. A good example is the emergence of a geo-tagging format on flickr.com for assigning locations to photos by agreeing on a common format (“geo:lat:<insert latitude>” and “geo:lon:<insert longitude>”) Based on this convention, a variety of applications has been developed to read, write and visualize these location tags.³⁸

³⁸ <http://www.flickr.com/groups/geotagging/>

Tagging allows the introduction of terms, but also of **multiple personal perspectives** and facets just as needed. Deciding to introduce a “toRead” tag to collect resources for later reading (task-oriented) or a “wow” tag for outstandingly interesting items (subjective judgement, annotation) can be done on-the-fly and does not interfere at all with existing or future tagging. However, these facets (or groups of properties) are only implicitly present, since usually, tags are not stored in an explicit formal relation to each other, but just as a flat list.

According to [Bateson:1979], information is “*a difference, that makes a difference.*” To sum up, tagging encodes exactly the meaningful **different and relevant** properties an information item has under the perspective of one specific user in a given situation, in a structurally light-weight and easy to accomplish manner. Tags are not used to model knowledge, but to encode **markers of personal, subjective relevance**.

THE SOCIAL DIMENSION OF TAGGING

The real strength of tagging, however, arises from making it a **collaborative, social** process: Collaborative tagging systems provide a framework for a user community to tag publicly available resources in a socially translucent [Erickson:1999] manner. These provide each user an awareness of both their individual tags as well as the tags and content that others contribute to the community. By providing immediate self and social feedback [Sinha:2005], stable, community-wide patterns in tag usage emerge over time [Golder:2005]. The resulting multi-faceted, bottom-up organization is often referred to as **folksonomy**. Reportedly, this term has been coined by Thomas Vanderwal in 2004 [Quintarelli:2005], and represents a blend of the words “folk” and “taxonomy”.

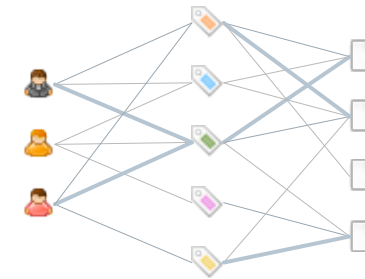


Figure 24: Folksonomy

This has an interesting effect on the social role of tagging: Tags are not only applied for personal benefits in later retrieval, but also for communication with a larger public, and providing a contribution to a collaborative structuring process.

Accordingly, Ames and Naaman [Ames:2007] identify several motivations for users to tag: The general purpose (**organization** or **communication**) is one dimension, while the primary target group (**self**, **friends&family** or **general public**) is another one. While both for oneself and the general public, organization is the primary incentive to tag, tagging plays a highly communicative role when intended for a peer group, friends or family. Independent of the original motivation, however, the potential future benefits remain in all dimension by sharing tags and resources in a community. Tagging, e.g. photos from vacations with “barcelona, awesome vacations, Juliet” might be a banal thing and mostly intended for oneself and a smaller group — nevertheless, it will help other users of the community to find pictures associated with that place, and moreover a hotel recommendation, if they dig deeper.

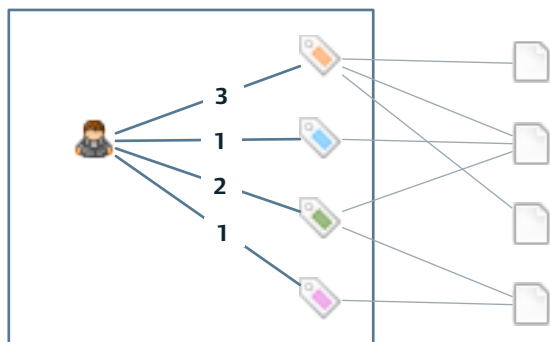


Figure 25: A user profile as the weighted set of tags used in posts by the user.

To conclude, the relevance of both semantic and social navigation for resource retrieval and discovery is long known (Dourish:1994). Tagging systems enable both types of navigation in a user-centered and highly efficient, scalable manner. Based on the primary incentive of tagging resources with minimal actions for later retrieval, each tagging action contributes at the same time to a community wide, continuously refined profile of users, resources and the community as a whole. This enables a rich action and navigation space, created from effortless, minimal tagging action, which, independent of original motivation, contribute to a variety of interesting benefits at the same time. This **multiplication of effect** (one simple action leading to a variety of potential benefits) is a highly economical and robust mechanism, where also applications outside of information architecture could profit from, if this mechanism can be transferred to the respective domain.

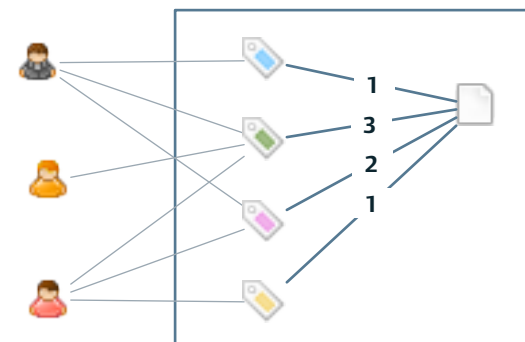


Figure 26: A resource profile as the weighted set of tags assigned to the resource.

A second multiplication effect concerns the **multiplicity of perspectives**: By aggregating a large number of personal, amateur contributions, a multivalent, multi-faceted picture of a resource can be drawn. This is in string contrast to the role of traditional indexing, where **experts** make a **definite decision on** terms applied from a **controlled** vocabulary. From this perspective, tagging can be related to the construction of **intersubjectivity** stemming from the multiplicity of subjective perceptions of the world exchanged in dialogue [Campbell:2006], resulting in a collaborative **triangulation of reality** [Davidson:2001]. To sum up, tags support the emergence of a community vocabulary based on the “meaning is use”-principle, rather than the before-hand agreement on explicit definitions.

SHORTCOMINGS

Of course, the introduction of such a simplified, uncontrolled mechanism has inherent structural problems [Guy:2006]:

- Typical language features like synonymy (multiple words denoting the same concept), homonymy and polysemy (one word denoting multiple concepts) cause inconsistencies in personal and community tagging.
- Moreover, spelling mistakes or inconsistent capitalization (“design” vs. “Design”) or pluralization (“cat” vs. “cats”) can accidentally lead to unintended use of multiple tags for the same intended tagging action.
- As mentioned above, people categorize on a basic level. Accordingly, tags are applied mostly on that basic level, encoding the relevant, interesting differences, and leaving out the obvious (tagging a picture of a cat with “animal” is very unusual, but might be valuable in later retrieval).
- Tags are unprioritized and per definition independent of each other. Encoding that there are a white cat and a black dog on a picture can lead to constructions like “whiteCat, blackDog”, but also “cat(white), dog(black)” or “cat:white, dog:black” etc. are in principle equivalent; the exact choice depends only on preference and community agreement. Moreover, additionally, the tags “cat, dog, black, white” should be added, to make the resource also available in more general searches, which in turn, makes the originally very simple process a cognitively demanding, tedious and redundant one.

The quality of an information system with respect to information retrieval is usually measured by **recall** (the number of relevant documents retrieved in a query compared to the whole number of documents relevant to that query in the whole collection) and **precision** (the number of relevant documents in the result set vs. irrelevant ones).

This has some interesting implications [Hassan-Montero:2006]: While **broad tags** (which have been applied a high number of times in the community) have a **high recall value**, they **lack precision**, since they typically represent too general concepts to distinguish resources in a meaningful manner. Narrow tags (less often used ones) define a more precise, distinguishing concept, leading to **higher precision values**—but due to the problems mentioned above, and since community feedback processes have not kicked in (due to the low number of times this tag has been applied), they usually have a bigger **recall problem**. E.g. searching for “surfing” will deliver a high number of resources, most of which will actually somehow refer to the topic of interest, but the result set will also contain items referring to “web surfing”. If the user is actually interested in kite surfing, she might search for “kiteSurfing”, however, missing out all the items that have been tagged with “kitesurfing”, “surfing:kite” or separate “kite” and “surfing” tags, etc.

HOW ARE TAGS USED?

Given the wide range of possibilities in free-form annotation, it is an important empirical question, how tags are actually used.

First of all, tagging is in fact a mass phenomenon: A study in the United States (December 2006) found that “28% of internet users have tagged or categorized content online such as photos, news stories or blog posts. On a typical day online, 7% of internet users say they tag or categorize online content.”³⁹

Most notably, it has been confirmed in many empirical studies on tagging(see e.g. [Golder:2005, Hotho:2006, Cattuto:2006]), that tag distributions tend follow a power law—a small number of tags is used very often, while a very large number of tags occurs very rarely. This holds true both for individuals as well as whole tagging communities.

Moreover, it has been shown that tag proportions for resources stabilize over time [Golder:2005]. Which means that the tag cloud representing a tag profile for a resource does not change much, once a sufficient number of tags has been collected. In a folksonomy, this is generally considered a good sign, since this indicates a certain agreement on how to judge a certain resource and what vocabulary to use — or at least that feedback mechanisms for tag suggestion provided by the tagging tool work⁴⁰.

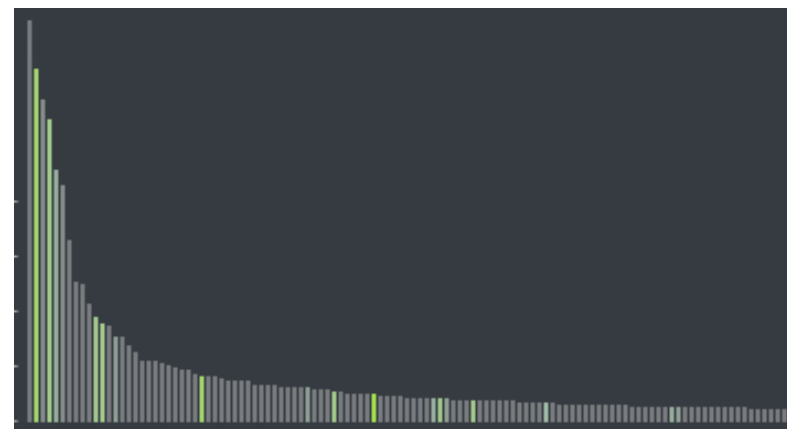


Figure 27: Typical long tail distribution observed in tag mapping experiment (see section 4.1) More recently applied tags are colored in green.

[Guy:2005] found “by testing against multilingual dictionary software, [...] that 40% of flickr tags and 28% of del.icio.us tags were either misspelt, from a language not available via the software used, encoded in a manner that was not understood by the dictionary software, or compound words consisting of more than two words or a mixture of languages.” Additionally, “almost 8% of the flickr tags and over 11% of the del.icio.us tags were plural forms of words”, contrary to the usual convention of using singular words.

³⁹ http://www.pewinternet.org/pdfs/PIP_Tagging.pdf

⁴⁰ In simulations, it has been shown that emergent vocabulary stabilization can also be reached in rather simple multi-agent systems (and hence the absence of semantics or common understanding), as long as specific “language game” feedback mechanisms are present [Steels:2000]

Additionally, users often make use of punctuation or capitalization to make compound tags more readable (“information_architecture” or “informationArchitecture”), specify tag types (“via:boingboing.net”) or prefix tags (“*checkout”), so they appear on top of alphabetical lists. However, a considerable amount of variation in using these practices can be observed [Tonkin:2006, Guy:2006].

Concerning different types of tags [Golder:2005] distinguish various classes of tags, among others:

- **Topic:** What is the resource about? This is the most common use, and typically results in the use of common nouns on many levels of specificity as well as proper nouns identifying people or organizations.
- **Type:** The kind of resource or its reference — e.g. “article”, “review”, “blog”, “book”.
- **Author:** Who created the bookmarked content, or who owns it?
- **Qualities:** Adjectives such as “funny”, “stupid”, “inspirational” tag bookmarks according to the tagger’s subjective evaluation of the content.
- **Task:** Tags associating contents with the individual’s task at hand. Examples include “toRead”, “jobSearch” or e.g. project names.

In a tagging study on movies[Sen:2006], the authors report 63% of **factual tags** (e.g. topic, type, author), 29% **subjective** (qualities in Golder’s terminology) and only 3% of **personal tags** (such as task organization). However, this low percentage is certainly due to the application domain (entertainment) and is expected to be significantly higher in other settings.

Again, it has to be noted that despite these apparent problems and inconsistencies in use, the overwhelming success of tagging can be seen as a clear users’ statement towards simple, expressive mechanisms, with a large degree of freedom for the individual and the utility of the resulting, highly personalized, dynamic and especially social information architecture.

2.6. A NEW VIEW ON METADATA

“So, in the Third Age of Order, all data is metadata. Contents are labels. Data is all surface and no insides. It’s all handles and no suitcase. It’s a folder whose content is just another label. It’s all sticker and no bumper.”

David Weinberger⁴¹

Regarding the discussion of new publishing formats, and social annotation, it becomes clear that not only our conception of content needs reconsideration, but especially the role and nature of meta-data:

The accepted definition of meta-data is “data about data”. Traditionally, metadata is understood as **objective** information characterizing a resource, which has a **fixed, indisputable value**. Metadata is stored referring to **schemata** describing both the syntax as well as the semantics of the values applied to fields to express certain properties of the item in question. [Nilsson:2002] As such, it represents the digital counterpart to library indexing systems, the information found on personal ID cards or the fine-print on the first pages of a book describing the publisher, volume, ISBN etc.

This represents a concept of metadata as subordinate or supplemental; it helps in identifying or finding things—but is not very interesting per se. In the social, intersubjective web, metadata is available in abundance—and is often more informative than the actual contents.

THE SEMANTIC WEB

Reconsidering the described Semantic Web vision in the light of current chapter, it becomes obvious, that it can only be enabled with a plethora of structured, precisely described and interlinked **metadata**. In this vision, metadata values are not merely strings or numbers, but complex objects, related to each other via ontologies and schemata.

In principle, the Semantic Web standards allow everyone to define and model a conceptualization of a domain, and encode statements in that domain in a machine-readable and interchangeable manner, based on a subject-predicate-object schema (“Lost” → “is a” → “TV Show”). As can be seen from the first part of Berners-Lee’s vision, the original motivation for conceiving this approach was a collaborative, democratized, bottom-up approach to metadata creation.

However, the average web user is obviously not used to or especially keen on formalizing knowledge, especially if immediate benefits are unclear. For this reason, the Semantic Web faces a fundamental **chicken-and-egg problem** [Huynh:2005]: In order to have the end-user experience the benefit of Semantic Web applications, a critical mass of contents marked up according to the standards and a variety of rich applications using these contents in a novel, convenient way would have to be in place already. As the analysis of the social web has shown, users prefer simple, participatory structures, where they can get started right away. Understanding pre-modeled domain knowledge, referring to the right namespaces and ontologies in the proper manner, and tediously encoding simple facts to ensure potential later

⁴¹ <http://www.hyperorg.com/backissues/joho-oct15-04.html#data>

interoperability (without an immediate reward or at least a wow-effect) is the exact opposite.

Secondly, top-down Semantic Web approaches run the risk of **perfecting the irrelevant**: Starting with the needs of machines and the one “proper” way of encoding information is not exactly a user-centered approach. It is a common experience in software and interface design, that after a first version of the product has been tested, the original designers get a surprising new views on the application—both surprised by the creativity of the users, as well as the apparent inter-personal differences in understanding what is obvious, and what needs explanation. The same might hold true for a-priori constructed ontologies.

A third, and maybe the gravest issue the Semantic Web has to face, is the one of subjectivity and personal perspectives. While it is true, that everybody can create her own conceptualizations with Semantic Web tools, in order to use them in a larger community, these will have to be **aligned and harmonized**. This objectivization of a large number of individual voices is often not only hard to achieve, but also undesirable.

All of these reasons have contributed that the Semantic Web, although widely acknowledged as a positive vision, has problems in finding wide-spread adoption, outside the academic, military or enterprise context.

In contrast, the success of tagging demonstrates, what reminds of a debate started already in the early 1990s by Gabriel in his essay “The Rise of **Worse is Better**” [Gabriel:1991]. He compares two software system design approaches: the “right thing” (or the “MIT approach”), and the “worse-is-better” philosophy (or the “New Jersey approach”).

The goals of the “right thing” are to create a design that is correct in all observable aspects, it has to be consistent, and it has to cover as many important situations as possible. Of course, the design has to be as simple as possible, but simplicity can be sacrificed in favor of the first three aspects. The “worse-is-better” philosophy puts emphasis on correctness, consistency and completeness as well, but the crucial factor is a favor towards simplicity in the interface, and even more important in the implementation design: “It is slightly better to be simple than correct”[Gabriel:1991]. Further, he states that “the lesson to be learned from this is that it is often undesirable to go for the right thing first. It is better to get half of the right thing available so that it spreads like a virus. Once people are hooked on it, take the time to improve it to 90% of the right thing”.

PACE LAYERING

Peter Morville [Morville:2005] introduced an analogy into this debate, which has been further elaborated by [Campbell:2006], which compares the different approaches to knowledge structuring, findability and information architecture to **pace layering theory** in architecture [Brand:1995]. In short, pace layering theory suggests that buildings can be viewed as having different layers defined by their **speed of change**. The basic structure changes very slowly, the skin or exterior surface change more rapidly, while the interior, the colors of the walls, the furniture, the people going in and out constitute increasingly fast-paced layers. Together, they form the building as a whole—the fast layers propose and innovate, the slow layers absorb and stabilize. A similar comparison can be made with respect to pace layering in society: fashion and art are the fast movers, followed by commerce, infra-

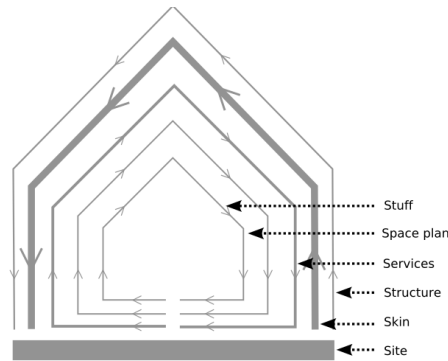


Figure 28: Pace layering [Campbell:2006]

structure, governance, culture and finally nature, as the more absorbing, stabilizing layers.

CONCLUSION

From this perspective, tagging and social media are not the “new way”, which will render older, more structured and especially slower approaches like Semantic Web or traditional librarianship and information architecture obsolete, as claimed e.g. in [Shirky:2005].

We have to acknowledge that for a vital ecosystem of information, as the web presents itself, each layer has a justification for existence. The social web and tagging is continuously testing and exposing alternatives to traditional approaches to content structuring; however, these do not solve all of our information problems. Assuming that in the worse-is-better sense, we have “...half of the right thing available so that it spreads like a virus.” [Gabriel:1991], the question is how to design the diffusion process. However, this does not mean, that tagging

and micro-blogging should slowly be replaced by more elaborate “right” approaches, but rather how both the information produced as well as insights gained on these fast layers can find their way to more structured layers. By its very nature, the web will never be a place as tidy and calm as a library, which has been not its weakness, but its strength, right from the beginning.

Accordingly, in the end, the socio-semantic web will not only need a meta-data architecture that is subjective, non-authoritarian, evolving, extensible, distributed, flexible, and conceptual [Nilsson:2002], but especially new interface design approaches. In the following section, I formulate the consequences of these insights in the form of principles for design, guiding me through my design experiments in the second half of this thesis.

3. GUIDELINES AND MAXIMES

As demonstrated in the preceding chapter, the discussed changes in information publishing and storage behavior and formats have some profound implications:

- In many instances, web design as the design of “web pages” has shifted to the design of web-based services, delivered over a variety of channels and in multiple user front-end incarnations.
- New content formats, such as micro-content, arise from de-institutionalized content creation on web scale and the specifics of the novel communication channels and practices.
- Self-expression, the formulation of individual perspectives and the resulting social interaction are important motors for the collaborative structuring of the web. These motivations should not be dismissed, but respected as the basis for any community-based effort.
- Accordingly, not only metadata gain importance compared to the actual contents, but also the temporal dynamics and life-cycles of contents and metadata.
- Web feeds are a first, preliminary version of what might constitute a decentralized, snippet-based approach to web content publishing and annotation.
- The information architectures resulting from web feeds as well as social web activity are typically flat, non-hierarchical and non-exclusive. In contrast to catalogues or classification schemes, metadata values are typically subjectively, weakly or even ill-defined and tend to follow a steep long tail distribution, where few values occur often, but a large number of entries is used rarely.

- Yet, by emerging and stabilizing usage patterns, meaningful correlations between metadata fields emerge. This is made possible by reaching a critical mass of simple contributions by amateur users, instead of analyzing complex contributions by few experts.
- These emerging patterns represent a multi-voiced statement on what people perceive as interesting, belonging together and how it should be named. Objectivized, more enduring structures can be built upon these in order to enable richer applications, but these must leave the fast-paced, subjective, ad-hoc, worse-is-better alternatives intact as a constant source of suggestions for adjustment and refinement.

The novel structures and practices arising from collaborative tagging, the snippetized web, long-tail dynamics and the multiplicity of channels can not be tackled with more metaphors, relating to old-known principles: in fact, we need **whole new interface languages**, to enable people to understand and act in the new, ever-changing information eco-systems.

How can we get there?

I postulate the following principles, guiding my design work as maxims and reference points.

ANALYSE AND UNDERSTAND EMERGING USAGE PATTERNS

Open mechanisms like tagging allow a wide range of usage scenarios. Integrating user contributions as a fundamental mechanism requires not only iterative, incremental development approaches, with constant reaction to the emerging practices, as well as deep understanding of how people actually use the new possibilities they have. Tags, rating and annotations provide a mass of valuable statements, what users are actually interested in, and what they consider relevant—in order to build successful applications, it is vital to analyse and react to these statements.

CREATE SPACE AND INCENTIVES FOR EFFECTIVE PARTICIPATION

One of the central lessons from the success of the social web was that people are happy to contribute to a bigger whole, but only connected to immediate personal benefits (be it only fame or improved image), and if the contribution mechanisms are simple. Accordingly, when relying on user contributions, we need to build applications bringing immediate benefit for **lazy users obsessed with their image**. At the same time, side-effects have to be designed to improve the system as a whole, based on small actions done by many users.

DISTRIBUTE AND SHARE— ONE NODE IN AN ECOLOGY OF SERVICES

For new applications, define first how they integrate into the existing ecology of services, and what niche they fill. What data can be reused, what new combinations of existing services does it provide and how can the results be used in other services?

Heaping up information in private spaces, keeping everything noteworthy stored for potential future access, is an inefficient way of dealing with information. If information is worth storing, it is most of the time also worth sharing—it just depends with whom.

WORSE IS BETTER

Given the choice between a simple, almost correct approach, covering 80% of the important functionality in a very specific, yet robust way and a precise, generic, pro-version—pick the first one, as long as there is a direct perspective for improvement. Tagging and content sharing platforms having shown that once a critical mass is reached, many structural problems are outweighed simply by reaching a critical mass of contents and contributions.

OR IS IT? GARDENING AND REFINEMENT

Spool characterizes tagging as “a continuous, full-site card sorting exercise that produces a dynamic, live navigation scheme as the users sort the cards.”⁴² Unfortunately this not the case yet. This the great perspective tagging offers — however, after the first rush, we need tools for refining, harmonizing and tidying tagging structures. Up to now, blind accumulation of tags with very limited restructuring possi-

⁴² http://www.uie.com/articles/web_2_power/

bilities is the predominant model, although the light-weight representation allows a variety of easy options for refinement.

MAKE THE LONG TAIL ACCESSIBLE: NEW FORMS OF CONTEXTUALIZED NAVIGATION

In order to make the overwhelming mess of resulting long tail items accessible on the web, we need to move beyond rigid classification schemes, or mere popularity from a global perspective, but disentangle the multitude of relations between long-tail items from a subjective perspective.

Two principle strategies can be identified:

- **Filtering** mechanisms can allow to extract the personal niche of interest as a sub-long tail in a top-down manner. This corresponds, e.g. to clicking one of the most frequently use tags in a tag cloud or the restriction of “all movies” to “action movies”. However, usually, it is not feasible to present all filtering options somebody might be interested in at any time in one coherent, yet simple interface⁴³.
- Quite often, users **jump** to arbitrary items deep in the long tail without prior navigation via keyword search and orient themselves in the found niche. Recommendation mechanisms, as used by e.g. amazon.com, build on user profiling and suggest related items. However, the mechanisms are often intransparent and hard to influence from user’s side. **Transparent context navigation** based

⁴³ This relates to the enormous human flexibility in constructing ad-hoc categories like “Books I could lend to a Pete”, which at best, could only be handled by storing a large number of personal as well as objective metadata along with the suitable interface to easily constructing a matching query.

both on social, as well as a semantic level is the key to uncovering the “local” long tail, containing the items of interest.

One novel, related paradigm introduced in social bookmarking tools is the so-called **pivot browsing** [Millen:2006]: “The ability to reorient the view by clicking on tags or user names [...] provides a lightweight mechanism to navigate the aggregated bookmark collection.”

Generalized, metadata is increasingly not only used to display information or refine search results, but as a tool for context-hopping. This can lead to interesting serendipity search chains, such as discovering topics, based on resources, which in turn leads to an exploration of a user’s bookmarks — however, current implementations usually only implement context-hopping and lack an effective drill-down mechanism or filtering the current context. A second challenge is the characterization of a context — what is the “difference, that makes a difference”?

THINK FLAT BUT MULTI-FACETED

From a metadata perspective, although web feeds represent a well-defined structured data format, the metadata contained in web feeds has simple nominal values or a standard date format. There is no agreed-upon mechanism to identify e.g. item authors across web feeds or refer to items in more complex information architectures such as domain ontologies. Of course, the same holds for tagging structures.

Accordingly, there will be an increasing need for dealing with the resulting flat, multi-faceted emerging structures—again, not only for browsing and navigation, but especially for consolidation and re-organization. This is in contrast to many approaches in application design and visualization, which presuppose either structured (e.g. hierarchical) or at typed data (locations, ratings, etc.).

THINK TEMPORALIZED

Presumably man's spirit should be elevated if he can better review his shady past and analyze more completely and objectively his present problems. [...] His excursion may be more enjoyable if he can reacquire the privilege of forgetting manifold things he does not need to have immediately to hand, with some assurance that he can find them again if they prove important. [Bush, 1945]

One of the most important features of the new content formats and publishing schemes is that there is a strong temporal and contextual dimension to their relevance for the individual. While a two-year old book is regarded as rather recent, a two-year old blog post is often already outdated. This fact, and the mass of items consumed alone, requires mechanisms for storage and retrieval, that take the temporal dimension into strong account. Given our limited perception and memory capabilities, we need applications that move through time with us, keeping the things we interact with at hand, while keeping outdated information potentially available, but hide it from daily view.

THINK INTERSUBJECTIVE AND MULTI-VALENT

A traditional conception of metadata provides only one value per attribute field. With the emerging multi-voiced, intersubjective creation of metadata, the presentation and especially visualization of multivalent structures gains tremendous importance. For tags, ratings, comments, but also “objective” information like locations, time-points, it will become increasingly important to characterize the entire spectrum of assigned values, as well as how they were created and by whom.

VISUALIZATION ALONE IS NOT THE ANSWER

There is a natural tendency, almost a reflex, to utilize **maps** or **graph visualizations** for visualizing inter-related or similarity-based structures. However, this practice needs to be questioned, since there are a couple problems with the presented approach:

From an implementation and feasibility side, the required calculations for mapping items based on similarity are expensive, which takes away flexibility in interface design and implementation.

Secondly, these types of visualizations often tend to fail, and maybe are even misleading: Spatial metaphors can capture only some aspects of the underlying information, because, ultimately, in digital space, “there's no there there”[Morville:2005]. Graph visualizations inherit these problems [Karger:2006], whilst at the same time often introducing additional visual clutter by line-drawing and emphasizing the **data structure** instead of the information structure.

When talking about future interfaces for the socio-semantic web, maps and graph visualizations will play an important role in exploration, analysis and occasionally, when combined with other approaches, also as application front-ends. However, they will not form the basis

for a new breed of interfaces in general, since they tend to create more problems than they solve.

AND FORGET ABOUT METAPHORS

Analogies and allusions are helpful, but the big age of metaphors is over in user interface design. Blogs are not diaries, tags are not stickers, web pages are neither places nor documents. Understanding and shaping new formats and action spaces is not facilitated, but ultimately hindered by continuous references to their roughly resembling counterparts from the physical world.

4. SYNTHESIS: EXPERIMENTS, VISUAL ANALYTICS AND APPLICATION DESIGN

4.1. EXPERIMENTS AND VISUAL ANALYTICS

As identified in the previous section, an understanding of the emerging structures arising in collaborative tagging systems under different conditions and also with respect to different kinds of users is crucial for improving current interfaces. Accordingly, a series of visualizations, exploring both the nature of the conceptual space spanned by tagging activity, as well as investigating their temporal dynamics have been produced. These serve not only as tools for visual analysis of hidden structure, but also as illustration of the discussed abstract principles.

UNDERSTANDING TAGGING STRUCTURES

Collections of tags are usually displayed as tag clouds. The basic principle is to display a list of tags; the more often a tag has been used, the larger and visually salient it will be presented. This mechanism can be used to both characterize single users, webpages, as well as whole communities. An important feature of tag clouds is that they represent a weighted display: Some values are apparently more important than others, since they occur more often. As a whole, each tag cloud represents an instance of the multi-valent nature of tags and the many voices involved in tagging activity as opposed to traditional indexing.

Often, tag clouds can also be used for navigation: Clicking one of the tags will take the user to a web page displaying all of the bookmarks matching this tag.



Figure 29: Tag cloud

While tag clouds represent definitely one of the most successful visualization principles of the last years, they have some shortcomings:

- Tag clouds alone are not enough for **effective long tail navigation**: By simply adding up over time, a certain pattern consistently emerges: there will be a some dominating tags (the “head”) and a vast number of rarely used tags (the “long tail”). Whilst the popular “head” tags remain rather constant over time and broadly characterize topics, the “long tail” contains more precise terms. Tag clouds visually prioritize the “head”. However, both for browsing and for searching, access to the long tail is vital, since this is where the real, distinctive information is contained.
- Summing up over time does not represent the **dynamics of interests**: Additionally, it can be questioned if merely summing up tags is the right approach in general. How about topics you were interested in, but now you aren’t anymore? Or conversely, very recent interests, which are pretty important to you but haven’t been tagged often enough to show up in the cloud? To solve this prob-

lem, Chirag Mehta ⁴⁴ had the idea of implementing tag clouds with a time slider. However, regarding these, another problem becomes evident:

- Tag clouds are not suited for **animation** or smooth changes over time: This is due to their alphabetical list order and visual messiness. Since every tag's position in a tag cloud is defined by its predecessor's size and position, things start jumping around once you start scaling tags. So tag clouds are not really suited to display the dynamical nature of tagging structures - how tags appear and disappear.
- Tag clouds are **ordered** the wrong way: Many tags denote concepts or properties. As such, they have meaningful relations to each other. Tag clouds are ordered alphabetically or by size - it would be much more effective, if tags that belong together could also be presented together. Some of these relations can be deduced automatically, by observing how tags are used: Some tags might always appear together, others sometimes and others never. If tags co-occur frequently or have many common "neighbors", the concepts denoted will be related in some manner [Montero:2006].

⁴⁴ <http://chir.ag/tech/download/tagline/>

EXPERIMENT 1: ELASTIC TAG MAPS

http://well-formed-data.net/experiments/tag_maps_v5

Accordingly, a mapping algorithm to analyse and display tag structures based on how tags occur together, has been developed to analyse and illustrate emergent structures in tag collections. The data used is a set of export bookmarks of 14 users of the public bookmarking service del.icio.us.

Technically, it is based on a vector-space model: Each tag defines one dimension, and each tagging event can consequently be represented by one point in a high-dimensional vector space. By applying the dimensionality reduction algorithms PCA (Principal Components Analysis) and CCA (Curvilinear Component Analysis), a two-dimensional map, which places frequently co-occurring tags close together, is computed [Stefaner:2005].

In its initial state, all tags are scaled according to their frequency. Since tags tend to follow a power law distribution, a proportional scaling is not advisable, as this would lead to a few huge tags and a high number of very small ones. Accordingly, a logarithmic scaling has been applied, leading to a linear decrease in size with respect to the rank of the tag. The first thing we can observe is that the most frequent tags also define the extremes of the spanned space and accordingly are placed at the outer areas of the tag cloud. Secondly, for most users, some of the frequently used tags are also quite strongly related (see e.g. philosophy, religion, culture), whilst others define their own "corner" of the data set in the absence of other frequently used tags.

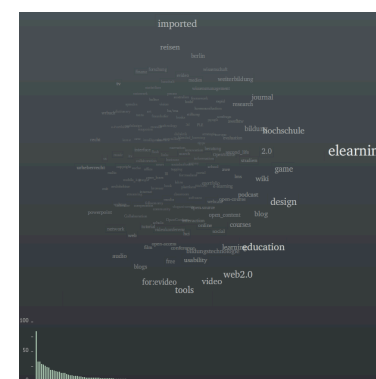
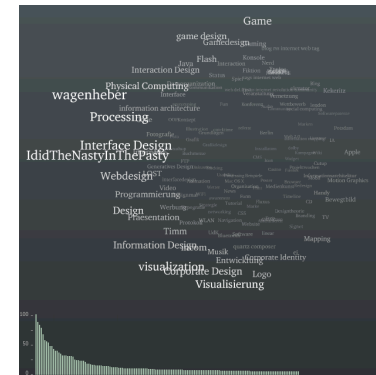
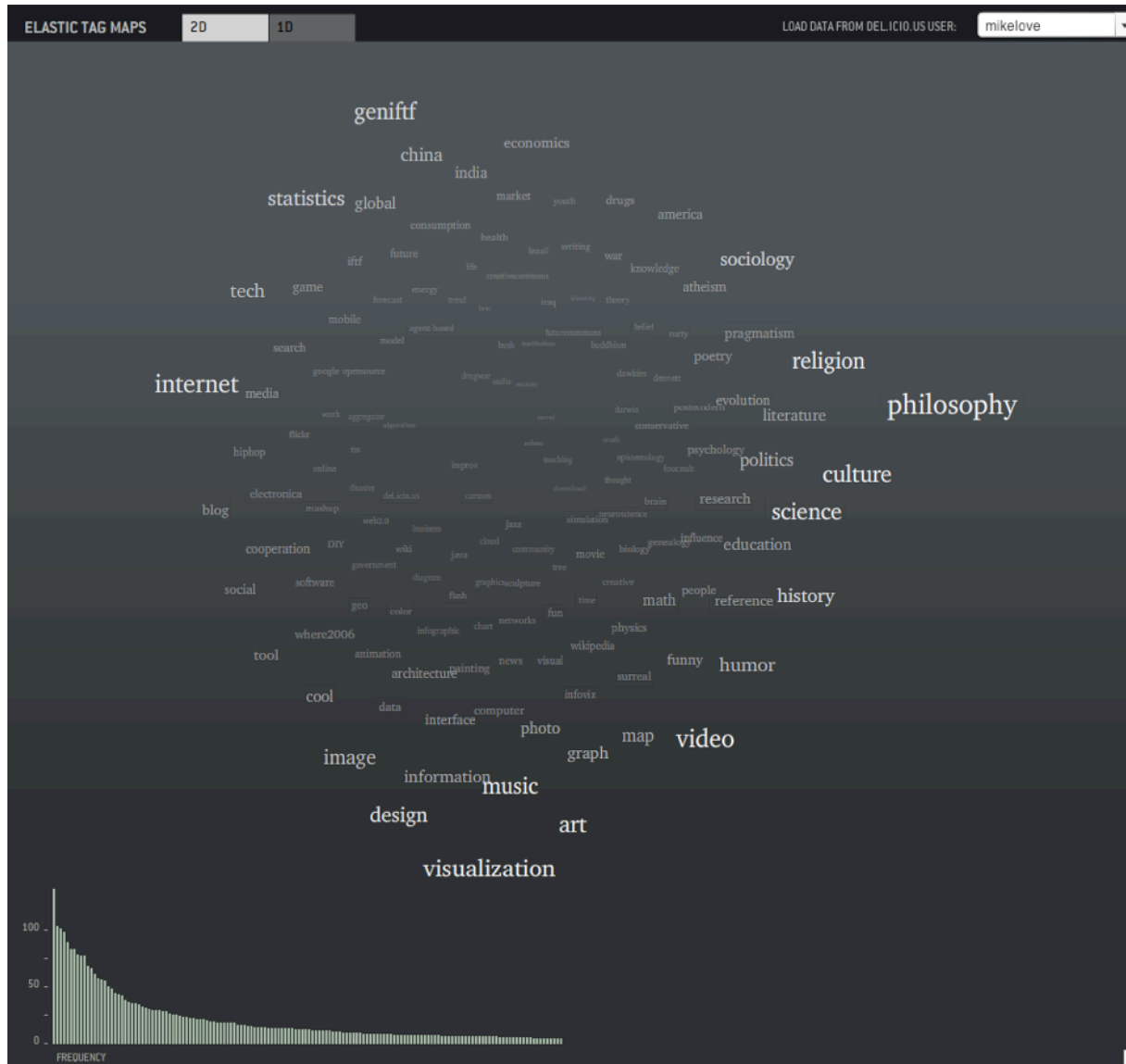


Figure 30: Elastic tag maps application



Figure 31: Related tags for tag “philosophy” for a del.icio.us user “mikelove”

Highlighting one of the tags per rollover brings “related” tags tag to the front, i.e. tags which tend to occur together with the selected one; additionally, connecting line thickness indicates the strength of the relation.

Since several data sets are available, we can also compare, how the same tag is used by different users; the same tag “philosophy” is related to different terms for the second user, hinting at a different understanding or at least usage of the same tag.

Several tags can be selected and highlighted per click. In this case, only tags having an **average** positive correlation with all selected tags are brought to the front. This could be due to a strong correlation to one of the selected tags, but no special relation to the others, or a positive correlation to all of the selected tags, in which case the single



Figure 32: Related tags for tag “philosophy” for a del.icio.us user “der_mo”

values can be less. This mechanism ensures a manageable number of visible tags at all time; at the same time it puts emphasis on tags **connecting** the selected tags, while not neglecting tags in a strong relation to one of the selected ones. In this case, the lines are of special importance to display if the appearing context tags are of the first or the latter kind.

A histogram displays the overall frequencies of the tags to exhibit the long tail nature of the tag collections, and especially sub collections. It is interesting to see that all examined collections show a clear long tail distribution, however, with different slopes. A second interesting insight is the compositionality of the long tail: Selecting one of the low rank tags almost always brought up on of the top rank tags, along with their associated middle-rank tags.

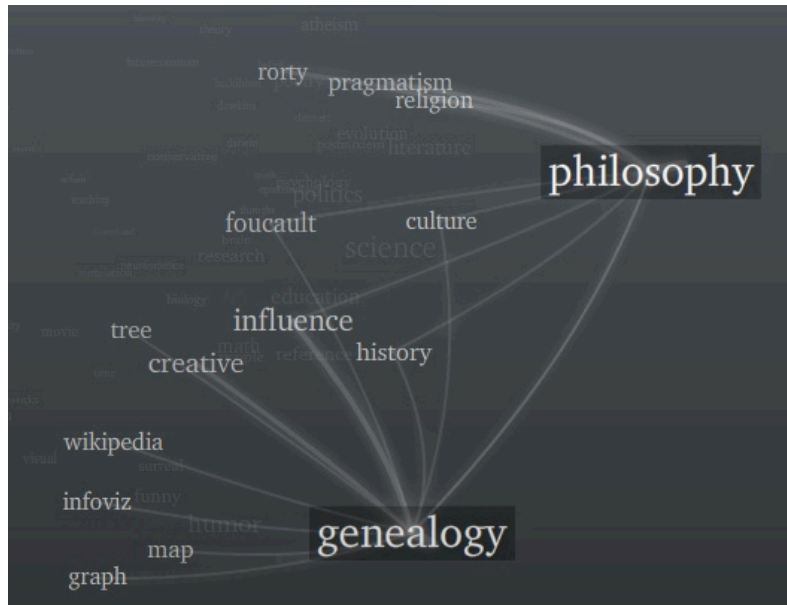


Figure 33: Connecting tags for “philosophy” and “genealogy”

This corresponds well to the Anderson’s notion of long-tail superposition [Anderson:2006], corresponding to genres or niches in the global long tail. However, it should be noted again, that these are not mutually exclusive, but rather, overlapping and defined only with diffuse borders. [Rui-Li:2007].

The visualization as such is valuable for illustrating, understanding and discussing the nature of the conceptual space spanned by tagging activity. Tagging’s relation to categorization rather than classification becomes very apparent when browsing tag distributions in this manner and the compositionality of the long tail.

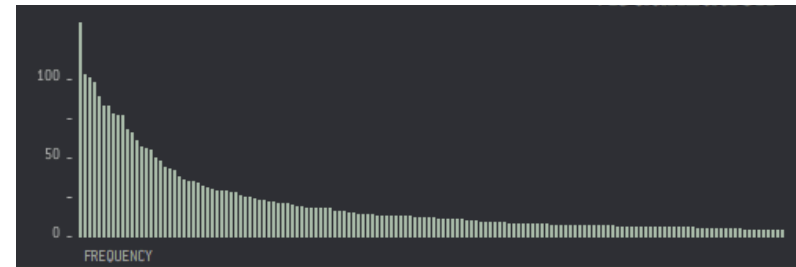


Figure 34: Long tail distribution and sub-distribution of related tags

As an interface, however, it suffers from the same issues as other attempts to map of the unmappable: The intrinsic dimensionality of the spanned space is too high to provide a truthful two-dimensional representation; even in fullscreen mode, the available space is too limited to display all used tags (currently, display is limited to the 150 tags). Additionally, there is an inherent information problem with mapping long-tail structures based on co-occurrence: per definition, most tags appear very infrequently, leaving us with very limited information about their relation to other tags. Thus, most of them will be placed somewhere in the indeterminate middle.

Referring to the guideline “Visualization alone is not enough”, the experiment demonstrates once again, that imposing spatial metaphors on placeless information is problematic for two reasons:

By reifying the abstract, one also imposes the constraints of physical surroundings on the objects, such as the fact, that one thing can only be at one place at a time, although, in fact, the relations are much more complex. Secondly, the maps produced are visually over-impulsive, suggestion information that is not contained in the data. The large amount of tags in the middle of the cloud are, in fact, in no special relation to each other. However, any placement on a plane of more than two objects—be it random, equidistant, overlapping, with varying distances, or on a grid—is automatically read as meaningful, leverages pattern seeking and an interpretation of the distances.

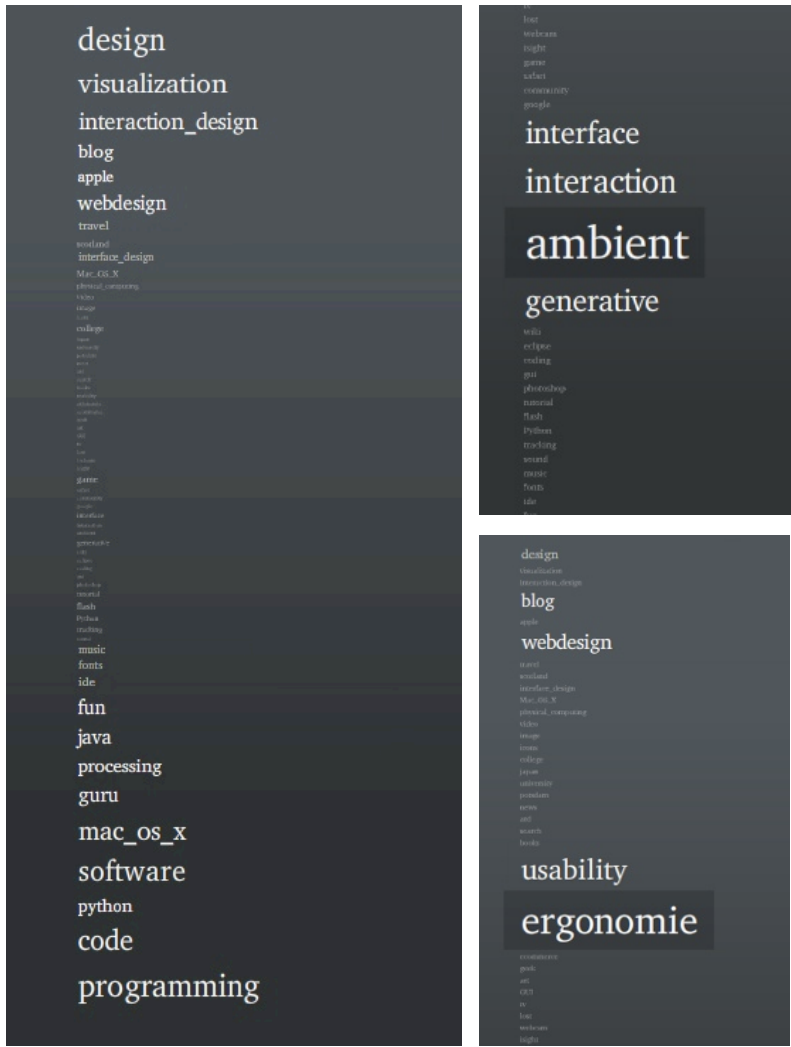


Figure 35: Elastic tag lists (or 1-D maps)

EXPERIMENT 2: ELASTIC TAG LISTS

http://well-formed-data.net/experiments/tag_maps_v5/index_lists.html

These observations lead to a variant of the tag maps. Since lists per se are more space-efficient, and fit better into existing, usually box-oriented interfaces, the described sorting as well as navigation mechanism have been transferred to a one-dimensional similarity map—a list. It allows the same exploratory context-hopping mechanisms as the map, while using much less screen estate. The trade-off, however, is that now the mapping algorithm has only one dimension to express the similarity ordering of the tags, which leads to a seemingly arbitrary ordering in the middle of the list.

Nevertheless, this approach hints at a promising direction for visual interface design: extracting the essential interaction and presentation features from over-the-top visualization approaches and gradually integrate them into existing, learned and efficient interface paradigms.

TEMPORAL DYNAMICS OF TAGGING AND CONTENTS

EXPERIMENT 3: EMERGING TOPICS (HISTOGRAM)

http://well-formed-data.net/experiments/emerging_topics_v2/

It has been shown [Golder:2005], that tag proportions for resources stabilize over time. Which means that the tag cloud representing a tag profile for a resource does not change much, once a sufficient number of tags has been collected. In a folksonomy, this is generally considered a good sign, since this indicates a certain agreement on how to judge a certain resource and what vocabulary to use.

For tagging individuals, and communities, this might — at first glance — hold true as well. Consider, for example, the visualization of a tagging community’s evolution (Figure 36): Each tag is assigned a band, with the thickness indicating the overall summed usage of a tag over time (time runs left to right). Thus, a vertical cut through the graph corresponds to taking a tag cloud snapshot at this time point. The vertical order is based on the first appearance of a tag. Cold colors indicate tags introduced longer time ago, warmer colors more recently introduced ones. Brightness is only used to facilitate the visual discrimination of neighboring layers.

In this visualization, tags are summed up over time. This corresponds to a collection process with “eternal memory”, as we are used to from daily interaction with our personal computer, and also the usual way how tag clouds are generated.

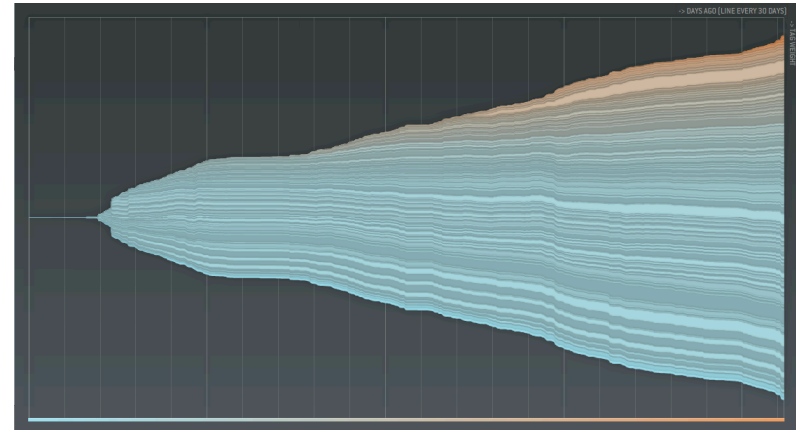


Figure 36: Summing up tags over time (left to right)

Obviously, most of the bands seem to grow in parallel, indicating a stable growth proportion for all tags. However, this does not make too much sense: For individuals and communities, the topics of interest evolve over time, so there must be some hidden variability not captured by the visualization and the underlying linear accumulation model.

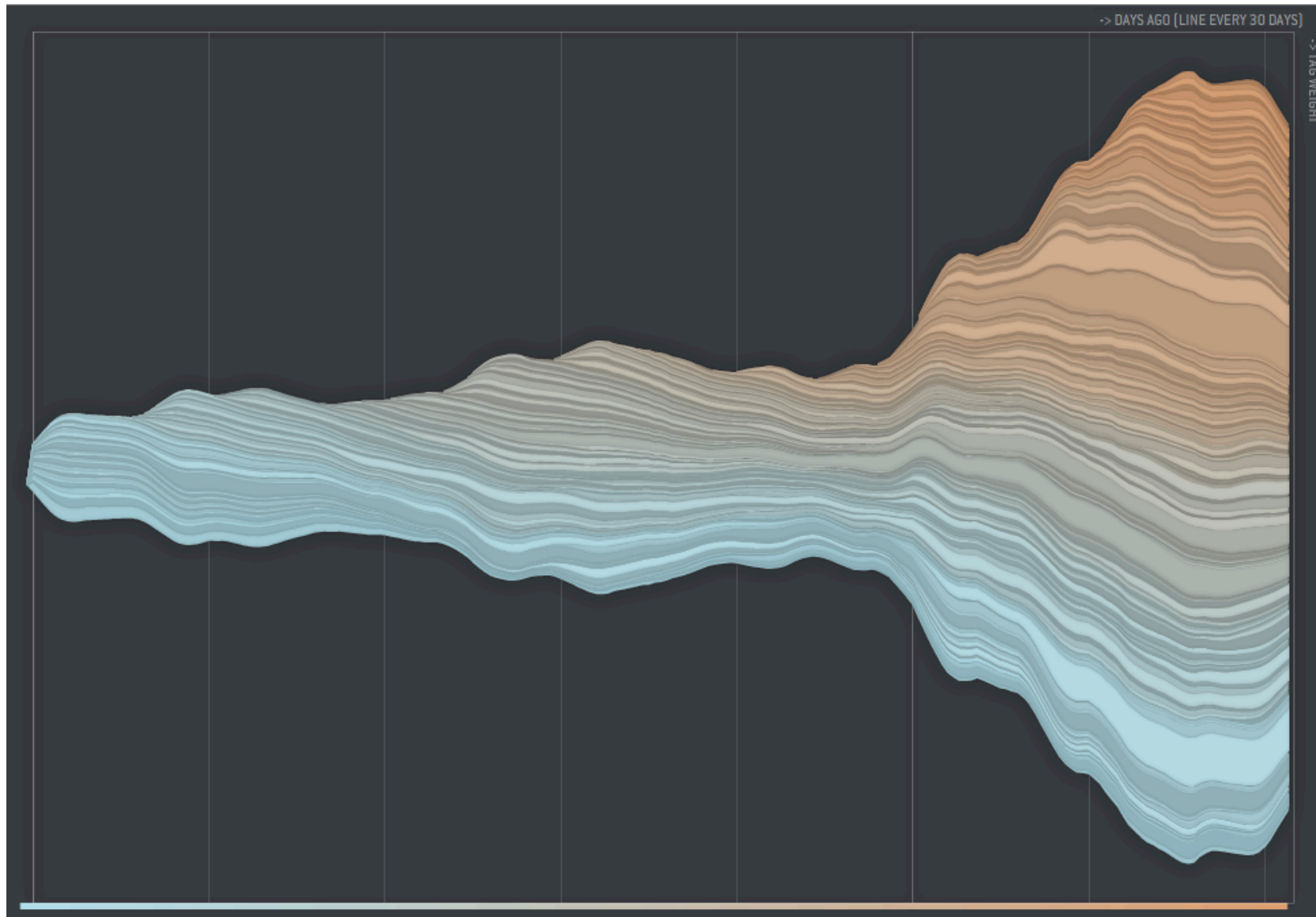


Figure 37: Emerging topics experiment: Visualizing a temporally dynamic, decay model of tagging.

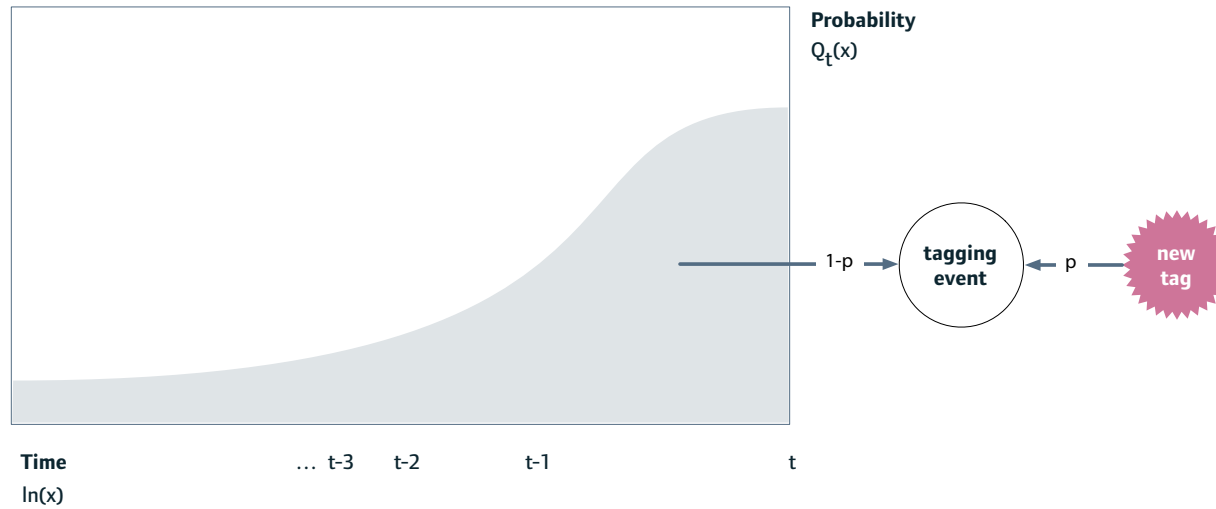


Figure 38: Yule-Simon memory process, adapted from [Cattuto:2006]

Alternatively, [Cattuto:2006] provides an interesting model of tag production based on a Yule-Simon memory process with long-term memory: At any tagging event, users will use a new tag with probability p , or re-use a previously introduced one. The probability of selecting a tag located x steps into the past is given by a probability function $Q(x)$. If there were no temporal dynamics in tag re-use, this function would be a constant. However, the authors found that the function modeling the observed tagging behavior best was a declining “fat tail memory kernel” —giving a bonus to recently used tags, while providing approximately constant, low access probability to less recently used tags. Metaphorically speaking, while some tags get con-

stantly “refreshed”, thus staying part of the current vocabulary, some tags vanish and get forgotten — either because the topic associated with the tag is not relevant anymore for the tagger, or the tag has been replaced by a better term. It is noteworthy, that none of the tested tagging systems actively supports this mechanism, which relates the observed pattern clearly to **usage practices of tags** and the associated **cognitive processes**.

Accordingly, to test and illustrate this model, and also examine inter-personal difference in this process, an alternative visualization for the data based on a decay model, where tags “age” over time and fi-

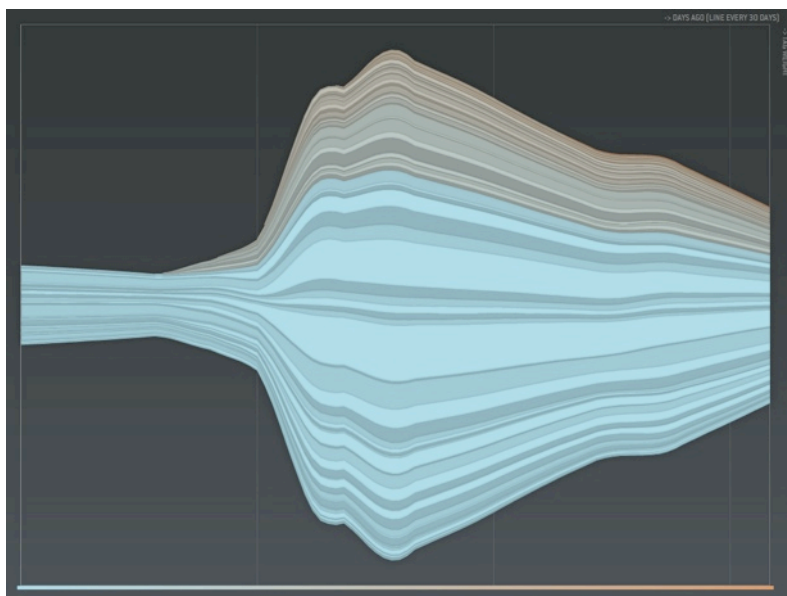


Figure 39: Almost the whole tagging vocabulary was defined in the beginning

nally get “forgotten”, if not used anymore, has been produced. It is based on a form of visualization first introduced in ThemeRiver [Havre:2000], and since then often applied to visualize temporal dynamics⁴⁵.

Tags are stacked in order of their first appearance from bottom to top in streams. Colder colors indicate an earlier first appearance, warmer colors more recently introduced tags. Time is plotted from left (first tagging event) to right (last tagging event). The thickness of each

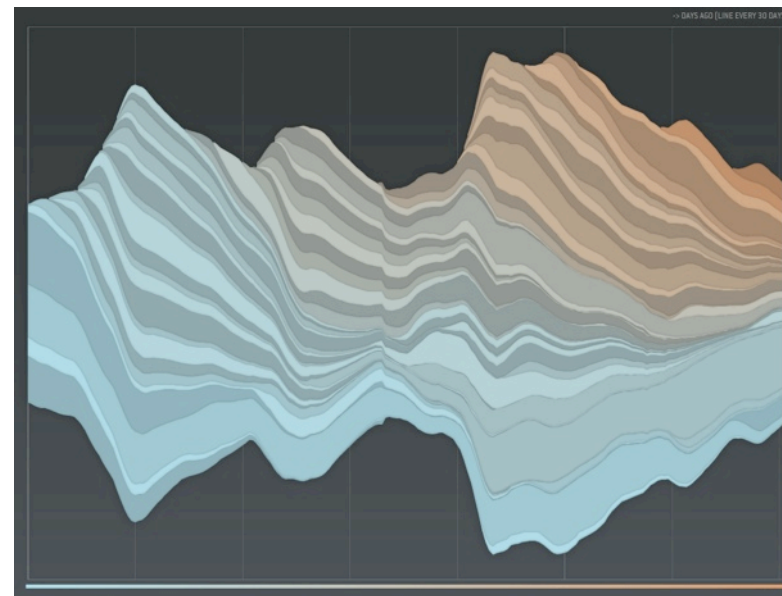


Figure 40: Sporadic activity with replacement of a whole set of tags by freshly introduced ones

stream is increased with each application of the respective tag. At the same time, the thickness is decreased gradually with a sigmoid function over 60 days, after that leaving only a small constant value. This leads to a fading out of tags, if they are not used anymore, leaving more space for the currently active vocabulary. Accordingly, each vertical cut through the diagram could correspond the weights of a temporally dynamic tag cloud, reflecting the **actual, active vocabulary** of a user at a given time point, rather than the usual overall summary usually reflected in tag clouds.

⁴⁵ see e.g. the Baby Name Wizard (<http://babynamewizard.com/namevoyager/Inv0105.html>) or Trace (<http://stamen.com/projects/trace>)

A comparison of the produced charts also reveals some interesting insights on inter-personal differences: While some introduce most of the vocabulary used in the first third of tagging activity, later mostly referring to existing tags, other seem to constantly refine and reinvent their vocabulary (see e.g. Figure 36).

On this background, and given the fast-paced nature of tagging, the presented understanding of tag collections as a dynamically changing vocabulary, with shifting weights, appearing and disappearing terms, is vital to understanding tagging structures, and accordingly, building suitable interfaces to support the associated cognitive processes. Accordingly, predictive suggestion mechanisms need to favor recently applied tags, since these provide, as shown, better probability approximations. In fact, in any situation, where a weighted selection tags is presented in a tag cloud, the temporal dimension of tag application need to be taken into account; otherwise, an important intrinsic property of tagging structures is neglected.

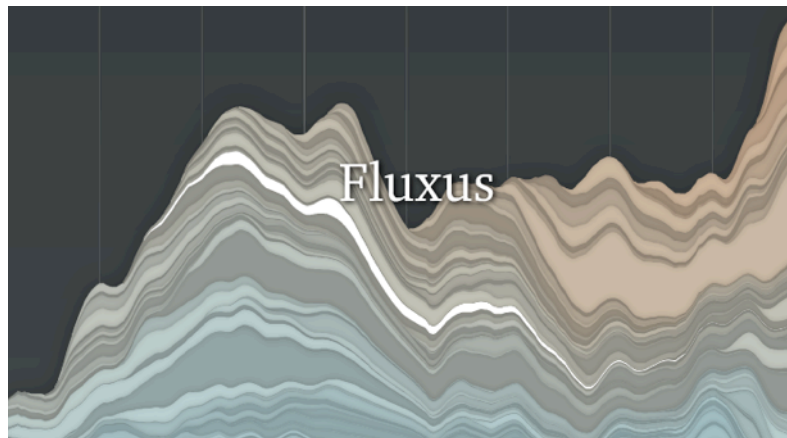


Figure 42: Rollover highlights an individual tag and displays its name

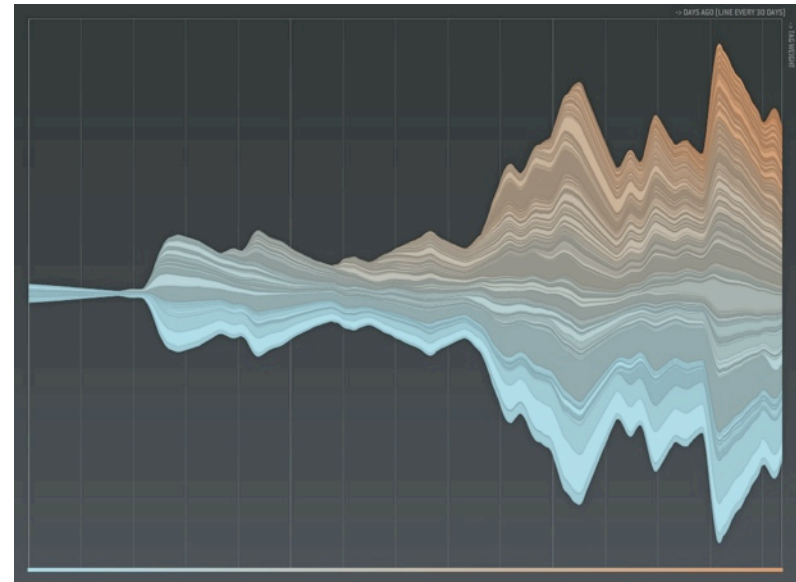


Figure 43: Bursty, increasing activity with some new vocabulary, but strong re-use of old tags

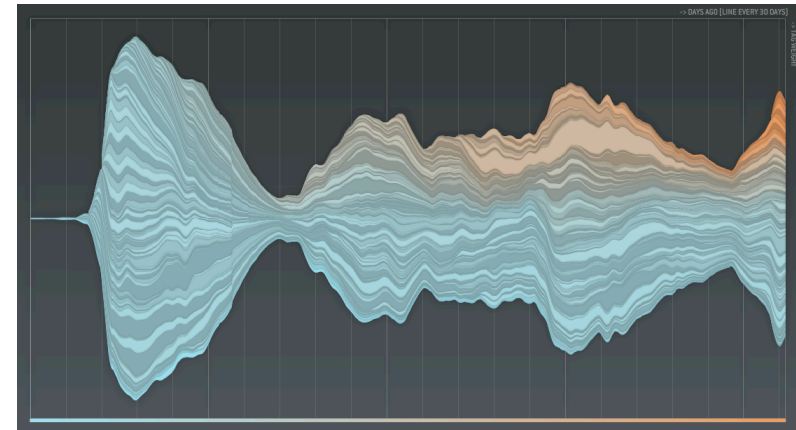


Figure 41: The activity of an online community blog (incom.org)

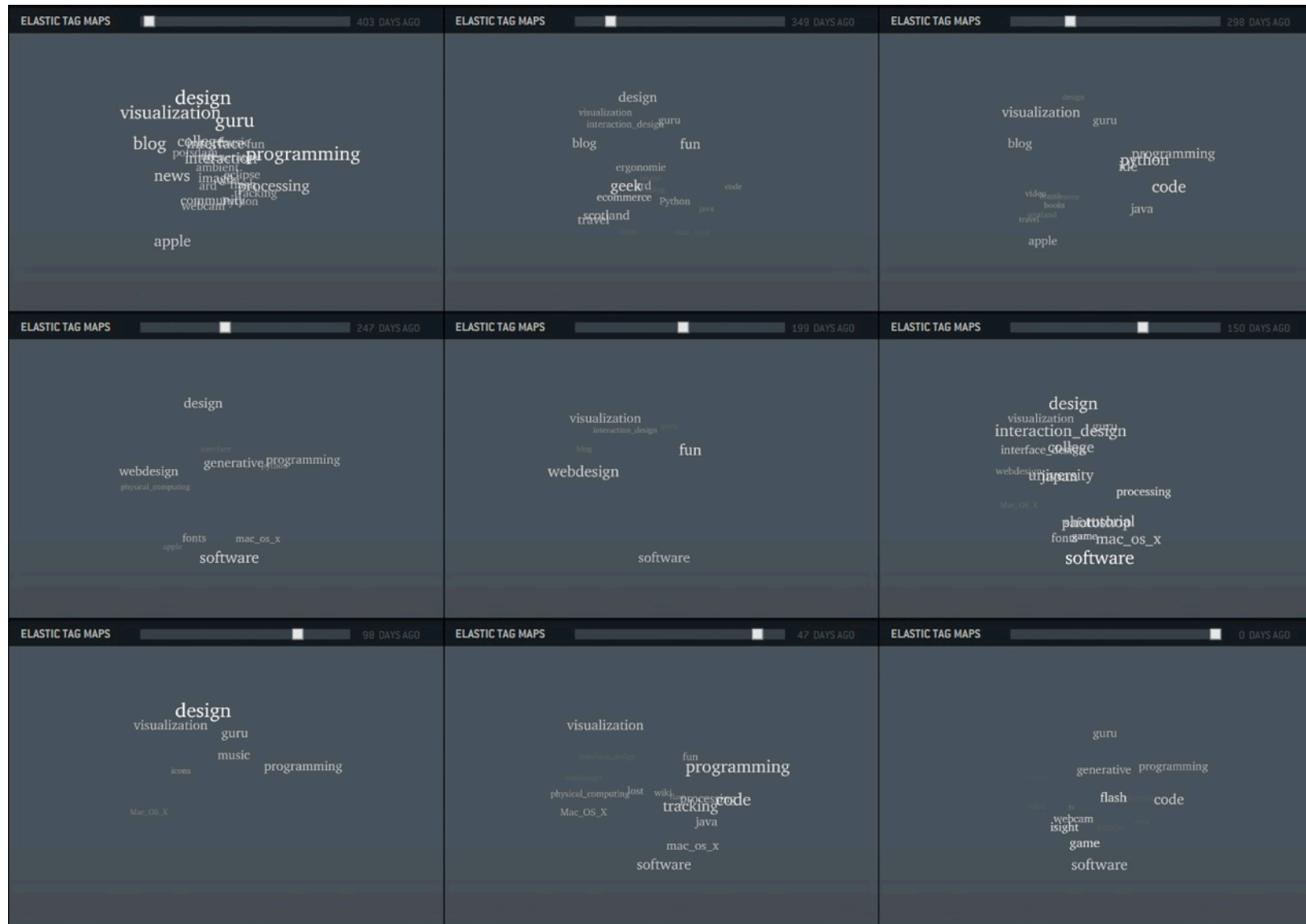


Figure 44: Tag cloud animation based on tag maps experiment 67

EXPERIMENT 4: EMERGING TOPICS (ANIMATION)

http://well-formed-data.net/experiments/emerging_topics/

In order to illustrate and examine the temporal dynamics of tagging further, an animated version of the tag clouds has been produced. It displays the appearance and disappearance of tags over time, with each second of the animation amounting to 30 days of tagging activity. The appearance of newly introduced or forgotten, but re-appearing tags is emphasized by scaling each tag according to a trend measure: The average frequency of a tag over the whole time range is compared to a weighted counting, which gives more impact to time points closer to current frame of the animation. Accordingly, only tags with an unusually high activity in the current time span are visible and slowly fade out, if they are not used anymore.

As a complementary visualization to the previous experiment, it is worse suited to provide an overview of the tagging activity as a whole, but shows the appearance of related tags and the according trends in tagger's or community's interests in a more transparent way. Ideally, these two visualizations should be combined into one application, however, technically, this was not feasible at this time.



Figure 45: Different approaches to time visualization (Left to right: linear, logarithmic, fisheye distortion, time bins, time bins with gap indication)

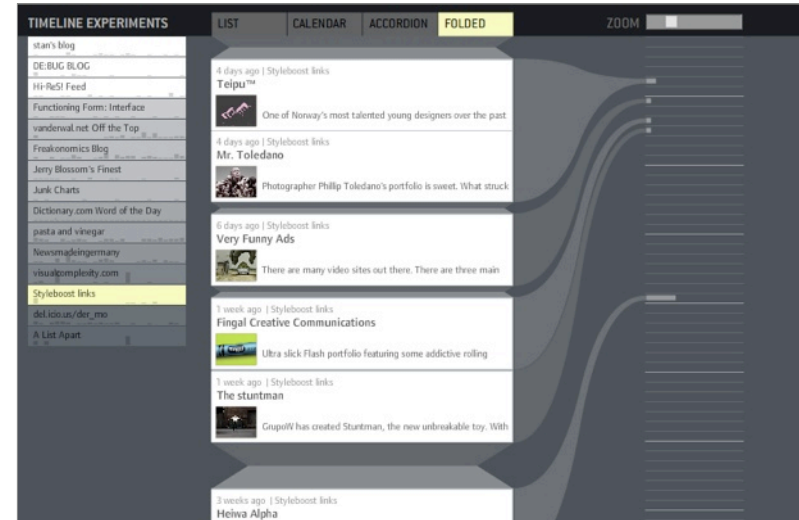


Figure 46: Interactive comparison of time-based list layout mechanisms, with interactive zooming and relation to linear time line indicated at the right

EXPERIMENT 5: TEMPORAL VISUALIZATIONS

http://well-formed-data.net/experiments/folding_time

Temporal rhythms are not only interesting with respect to tagging, but also micro-content production. A first examination of subscribed web feeds revealed a high variability of posting activity, both with respect to different feeds, but also within feeds. Often long periods of inactivity are followed by short, bursty periods of strong activity, again followed by longer gaps. While many blogs show sparse, bursty activity over time, news services or blogs run by full-time bloggers, on the other hand, show more constant amount of activity over time.

An informal blog survey⁴⁶ by Darren Rowse investigated reasons why people unsubscribe from feeds. The results were hinting at a strong role of temporal dynamics and frequency of posting as a quality indicator for web feeds: for “35% of respondents [...] too many posts was reason for unsubscribing and 28% saying that infrequent posts was reason to delete a feed from their reader.” Form and frequency of posting was a bigger factor than dissatisfaction with only partial content delivered (24%) or off-topic posting, a generally too broad or changing focus of the feed (22%).

Moreover, temporal rhythms are also important to understand the context of single posts. The usual ordered list representation of feeds and items in feed readers neglects this important dimension.

Consequently, several ways of treating the temporal display of news items have been explored. See Figure 45 for a first comparison of time mapping approaches: A direct, linear timeline display suffers from large gaps and cluttered display in phases of activity. A logarithmic

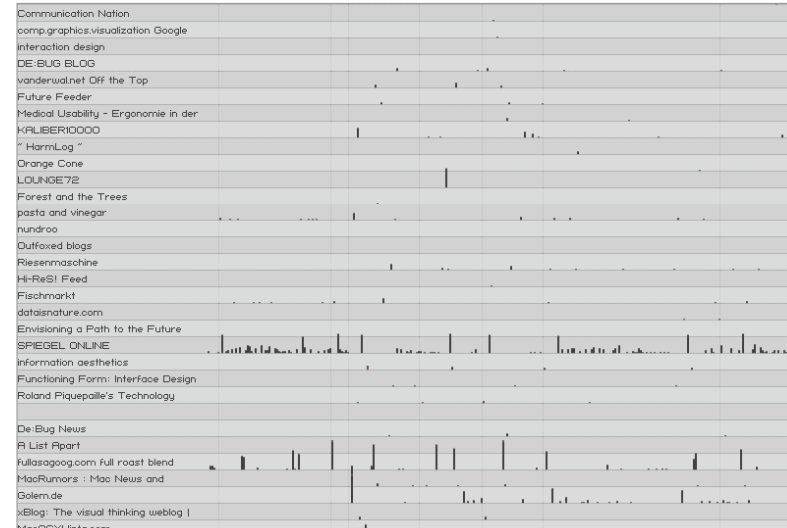
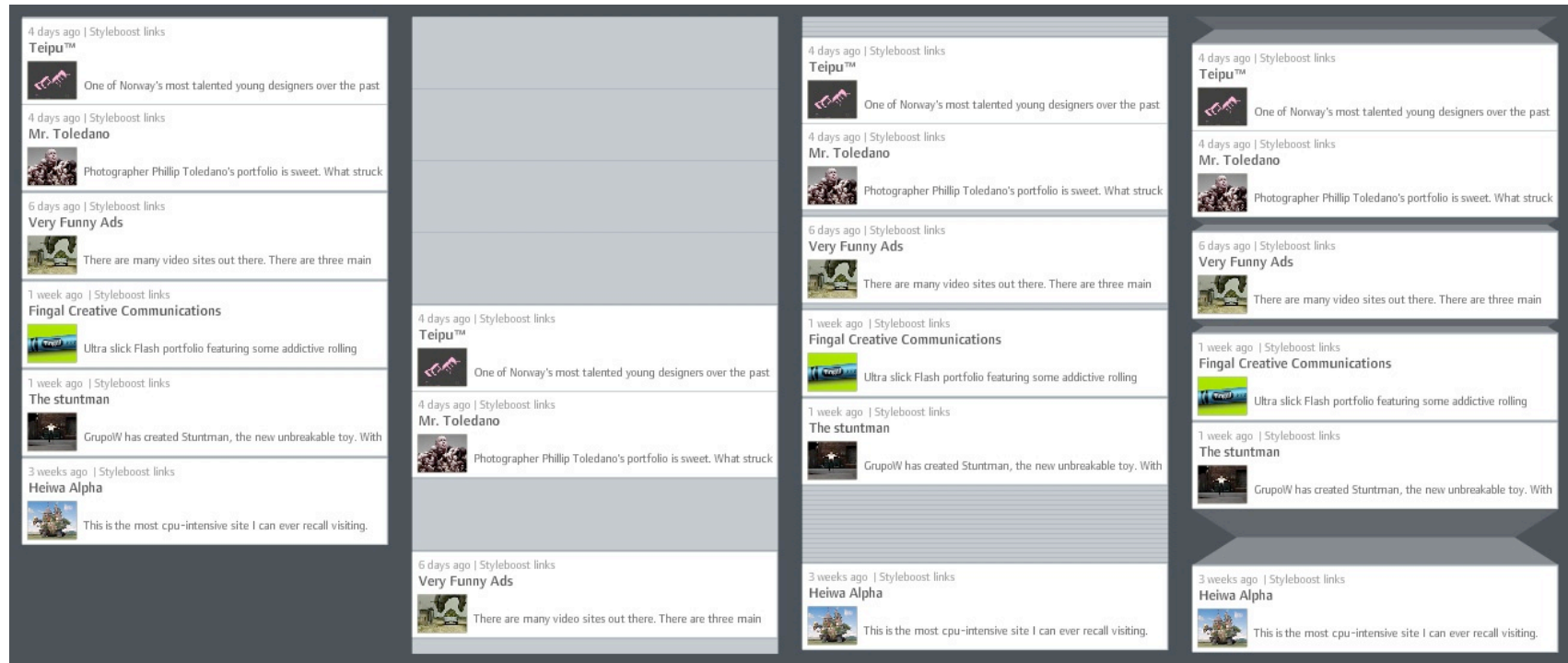


Figure 47: First visual analysis of web feed rhythms

transform can be used to create more space for items on top of the list (i.e., more recent items). In order to shift this focus, dynamic distortion mechanisms like fish-eye distortion can be applied. However, all of these approaches tend to lead to cluttered, hard to manage layouts.

Traditional list representations have the advantage of clean, space-efficient layout, leaving much space for the actual contents to be displayed.

⁴⁶ <http://www.problogger.net/archives/2007/03/01/34-reasons-why-readers-unsubscribe-from-your-blog/>:



Ordered list

Calendar

Accordion

Folded gaps

Figure 48: Comparison of time-based list layout mechanisms

Accordingly, several ways to enhance lists with temporal cues were tested in an interactive demonstrator⁴⁷ (see Figures 46 and 48):

- **Ordered list without gaps:** Clearly, the most space-efficient solution, however, only temporal ordering is preserved and not temporal structure. It is not visually evident how the items are distributed over time.
- **Calendar:** Each time unit (days for example) has equal space assigned, regardless if there are items assigned or not. A precise display, however, very space-inefficient, since a lot of the display space is typically used for displaying “nothing”.
- **Accordion:** Similar to calendar view, but empty time units are displayed on much less screen estate. This provides a first-glance impression of large gaps and close-together items. However, depending on the temporal structure, there might still be large streaks of wasted space for large gaps.
- **Folded gaps:** Based on the accordion, and trying to solve the problem of plausibly shortening longer empty streaks visually: Temporal gaps are displayed as if a part of the list was folded to the back of the display. Short gaps have almost the same size as in accordion view. Long gaps are larger, but do not grow linearly, but with the square root of the number of empty time units. Visually, this is justified by introducing shading to indicate that the “list material” is folded to the back. Folding also provides a plausible model for interactive adjustments such as regulating the gap size.

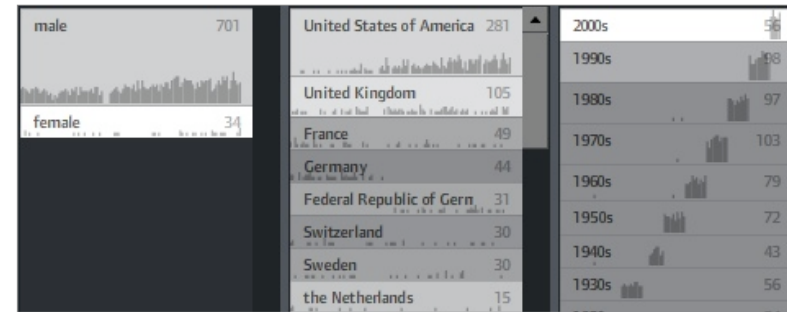


Figure 49: Sparklines for Nobel prize winners data set: A rising number of prizes for the United states, as well as the much higher number of male vs. female winners can be recognized immediately

Another approach is to enhance not list layout, but individual list entries with temporal cues: Edward Tufte coined the term **sparklines** for “small, high resolution graphics embedded in a context of words, numbers, images” [Tufte:2006]. These are a premier candidate for embedding additional information about the temporal nature of a feed, a tag, or any metadata value into standard user interface components like list entries, while at the same time leaving standard interaction mechanisms intact.

To sum up, visual indications of temporal rhythm can also enhance traditional presentation forms of content in a space-efficient, unobtrusive manner, and this area of visualization will gain importance, due to the discussed increased relevance of temporal dynamics and rhythms of web feeds as well as metadata values in general.

⁴⁷ http://well-formed-data.net/experiments/folding_time/

LIFESTREAMS AND MASH-UPS

EXPERIMENT 6: LIFESTREAM MASHUP (HOURLY WEBCAM SHOTS + TWITTER + DELICIOUS)

http://well-formed-data.net/experiments/lifestream_mashup

Displaying time points, histograms or frequency distributions in diagrams is a generic, data-centric approach. In contrast, personal perception of time is highly non-linear, context-dependent and episode-based [Krishnan:2005]. Grounding time visualization in personal experience, and picking up the mash-up idea of connecting services, a visualization of hourly taken webcam shots from the author's personal computer, along with his del.icio.us bookmarks and short twitter comments is combined in a unified documentation of digital activity. Days are ordered left (newest date) to right (oldest date). Hours start at the top (6am) and go down to the bottom. The pictures taken are put in the corresponding hourly slots. Together, they form a perceptually rich grid, where streaks of activity, staying at the same places, or constant lighting positions for different day times, are identifiable from the pictures. Under closer examination, different moods, haircuts, clothing preferences can also be identified. The photo grid provides hooks of connecting time points to landmarks in personal experience, travels, work or private situations. The digital output on bookmarking and micro-blogging services is superimposed as an additional layer. To improve readability, a spring-based layout mechanism has been used. Individual entries are connected via lines to their corresponding time points.

This experiment asks more questions than it answers: Foremost, how interesting is it to see thousands of pictures of yourself in front of the computer? This referential self-reflection of digital life can be seen as

a metaphor also for the self-referential nature of the new communication forms: In fact, a bulk of the use of the new publishing forms is in fact — discussing these new publishing forms.

Secondly, who would you share such a chart with? The world, your friends, your spouse, or keep it for yourself? How transparent do we want to be?

On the other hand, the basic idea of grounding time display in personal experience can in fact constitute a valuable, new approach to time visualizations and digital structuring very much in line with the discussed transitions towards subjectivity, personalization and contextualized information access.

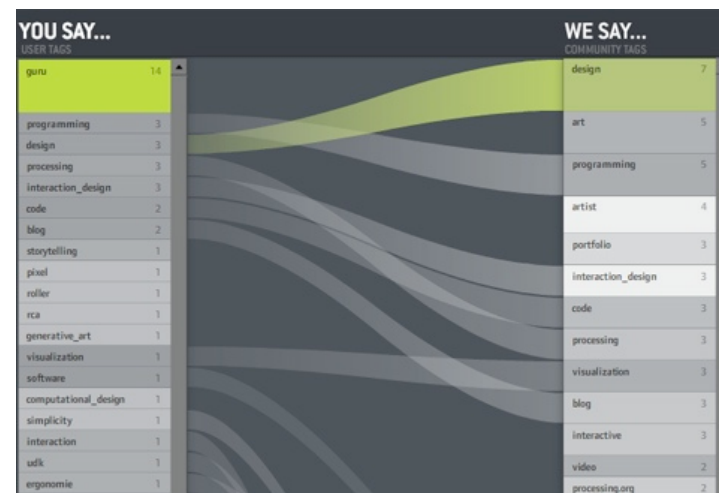
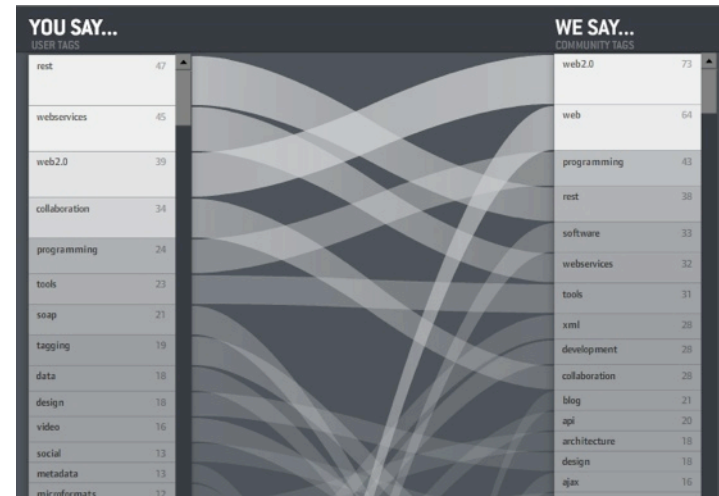
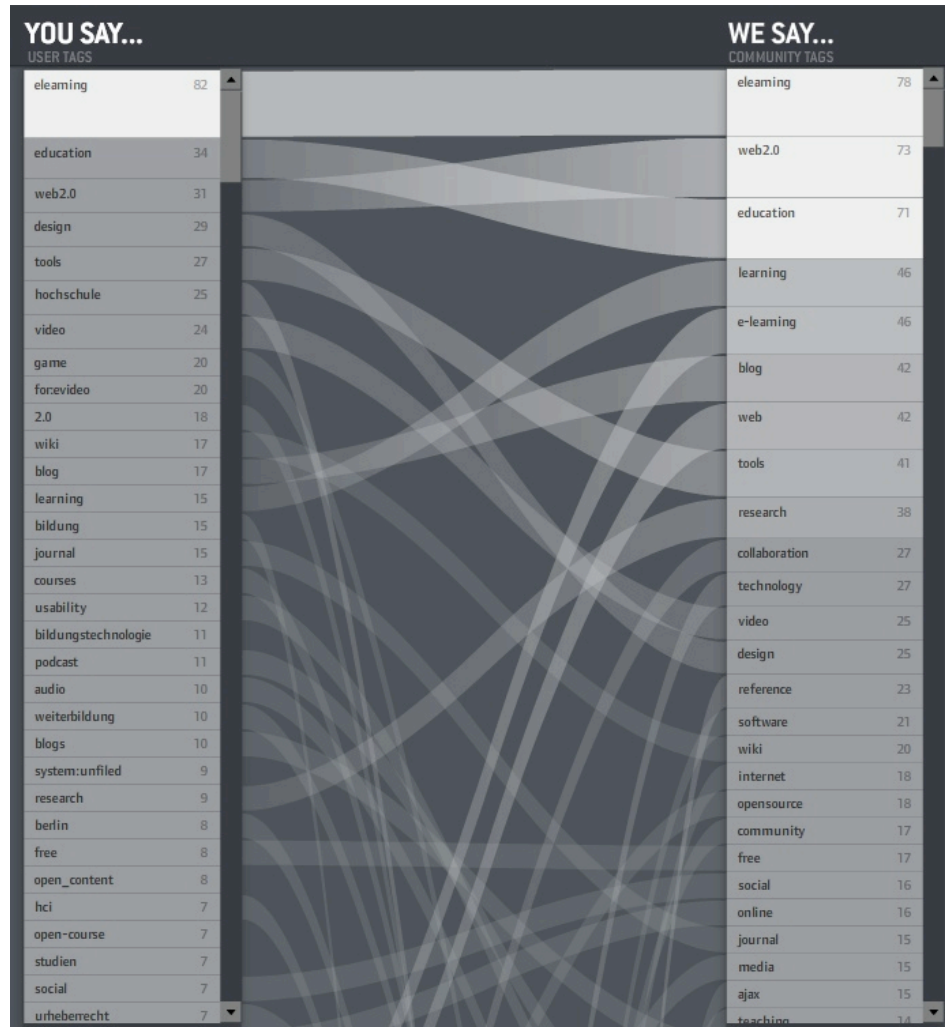


Figure 51: You Say We Say: A comparison of community tag usage vs. personal tag usage

INTERSUBJECTIVITY AND COMMUNITY AGREEMENT

EXPERIMENT 7: YOU SAY WE SAY

<http://well-formed-data.net/experiments/YouSayWeSay/>

As discussed in the analytic part, tagging is a highly subjective, unconstrained activity. As a result, each user constructs his own tag vocabulary, without explicitly stating, what she exactly means when tagging a resource with a word, as the personal significance is clear. In the tag maps study, we could already observe some differences how term usage differs between persons. The experiment “You say... — we say...” sheds another light on the differences, but also agreements in tag usage, by comparing individual tag associations to the whole tagging community.

In the left column, the personal tags for a user’s bookmarks are displayed. These are ordered by frequency, additionally, the size and brightness of the containing box indicates the relative number of times the tag has been applied. Again, a logarithmic transform leads to a more readable scaling by damping the extreme long-tail distortion. In the right column, the community tags for the **same resources** are displayed in the same manner. Tags with the same name in the left and right column are connected by a bezier line area. If a line is approximately horizontal, the individual and the community essentially agree on the relevance of the tag for the resources. The steeper it is,

the larger the disagreement. If no line starts at a tag, it means it is not present in the other list.

Moreover, individual tags can be clicked in order to make a comparison for specific tags. In this case, both lists are re-ordered, putting related tags to the top.⁴⁸ This is especially interesting for obscure tags like “guru” (see Figure 50). A better understanding of what the tagger means with this tag, can be gained by looking at the distribution of the community bookmarks (in this case “design - art - programmer - artist”). But also for common words like “design”, “art”, “science”, “philosophy”, the related tags as well as the associated community tags can differ across persons, illustrating the individual understanding of the concept by the respective user. On the other hand, especially the high-rank tags usually show good agreement between community and individual, while more precise, specialized long-tail tags exhibit a higher degree of variability.

This visualization is an illustration of the “meaning as use” principle, and the intersubjective, multivalent nature of tagging. It can also serve as a starting point for the individual to reflect her own tagging behavior, and adjust future practices or re-organize the tagging collection. The visualization principle as such is well-known: See e.g Ben Fry’s “salary vs. performance” visualization⁴⁹ or the more expressive “parallel sets” technique⁵⁰. However, to the author’s knowledge, it has not been applied a comparison of personal vs. shared vocabulary in tagging before.

⁴⁸ Additionally, tags having a higher weight in the local context than compared to the overall distribution are presented brighter—a principle that will be discussed more in detail in the following section.

⁴⁹ <http://www.benfry.com/salaryper/>

⁵⁰ <http://www.vrvis.at/via/research/parssets/index.html>

These terms define your current search. Click the to remove a term.

GENDER: female

33 results
Group by: [gender](#)
Sort by: [usual name](#), [year of birth](#), [year of death](#), [country](#)

Refine your search within these categories:

GENDER: [all](#) > [female](#)

COUNTRY (group results)

- Austria (2)
- India (1)
- Byrna (1)
- Iran (1)
- Chile (1)
- Italy (2)
- Federal Republic of Germany (1)
- Kenya (1)
- France (2)
- more...
- Guatemala (1)

AFFILIATION (group results)

- Federal Republic of Germany (1)
- Sweden (1)
- Switzerland (1)
- France (2)
- United Kingdom (1)
- India (1)
- United States of America (6)
- Northern Ireland Peace Movement (2)
- Women's International League for Peace and Freedom (2)

PRIZE (group results)

- chemistry (3)
- literature (10)
- medicine (7)
- peace (12)
- physics (2)

YEAR (group results)

- 1900s (3)
- 1910s (1)
- 1920s (2)
- 1930s (3)
- 1940s (3)
- 1960s (3)
- 1970s (4)
- 1980s (4)
- 1990s (7)
- 2000s (4)

Alva Myrdal 1902-1986

Aiuna San-Sau Kyi 1945-..

Barbara McClintock 1902-1992

Bertha von Suttner 1843-1914

Betty Williams 1943-..

Christiane Nusslein 1942-..

Dorothy Crowfoot Hodgkin 1910-1994

Etrigede Jeltink 1946-..

Figure 53: Flamenco facet browser

Basic Search | Advanced Search | /facet | Relation Search | My Collection (en nl id ru uk zh)

Title Creator Material Location Date Subject Culture >>

within

Main Category

Current Repository

Culture

AAT Concept All >1000

Place KIT >1000

Person RMV 17

SVCN Concept >1000

Work >1000

Insular: Zuidoost-Azië >1000

Europees >1000

Surinaams >1000

Toba >1000

Javaans >1000

Baliness >1000

Indonesisch >1000

facet options

Results grouped by Culture

Insular: Zuidoost-Azië (2)

Gong van brons (dc:creator unknown)

Dames pantoffel (dc:creator unknown)

Europees (4649)

Figure 55: /facet

MIT Libraries
A SIMILE Demo

2 filter criteria (remove all)

- type: Notated Music (remove) Musical Sound Recording (remove) Non-Musical Sound Recording (remove) Cartographic (remove) Text (remove) Software & Multimedia (remove) Manuscript (remove) Moving Image (remove)
- type: Musical Sound Recording (remove) (add more)

245 items

< previous 1 2 3 4 5 6 7 8 9 10 ... 25 next >

The color of brass

Creator
Harmonic Brass (Musical group)

Publisher
Anker Musik

Physical Description
1 sound disc : digital : 4 3/4 in. | sound recording |

Note
Compact disc.
Principally consists of arrangements for brass quintet.
Program notes and biographical notes on the composers by Christian MÄhne and biographical notes on the performers in German with English translations ([8] p. : ports.) inserted container.
Harmonic Brass (Gerd Fischer - Horn; Leon GrÄbblner - trumpets - Andreas Binder - horn - Hannes

Subject

Type here to filter

- Fiddle_tunes (13)
- Music (12)
- Concertos_(Violin) (11)
- Symphonies (11)
- Folk_music (10)
- n-en-ns (10)
- Nova_Scetia (10)

Creator

Type here to filter

- Abraham_Gerard_1904 (4)
- Perlman_Itzhak_1945 (4)
- Bach_Johann_Sebastian_16851750 (3)
- Ives_Charles_18741954 (3)
- Recorded_Antology_of_American_Music (3)

Figure 54: Longwell facet browser (MIT project SIMILE)

4.2. MULTI-FACETED FOCUS & CONTEXT FOR LONG-TAIL NAVIGATION

There are a variety of approaches to improve tagging structures [RuiLi:2007], such as tag clustering [Begelman:2006], the automatic construction of hierarchies from tagging structures [Heymann:2006], using collaboratively constructed thesauri for tagging as in Wikipedia [Voss:2007] or to giving users the option to specify hierarchical relationships while tagging [Jaeschke:2007].

In line with [Quintarelli:2007], I want to argue the most promising way to refining and re-organizing tag structures is a gradual transformation from unordered tags to **faceted tag collections**. As discussed, tags are closer to categories and properties than classes or clearly defined topic descriptors. In fact, empirical analysis has shown that users in fact implicitly mix different **types** of tags such as topics, opinions, dates or associated actions. Grouping these categories and properties is a natural next step, which follows the bottom-up logic of tagging. While there might be a large amount of inter-personal disagreement on the exact meaning of a tag, we can hypothesize that the type of a tag is often less disputable. A transition process from an unstructured tag collection towards a faceted tag collection is seamless, since it does not require any restructuring, but only a step-wise, optional association with their types. Hierarchical relations can be established later within a facet, if necessary.

Also from a user interface perspective, facet browsing is a promising paradigm. Pioneered by the Flamenco Browser system [Hearst:2003], facet browsers follow the unique filtering principle, presenting the user only with choices that can result in a non-empty result set in subsequent clicks.

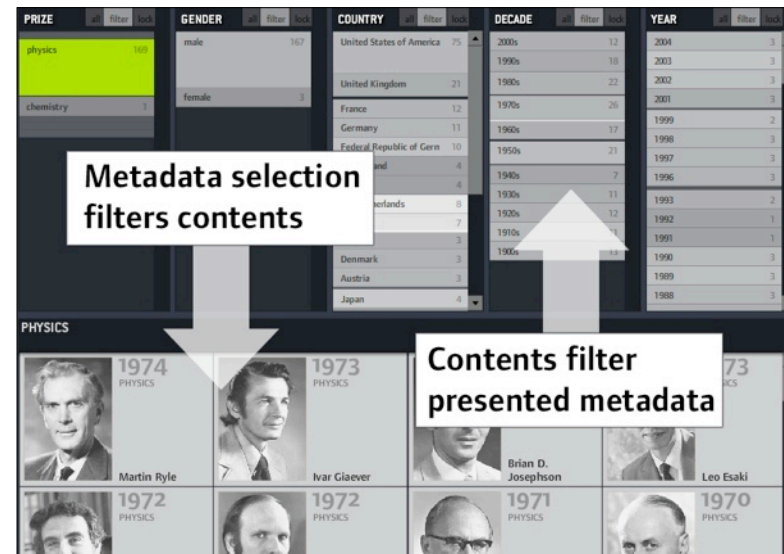


Figure 52: Facet browsing principle

Take, for instance, the Flamenco browser’s “Nobel Prize winners” demonstration (see Figure 53): in initial navigation, the value “female” was selected from the attribute “gender”. This restricts the display of contents to ones matching this attribute value; in turn, all metadata attribute fields are restricted only to values occurring together with the selected attribute. On subsequent filtering steps, this makes it impossible to construct queries with an empty result set, which is commonly regarded as one of the biggest benefits of facet browsers.

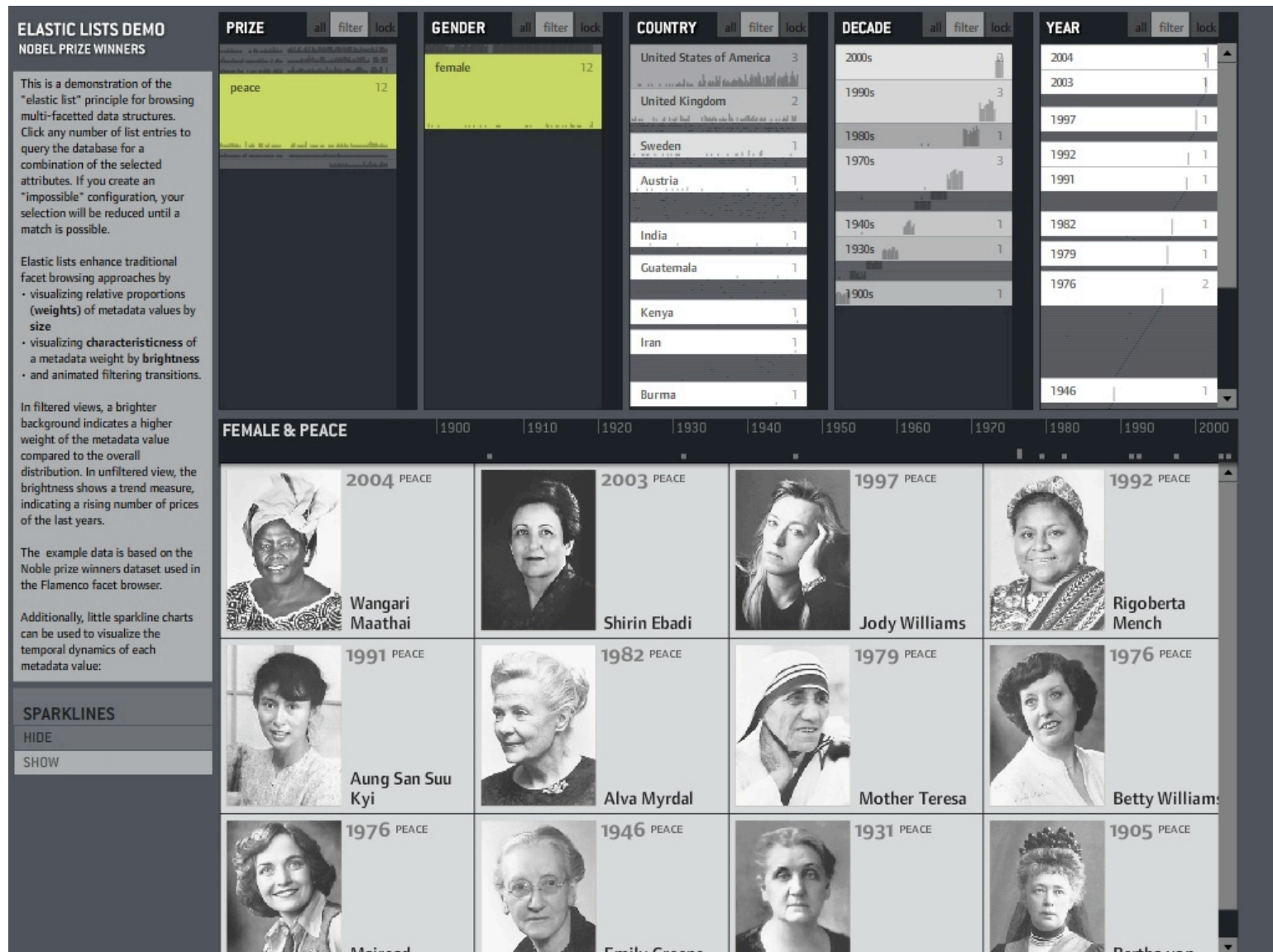


Figure 56: Elastic lists for facet browsers (Nobel Prize winners demo)

ELASTIC LISTS FOR FACET BROWSERS

EXPERIMENT 8: ELASTIC LISTS FOR FACET BROWSERS (NOBEL PRIZE WINNERS DEMO)

http://well-formed-data.net/experiments/elastic_lists/

Accordingly, the insights gained from the elastic tag maps and lists, as well as from the characteristics of flat, non-exclusive metadata structures, have been the inspiration for an improved approach to facet browsing interfaces (see also [Stefaner:2007]).

It aims at enriching current interfaces with additional visual cues about the **relative weights** of metadata values, as well as how that weight **differs** from the global metadata distribution. This is in line with the notion of information as “a difference that makes a difference”, and emphasizes the characteristic metadata values of contents. Following a focus & context tradition in information visualization, filtered-out items never disappear completely, but are collapsed to a minimal height in smooth, animated transitions.

Central to this approach is the notion of **metadata profile**. If a context is defined by a set of contents and their metadata values, a metadata profile expresses the characteristics of a given context in terms of its metadata distribution. In its simplest version, a metadata profile is represented as the set of occurring metadata values weighted by the number of occurrences.

The **global** metadata profile is the metadata profile for all available contents and hence represents the a priori distribution of metadata. A **local** metadata profile characterizes a subset of contents, such as a search result, the result of a filtering operation or a single content.

In this terminology, traditional facet browsers display the local metadata profile for the selected context by employing a simplistic visual mapping: Only values with a weight greater than zero are presented, usually in a list and in visually uniform manner; often, the weight is presented as a number in parentheses.

Building upon the navigation principle of facet browsing, **elastic lists** enhance the information presentation with respect to the following features:

- **Visualize the weight proportions of attributes** In many situations, it is informative to immediately see which are the predominant values and which cover only a minor part of the data set.
- **Emphasize the characteristic values of a local profile** In order to understand what makes a data set special compared to the whole collection, it is helpful to indicate how the displayed proportions differ from the global distribution. In the Nobel Prize winners example, e.g. it would be informative to see that 35% percent of all female prize winners received a peace Nobel prize, while the global ratio is only 14,4%. This makes “peace prize” a characteristic attribute for the selected subset, which is not evident from a plain list presentation.
- **Animated filtering** For users of facet browsers, the sudden disappearance of list items after click is a common source for misconceptions and confusion. In our elastic list representation, transitions are animated smoothly and even filtered-out attribute values are still visible as flat lines. This makes the filtering process transparent to the user and allow easy localization of the local metadata profile compared to the global profile.

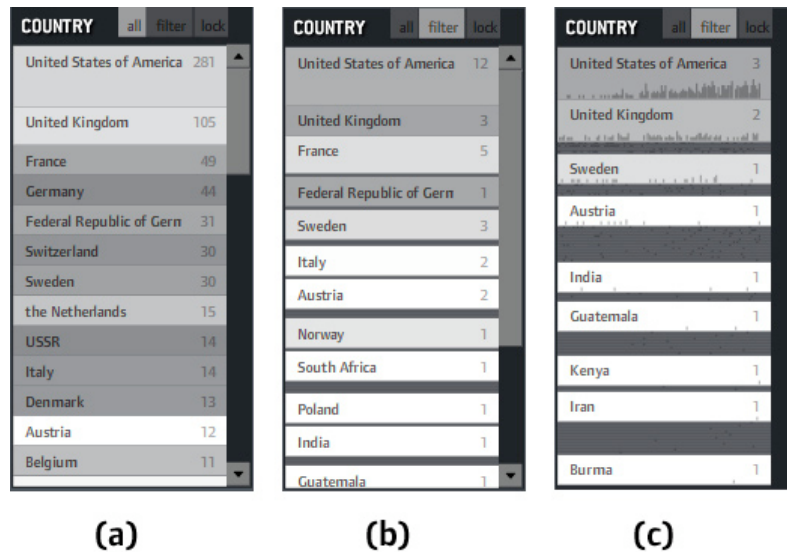


Figure 57: Different states of elastic lists

Elastic lists follow the following principles: Items are presented in form of an ordered list. The size of an item indicates the proportion of items associated with the respective metadata value.⁵¹ The brightness of a list item indicates the “unusualness” of an item weight in the given context.

Two modes can be distinguished:

In its initial state, an elastic lists display the global metadata profile. All items are visible. (see Figure 57a) The measure of unusualness is

⁵¹ Theoretically, the size of the list entries should correspond directly to their proportional weight. However, for usability reasons, each entry with a non-zero weight has been assigned a minimum height in order to make all entries of interest readable. Additionally, due to the often skewed distribution of values, a logarithmic transform on the weight is applied to dampen the influence of high weights.

defined in terms of a trend measure — metadata values with recently rising activity are visually emphasized by a brighter background color. For ordinal data, such as time points, items are presented in descending order; for nominal data either the trend measure or the weight in the global profile can serve as ordering principle.

In their filtered state, elastic lists maintain the same order of items, but metadata attributes with a weight of zero (i.e. not occurring in the current context) are collapsed to a minimal visible height. All other metadata items are scaled according to their proportional weight. A brighter color indicates that the proportional weight is significantly higher than compared to the global profile. (see Figure 57b)

Transitions between states are animated in order to facilitate an understand of the filtering process. Switching between “global” and “filtered” mode is possible at any time by using dedicated buttons. Any state of the elastic list can be frozen via the “lock” button to allow sequential exploration of the presented values without continuous transformation of the list. Additionally, small bar charts (so-called “sparklines”), indicating the temporal dynamics of the metadata value, can be displayed (see Figure 57c). These represent a histogram of the occurrence of the respective metadata value, with time points—in this case years—running from left to right.

In order to make this approach directly comparable to others, a demonstration based on the Nobel prize winners dataset used in Flamenco has been implemented.

PRIZE	all	filter	lock	GENDER	all	filter	lock	COUNTRY	all	filter	lock
chemistry				male			80	United States of America			26
peace				female			12	United Kingdom			14
								France			9
								Germany			3
								Federal Republic of Gern			1
								Switzerland			20
								Sweden			5
								the Netherlands			1

Figure 58: Unusually high number of female and Swiss winners in the peace category.

The visualization approach leads to interesting insights on the data set: When e.g. selecting the value “peace” from the “prize” category, we can observe that although more men than women have achieved a peace nobel prize overall, the proportion of women in this context is higher than compared to the global profile. This is indicated by the increased brightness of the list row. (see Figure 58) The same mechanism makes the countries Switzerland and Belgium visually more salient for the given context. This simple mechanism demonstrates how metadata can not only be used to find information, but especially to **understand** information and its context.

RELATED WORK

The rubber sheet [Sarkar:1993] as well as the table lens [Rao:1994] present the first instances of dynamically scaling list or table entries based on user interaction, thus introducing the focus & context principle for these forms of data presentation. However, scaling in this case only serves to make the contents visually accessible and size does not, as in our case, encode numeric information.

The InfoZoom software (see e.g.[Spence:2001]) uses dynamic scaling of horizontal list entries as indicator of relative proportions as well as miniaturized data plots to visualize quantitative data. However, designed as a database exploration tool, it aims at a diagrammatic representation of the data. Indisputably more powerful and elaborate than our approach from a data exploration perspective, we believe that our strategy of reducing complexity is more user-friendly for browsing and navigation purposes. Moreover, additional visual parameters indicating unusualness or temporal dynamics are not present as they are in this prototype.

TAGS AND FACETS

ALLTAGS all filter lock

- design 24
- visualization 7
- maps 4
- information 4
- flash 4
- portfolio 4
- m.a.thesis 2
- art 2
- agency 2
- web2.0 2
- networks 2
- fhp 2
- blog 2
- webdev 1
- ivis 1
- code 1
- news 1
- gadgets 1
- tagclouds 1
- folksonomy 1
- tags 1
- text 1
- activitytheory 1
- friends 1
- interaction 1
- hci 1
- mace 1
- search 1
- books 1
- german 1

PLACE all filter lock

- place:berlin 1
- place:hamburg 1

FOR all filter lock

- for:borism 1

SYSTEM all filter lock

- system:imported 2

TOPTAGS all filter lock

- design 24
- visualization 7
- flash 4
- m.a.thesis 2
- news 1
- webdev 1

CREATE A FACET

Person +

SEARCH

24 ITEMS design

ACTING WITH TECHNOLOGY: ACTIVITY THEORY AND INTERACTION DESIGN	design books hci interaction activitytheory
ARTIFICIALDUCK.NET	design patrikdejong artificialduck agency relaunch german
83 BEAUTIFUL WORDPRESS THEMES YOU (PROBABLY) HAVEN'T SEEN AT SMASHING MAGAZINE	design webdev blogging lotsof wordpress themes
THE PATHETIC FALLACY OF RDF	visualization design rdf networks ui fallacy semweb grap
ANDREAS SCHLEGEL SOJAMO	design portfolio code processing sojamo andreasschlegel
THE WORK OF JONATHAN HARRIS	visualization design flash ivis art
SI SCOTT DESIGN	design experte schnörkel graphic
COLOR GUIDELINES, STANDARDS, AND REQUIREMENTS	design color guidelines nasa

Figure 59: Elastic lists for facet browsing of tag structures

FACET BROWSING FOR TAGGING STRUCTURES

EXPERIMENT 10: ELASTIC LISTS AND FACETS FOR TAGS

http://well-formed-data.net/experiments/tags_and_facets/

Along the same principle, a tool for browsing tag structures based on facets is currently developed. At the moment, it is a semi-functional prototype.

It is based on the observation, that some users create typed tags already, by using syntactic delimiters, such as colons or slashes (e.g. “for:tinax” or “by:Weinberger”). Accordingly, the application imports existing tag collections (in the given example, del.icio.us bookmarks) and groups the tags according to these delimiters. Default facets are “all tags” and “top tags”, which selects the top used tags, since they, as argued before, represent important entry points to the sub-collections of tags. The navigation principle follows the elastic list principle as introduced above.

The user can browse the bookmark collection based on these pre-existing facets, assign existing tags to facets per drag-and-drop (dragging the tag “bonn” on the “place” facet will rename the tag to “place:bonn”), but also create new facets and assign existing tags to them (such as dragging a name on a newly created “person” facet, see Figure 60)

The resulting, improved organization allows not only parallel browsing within the application but can easily be re-exported to del.icio.us. As a consequence, the typed tags are visible to other users, made available in suggestions, etc. Since facet-naming follows the same procedure as free-from tagging, effectively this could lead to the emergence of stable tag **typing** in a tagging community, allowing fac-

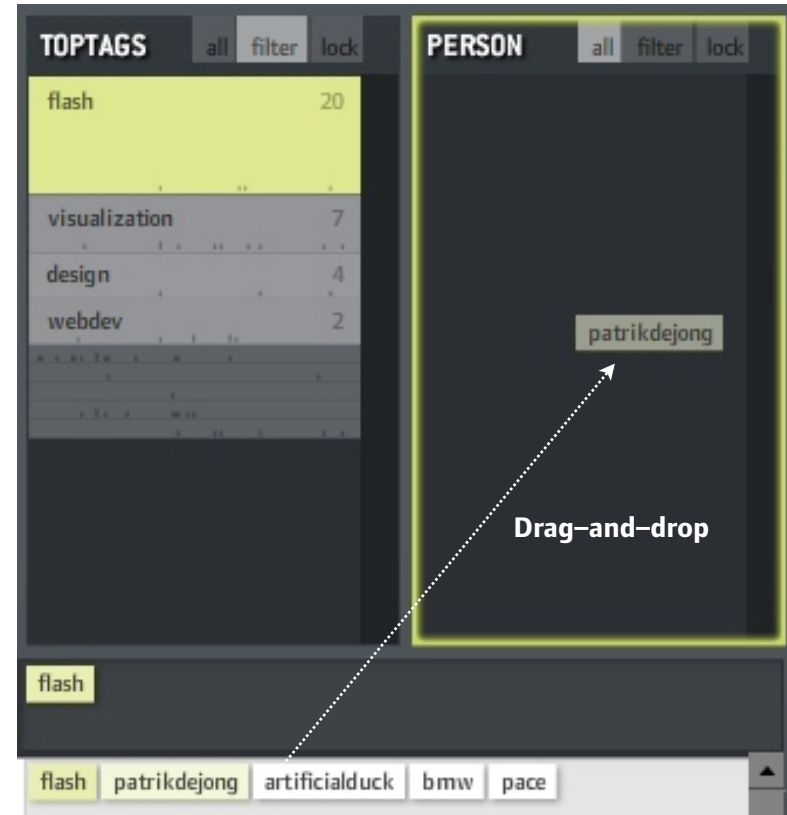


Figure 60: Assignment of tags to facets per drag-and-drop

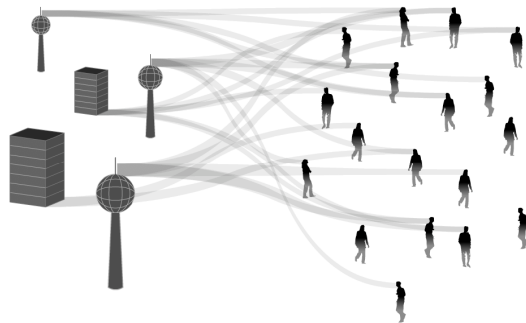
eted browsing and retrieval, but especially mash-ups, by re-using tags of a certain type automatically in different services (such as ratings, locations, projects, etc.). This is a great advantage compared to the bundles (named sets of tags) already present in e.g. del.icio.us, which are a mere grouping mechanism, without statement about the nature of a tag or an effect on tag representation.

4.3. KONDUIT—A MODEL FOR A WEB FEED HUB APPLICATION

Throughout my work on this thesis, the vision of a unified web feed application, allowing both subscription as well as publishing of microcontent and integrating the above described experiments, has served not only as a carrot in front of the donkey, pushing my developments, but also as a plausibility reference for the relevance of my experiments. Although a functional prototype, it remains unfinished. In the following chapter, its basic workings and underlying principle shall be described.

BACKGROUND

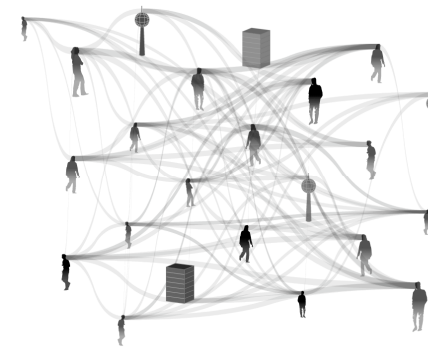
HUMAN AGGREGATORS



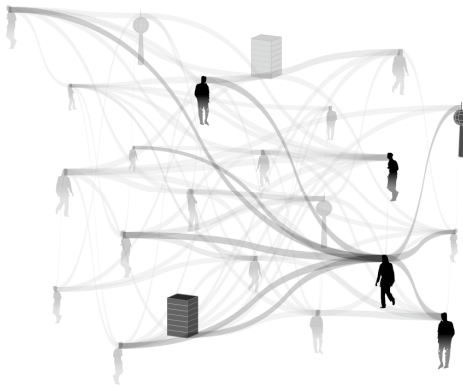
Our traditional conception of media is a few-to-many scheme: A small number of institutions broadcasts or publishes information to the receiving crowd.

The success of web publishing platforms and social media sites lead to a boom of bottom-up publishing and amateur content creation.

As of today, typically, participants in the Web 2.0 have multiple identities and receive messages and news over a variety of channels—be it social news sites, individual's blogs, community blogs, automatically subscribed queries, social bookmarking sites etc.



Consequently, this results in too much information to be handled properly. How can we select the relevant, and restrict our new awareness to what is interesting? Both automatic content analysis approaches, or popularity and attention analysis might help, but the most effective mechanism is to let **people whose opinion you trust** weed out the relevant in **their area of expertise** and share it with others.



Accordingly, I see the most promising perspective in filtering relevant, personal information in leveraging the powers of **human computation** [Ahn:2004], by facilitating the quick and easy sorting and annotation of contents, in order to share these with a wider public or a closer circle. The pre-dominant use of the web, under this perspective, would not be page navigation and search, but the subscription of and interaction in information channels. In many instances, information search and active access will be replaced by information awareness and automatic attraction of the relevant information.

COGNITIVE MEMORY MODELS

An important inspiration has been Broadbent's filtering theory on human memory and attention (see e.g [Sweller:2002]).

It is based on the several insights: our perceptual channels filter relevant new information based on the perceptual context, as well as ex-

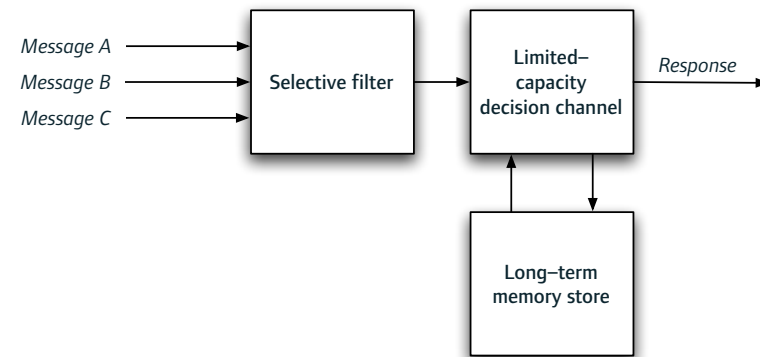


Figure 61: Broadbent's filter theory of selective attention

pectations and pre-conceptions. Processing of information, and actuating a long-term storage, i.e. learning, or appropriate responses is done in an interplay of a very limited—both with respect to capacity as well as duration—working memory and a long-term memory store, suffering from neither of these limitations.

While in detail, this model has been shown to be overly simplified, in principle, it gives a good model, of what a web feed application should be capable of: Extracting the novel and relevant, instead of flooding the user with unprioritized information, visually present relevant items explicitly and in detail (but as the working memory, screen estate is limited), and keep all that might be of future relevance in a usually hidden, but easily accessible memory store. At the same time, responses or action on the items should easily be possible as well, in order to allow the user to play the **selective filter role** for others.

PRESTO

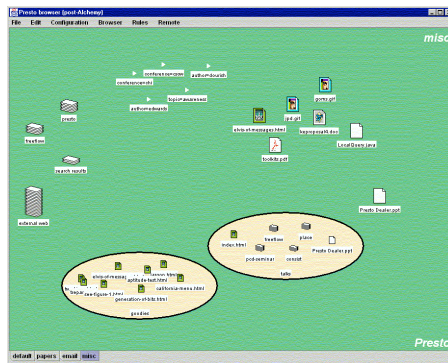


Figure 62: Presto project

The Placeless Documents project, developed at Xerox PARC in the 1990s, presented interesting alternatives to single-inheritance file structures.

In the Presto prototype, a document management system that made use of “meaningful, user-level document attributes, such as ‘Word file’, ‘published paper’, ‘shared with Jim’ or ‘Currently in progress’” [Dourish:1999]. The whole system was designed upon the notion of properties (instead of places, as the desktop metaphor). Collections of documents could be constructed logically via metadata search, or manually; but also mixtures of these approaches were possible, allowing manual inclusion or exclusion of items in result sets of logical queries. Actions were initiated via so-called **active properties**, essentially labels for items, that executed a piece of code, when applied. For example, applying the label “nightly backup” would execute a nightly backup of the associated files — but representing a property,

it could also serve as basis for a search (Which items are backed up nightly?).

On a side note, this simple, yet powerful concept is what we encounter again ten years later, when collaborative bookmarking systems offer special tags like “for:Pete”, which will automatically put the tagged item in Pete’s inbox.

LIFESTREAMS

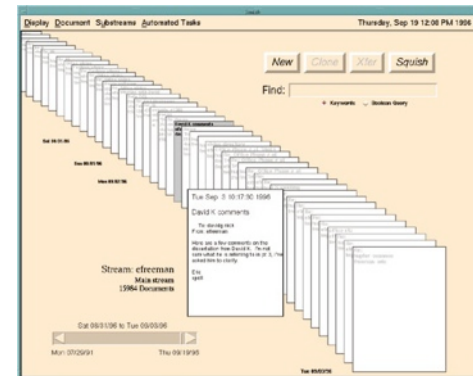


Figure 63: Lifestreams project

The Lifestreams project [Gelernter:1996] replaces folders with streams of documents in temporal order. Streams could be split, merged and redirected, but also shared among user groups, which is interesting analogy to today’s web feeds. Based on a small set of additional documents actions, such as new, clone, freeze, transfer, find and summary, basically all usual desktop interaction could be replaced with that stream-based system.

KONDUIT — A CONCEPTUAL MODEL FOR A WEB FEED HUB APPLICATION

The Konduit application is built around a simple model. It consists of only three basic entities:



Microcontent: A microcontent consists of structured text and media (encoded in HTML) and several intrinsic metadata values (such as the author, date posted, the source web feed, a link etc.) If microformats are used for HTML mark-up, additionally, the type of microcontent can be differentiated (such as review, event announcement, etc.).



Feed: A feed is a temporally ordered set of micro-contents. It can represent external web feeds as introduced above, but also dynamic metadata-based groupings by e.g. specific tags ("all microcontent tagged with 'visualization'"), authors ("all posts by 'Gus Hansen'") or system flags ("all unread items"). Feeds can also be associated with automatic actions ("save to disk", "post to blog").



Feed collections are sets of feeds, such as "all incoming feeds", "all tags", "all authors".

These entities can be related to each other by two types of relations:



Activation A simple, transitive, directed relation. If used to relate micro-contents, it expresses a hyperlink. If used between microcontent and feed, it adds the microcontent to the feed. If used between feed A and feed B, it expresses the general rule, that, whenever feed A is activated by another entity, then this applies to feed B as well. Accordingly, activation can not only be used to model **containment relations**, but also **flows**.



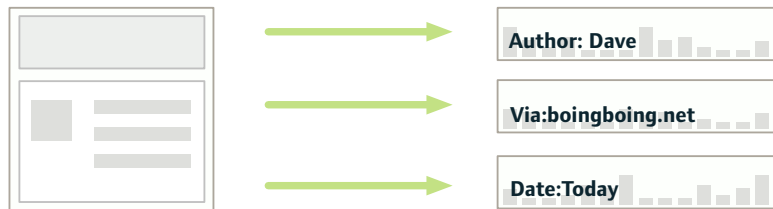
Transformation An activation, but removing the originating entity from an activation chain. It can be used to move (instead of copy) contents or feeds and build automatic command chains from metadata values.

Based on the ideas of "active properties" introduced in the Presto project, each feed can be used either internally for **creating dynamic collections**, trigger a **command** or be **shared** with others. Together with the activation model, this allows it to create action cascades based solely on the assignment of metadata values. In turn, a history feed of an action can be used as a dynamic content collection used for publishing or retrieval of information ("show me all items I have commented on").

This model is extremely simple and robust, yet expressive enough. In contrast to the Semantic Web language RDF, the links between entities and metadata are **untyped**. However, feeds themselves are typed, which corresponds to an alternative view of **feed collections** as flat facets — groups of properties represented by feeds. Syntactically, feed types are expressed by pre-fixing the tag name with a colon, such as “author:dave”, expressing the tag “dave” with type author.

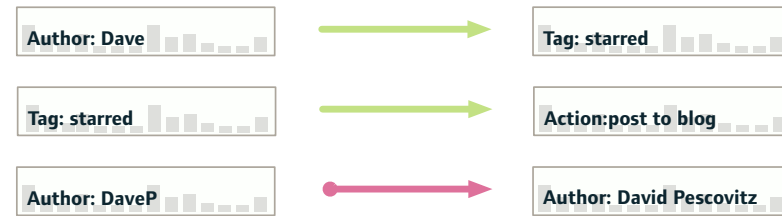
For illustration, some typical workflows and activation chains are explicated in that model:

A microcontent is automatically connected to its originating feed and its "author name" feed, the corresponding “date” feed etc.

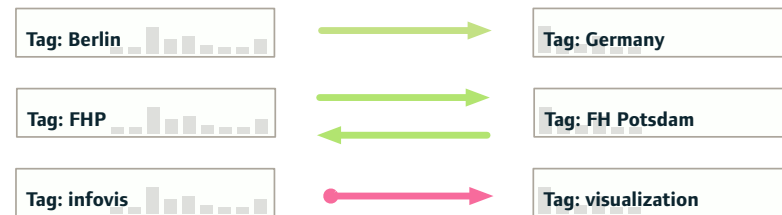


Incoming microcontent

Additional rules can be defined, such as if a microcontent activates "author name" feed “Dave”, the tag “starred” is automatically assigned, to mark the item as interesting or important. Starred posts, in turn, might automatically be re-blogged and thus shared with one’s own readers. The transformation arrow allows replacement of metadata values, such as the resolution of a nick name to a real name.



The same principles can be applied to model relations between topics or concepts, such as containment (top), synonymy (middle), or replacement (bottom):



New tag types can be created on the fly: either by introducing a new typed tag while tagging, or creating a new feed collection with the type name, and associating already used tags with it.

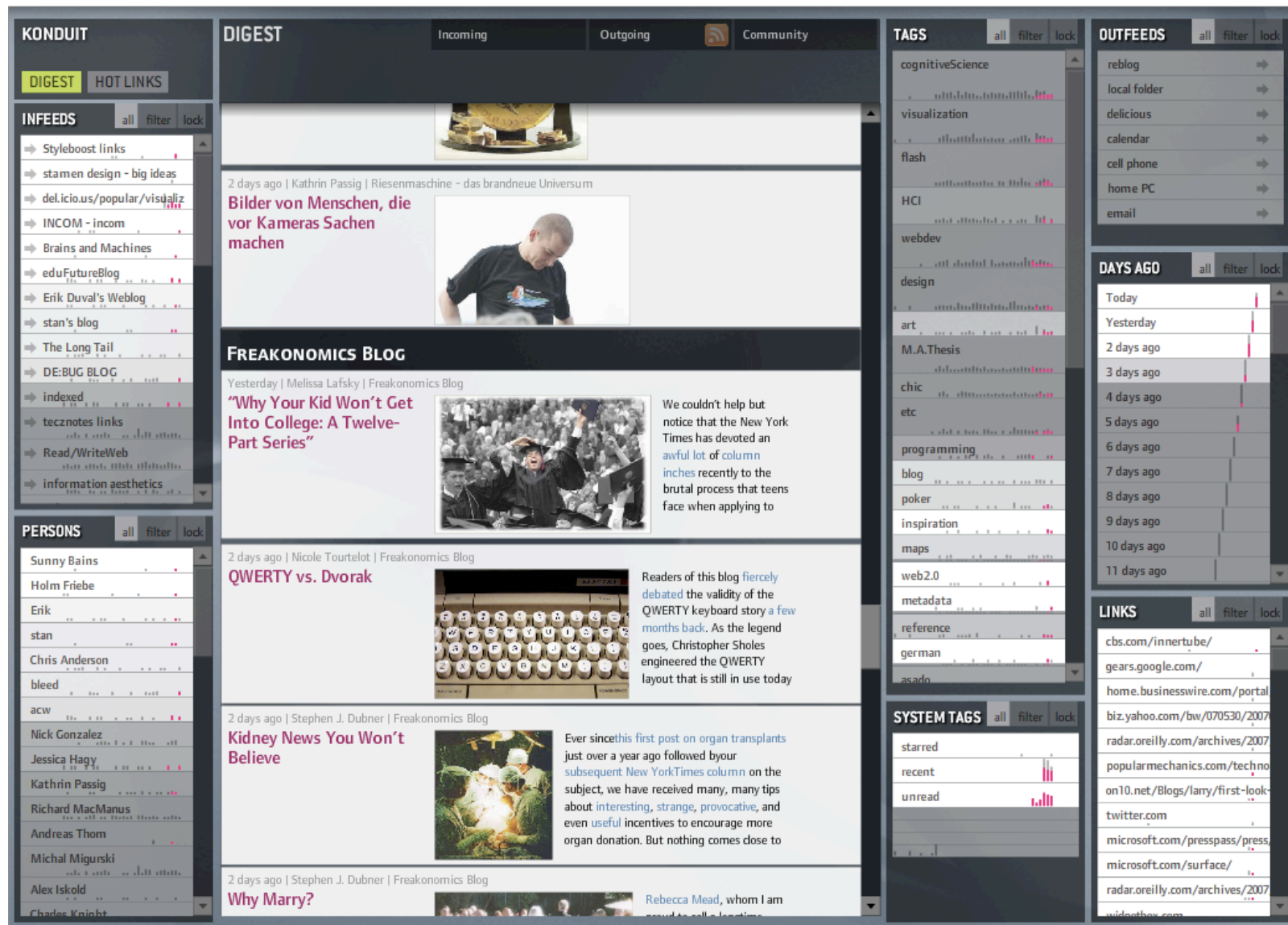


Figure 64: Konduit application in Digest mode, presenting unread items and all facets fully expanded

APPLICATION DESIGN

Konduit⁵² is designed as an always-on desktop application with different visibility states: in its minimized state, only a small panel displaying status of unread posts and activity is visible. In reduced view, subscribed feeds and their contents are visible and navigable. The full view offers additional contextual information and navigation by presenting all available facets for the selected contents. By using semi-transparent window and panel borders, it seamlessly integrates into the user's desktop environment.

Different view modes are available: "Digest" presents a limited selection of unread contents. "Hot links" presents resources frequently linked to—however, not from anywhere on the web, but solely from the subscribed information sources. Clicking any of the incoming feeds or other metadata values will display the associated contents in the main panel.

FACET BOXES

Each facet of the incoming and collected microcontents is displayed in facet boxes. The visualization and interaction principle follows the elastic lists principle introduced in the Nobel prize demo.

The order of displayed items is determined by their relative activity: Values with usually few postings, but recently rising activity are put on top. An additional bonus is given for unread posts. Sparkline histograms display the temporal development of the associated feed, additionally unread items are marked with red color.

⁵² <http://well-formed-data.net/experiments/konduit/>



Figure 65: Facet boxes (right: with draggable search filter applied)

Facet boxes are searchable with a draggable search filter, activated via hot-key.

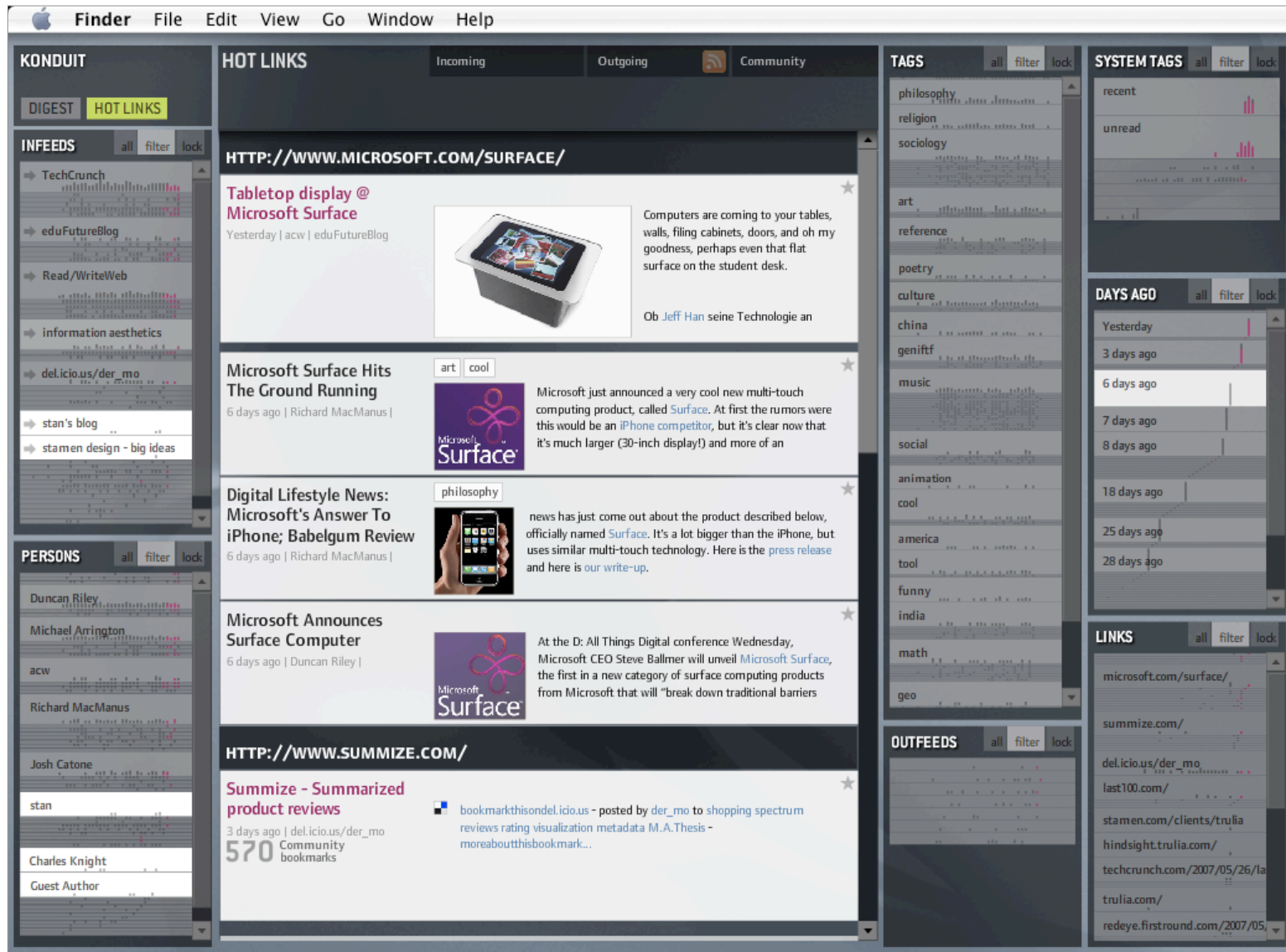


Figure 66: Konduit application in Hot links mode, presenting items linking to the same resources; facets display context information

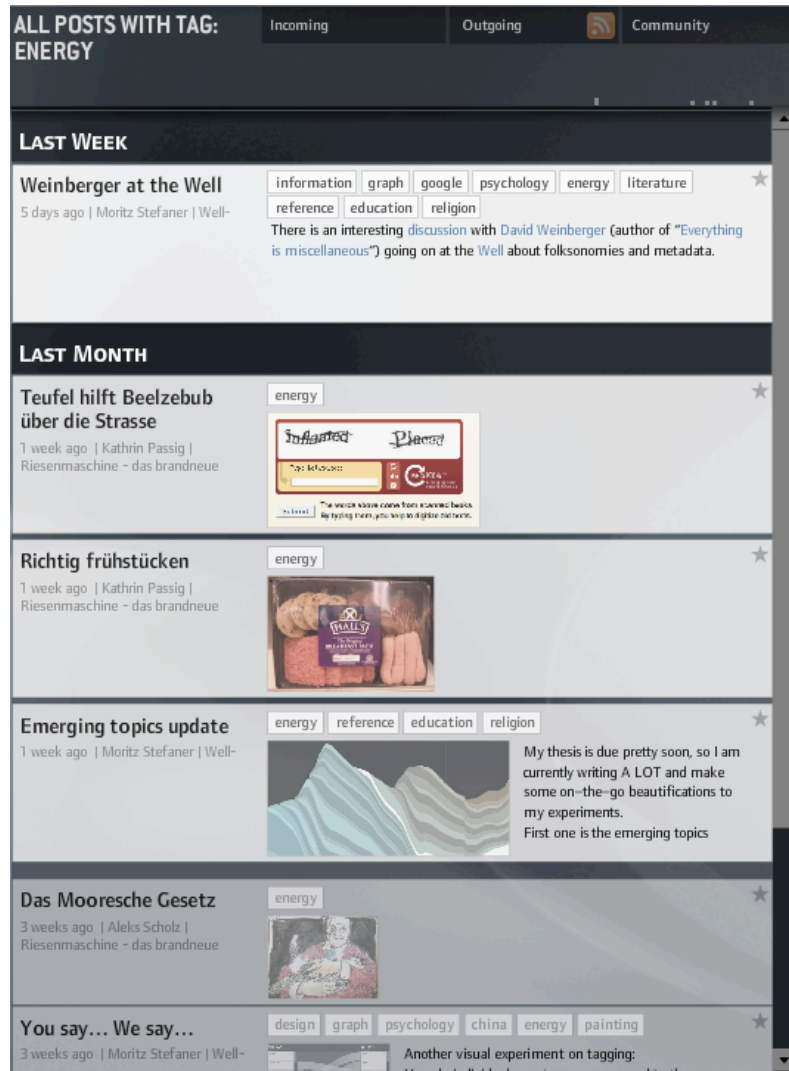


Figure 67: Feed display with temporal cues (gaps, size, opacity)

FEED DISPLAY

Feed items are displayed as an ordered list, with newest entries on top. Gaps between items indicate the difference in days between subsequent postings. Additionally, more space is assigned to newer, unread or starred (marked as interesting) posts. Older posts, which have not been interacted with, fade out and are finally removed after a fixed number of days. Accordingly, each feed will only contain all fairly recent items, and all items which haven been marked as interesting, or tagged. If a feed item has received public bookmarks, the number of bookmarks is displayed under the title, and the assigned tags are revealed on rollover.

The header of a feed displays the title, incoming and outgoing feeds (defined by tagging the feed) and, if available, community bookmarks and tags for the information source. This allows it not only to quickly inspect the popularity of a feed, but also to re-use community tags for own tagging.

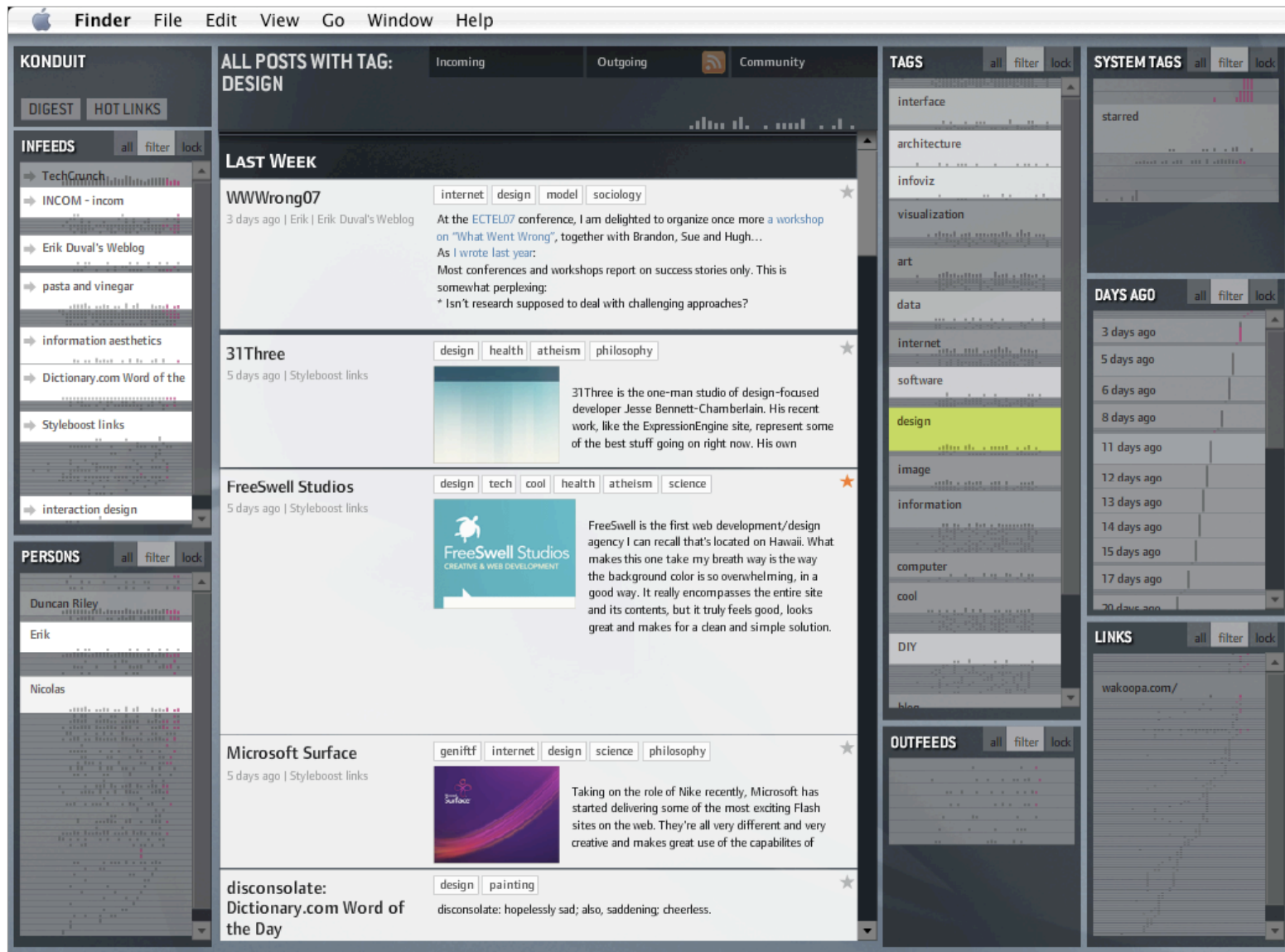


Figure 68: Related authors, feeds and days for tag "design"

CONTEXTUALIZED NAVIGATION

Since all facets contain a collection of feeds themselves, each of them can be used as a selection criterion. Clicking a person feed will display all posts by the respective person, clicking a day, all posts from that day etc. When this happens, the other facets switch into “filter mode”, displaying only values occurring in the selected feed.

Clicking, e.g. the tag “music” will display all contents tagged accordingly. As a consequence, the “infeeds” facet displays only subscribed feeds, the “persons” facet only authors, etc. whose items have been tagged with music in the past. Following the elastic lists principle, characteristic, i.e. unusually high weights for the values are emphasized visually by increased brightness. This navigation principle makes any metadata value an entry point into a multi-faceted context, which is not only made navigable, but also visually characterized and summarized.

Viewing the “Hot links” selection in filtered mode (see Figure 65), e.g., reveals that the “Stamen design blog” and “stan’s blog” are major contributor here and “yahoo” and “patterns” are apparently much discussed topics, since their tags have an unusually high weight in this context. Most of the posts are from 2 days ago, the oldest one is from almost a month ago, etc.

CONTENT AND FEED TAGGING

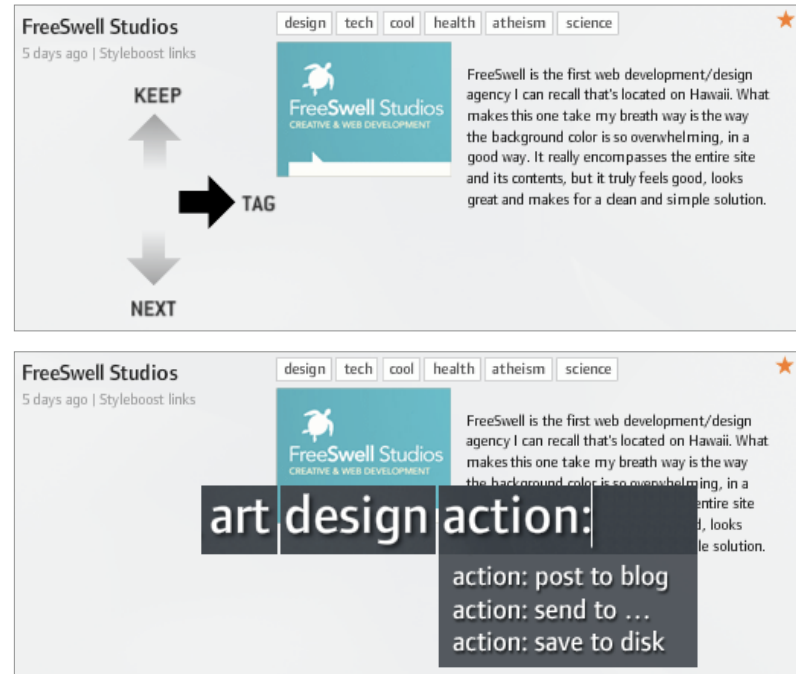


Figure 69: Mouse-gesture menu and tagging auto-complete

Contents and feeds are organized solely via tags—be it user-assigned or automatically defined (such as system tags like “recent”, “unread”, etc.)

Tags can be assigned in different ways: Existing own or community tags can be assigned by dragging the tag onto the target content or feed. For microcontent, a quickly accessible mouse-gesture context menu is available (see Figure 69).

Clicking and holding brings up the menu. Moving the mouse to the top and releasing the button will mark the item as interesting (indicated by a little star) and scroll the display to the next feed. Moving down will scroll to the next item without marking. This mechanism allows a quick scanning of news item, and at the same time making minimal statements about their personal relevance.

Moving to the right brings up a tagging menu, to assign tags for re-finding or re-distributing the item. Whole feeds can be tagged by adding tags into their tag panel, or manual typing. Following the transitive activation logic, this will automatically associate all contained items with the respective tag, both already present ones as well as ones added in the future. Actions, such as posting to a blog, or saving items to the hard disk, can be executed by tagging with the associated tag.

OUTPUT

Konduit's conceptual model allows interplay with other applications: Since all important properties of items are represented both as tags and feeds, each view on the application can be published as an RSS feed, open to subscription for others. Properties of items are attached as faceted tags, e.g. "konduit:system:unread", "via:boingboing.net", "for:der_mo". This allows an easy re-use in different applications, such as Yahoo Pipes, or the automatization of workflows, such as saving all unread items to a mobile device or posting starred items to a public bookmarking service.

DISCUSSION

The application has been developed in an iterative design and prototyping process and works as a prototype. In order to avoid difficult parsing of RSS formats, the web feed data is pulled from Safari's (built-in browser of Mac OS X) feed database. The tags are assigned at random to the posts, however, distribution and similarity measures are based on the delicious data sets used in the previous experiments. It was interesting to test with realistic data, and naturally, I encountered some problems:

The display of facets suffers from the unstructured mass of available values. Additionally, in many contexts, only a couple of the available facets display interesting information. A grouping or display selection of facets would be vital to making the application manageable in a better way. However, this is a current research issues for facet browsing in open information spaces [Tvarozek:2007]: how to select the right set of facet in each context, taking limited screen estate into account,

Secondly, it remained open, how to integrate a good model of dealing with different types of tags, such as user-defined, author-defined and community tags. It might have been a better approach of starting at this end, and building the application around these types of tags and their relations, before introducing additional facets based on microcontent metadata. However, an analysis of the feed data revealed, that only a small fraction of feed posts actually contained embedded tags.

Drill-down, i.e. selection of a conjunction of several metadata values, as presented in the Nobel prize winners demo, would be useful in many situations; however, it introduces the additional challenge of

how to make an intuitive distinction between “hopping” and “drill-down” mode interaction-wise.

The generic approach of unifying tags and feeds is promising from a conceptual side, but from an interface design perspective, lead to an overly unprioritized, generic interface. As a whole, the application takes much space, and puts emphasize on cross-facet browsing, instead of simple essential tasks like reading and tagging. The construction of feed cascades as well as the facet box logic would require a separate management view.

Nevertheless, some of the features presented can enhance traditional approaches in a variety of contexts:

- The general understanding that every view of the application defines a dynamic category of items along with their metadata context, which can also be treated as a whole or shared with others, is an important principle for the construction of information flows both between persons and applications.
 - The scaling and emphasizing principles with animated filtering transitions, as introduced in the elastic lists principle, work well also in the given context. However, space-efficiency is an issue, which might be resolved by dynamically rescaling facet boxes depending on the amount of highlighted items, or collapsing filtered-out items to zero height.
 - The unobtrusive introduction of sparklines, list gaps of variable size and fading-out of older contents adds the important temporal dimension as an omnipresent, almost ambient information visualization. This enables a visual understanding of a feed’s or content’s temporal characteristics at a glance.
- The general approach of displaying “the tip of the iceberg”, i.e. the newest of most often used items, in default views, but presenting a weighted set of associated metadata in filtered views, results in an information environment, where everything, that is characteristic for the given context, is automatically around and at hand. This sort of contextualized navigation will be a tremendously important principle in the future, but creates its own interface design and usability challenges with respect to value selection, presentation, and especially maintaining a stable, predictable and simple interface.

4.4. OUTLOOK

Tags and feeds are extremely interesting phenomena, which shed a new light not only on user-centered information architecture, but also on how simple, transparent, robust and communicative mechanisms can enhance our digital interaction with information. The quest for interface solutions satisfying my maxims is still open, yet I hope my analysis, visualization experiments and interface designs can contribute to further exploration of their nature, emerging usage practices and potential for future interfaces.

Enriching tag navigation with the presented principles for facet browsing is a promising approach. Another obvious next step is to extend the described weighted, contextualized presentation mechanisms to further forms of metadata visualizations; in the context of the MACE project⁵³, we are currently extending and testing the principle in a variety of visualization forms [Stefaner et al.:2007].

With the growth of tag collections, a second important line of research will be the refinement and harmonization of tagging structures. There is a large potential and need for interfaces in this area. Moreover, finding good solutions for exploiting the relations between author tags, community tags and personal tags is an interesting, and not yet tackled topic.

If tags can replace established mechanisms like file-folder structures on PC desktops, will depend on the user interfaces: Applications like TagBot⁵⁴ set off to bring tagging to the file system. However the cur-

⁵³ Metadata for Architectural Contents in Europe, co-funded by the European Commission in the eContentPlus programme ECP 2005 EDU 038098.

⁵⁴ <http://www.bigrobotsoftware.com/>



Figure 69: TagBot integrates a tagging interface into the MAC OS X Finder

rent version is spatially limited to a small set of tags and lacks further navigation capabilities. Additionally, the drag-and-drop assignment of files to tags makes the assignment of multiple tags an extra effort. Tags can be used to gather items with the same tags in a dynamic collection, but remain invisible when browsing for files. Consequently, TagBot does not offer a full-fledged tagging interface, but rather the supplemental marking of files with an extensible set of author-defined labels. Nevertheless, in a worse-is-better sense, solutions like

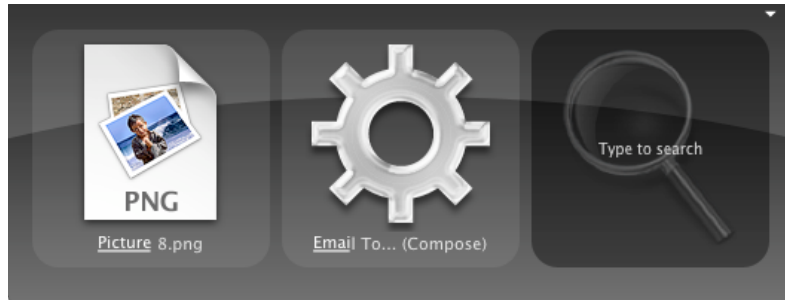


Figure 68: Quicksilver allows complex commands and file access based on typing abbreviations

these can constitute a first step towards getting users accustomed to a multi-dimensional file organization via tags, potentially leading to new information and metadata understanding in the future.

From another perspective, tagging brought the power of plain, simple **words as tools** back into everyday applications. Together with keyword search, having become the most powerful retrieval paradigm, we might experience a revival of command line interfaces [Norman:2007]. Traditional command line interfaces like UNIX shells suffer from cryptic abbreviations (“tar -xfvz”) and the vocabulary problem in HCI in general [Furnas:1987]: it is almost impossible to guess all words that users might associate with commands beforehand. However, a new breed of applications like Enso and Quicksilver set out to overcome these problems by autocompletion, good disambiguation mechanisms and especially adaptivity to user’s preferences and habits. Bringing these mechanisms together with the user-centered association of documents and resources with topics, tasks and properties—of course, tagging would be the premier candidate here—could result in extremely expressive, yet efficient interfaces. Typing “mail pictures from barcelona trip last week to sina” is more direct

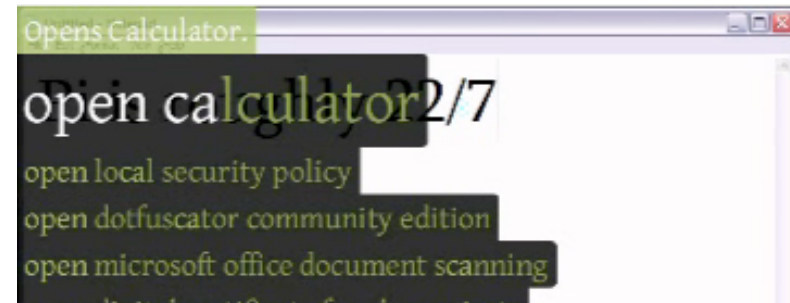


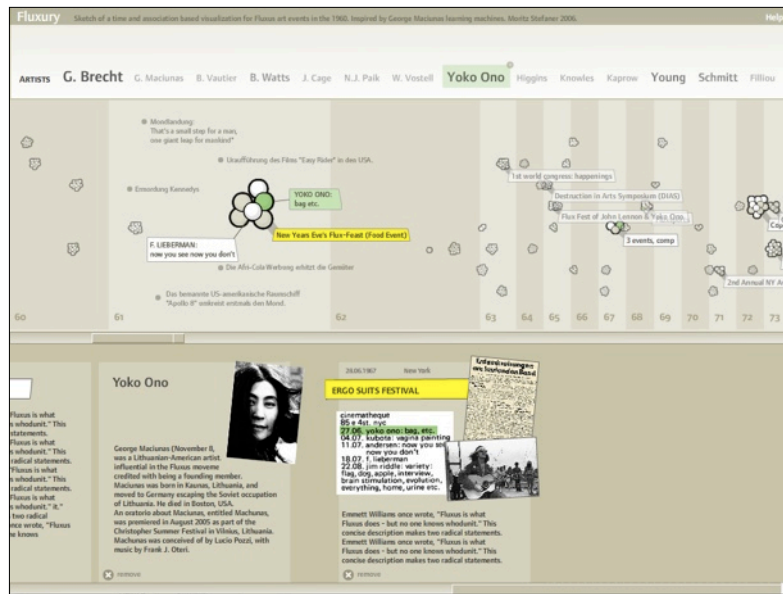
Figure 68: Enso interface based on automatic command completion

and efficient than opening a mail program, navigating to the pictures in the folder structure, adding the pictures, typing the address and clicking the email button. Navigation in such cases is just a means to an end, and if it can be avoided totally for goal-directed tasks—the better.

Yet, **fluid, sensual, visual and ultimately physical interfaces** interfaces have to play the complementary role—for shaping our digital environment, exploring what is there, surrounding us with an ambient awareness of the multitude of activities we are participating in. Compensating the lack of sensual experience and transparency of command lines and keyword search, visualization will be the key to giving shape to the arising novel spaces for action. However, the big age of metaphors in HCI is over; we need novel forms of visual and interaction languages, as interaction in the digital world creates its own rules, patterns and formats.

5. APPENDIX

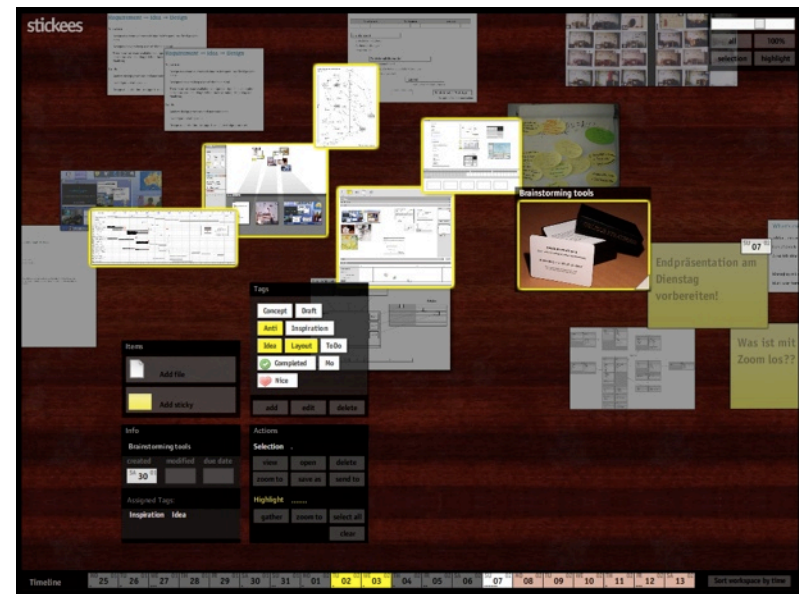
ADDITIONAL MATERIAL



The fluxury application⁵⁵ was created in the course “Fama Fluxus Mythos Beuys” lead by Prof. Danijela Djokic. In a very rudimentary form, it already contained the basic interaction principle of weighted co-activation, in this case for the interaction between art events on a timeline and the associated artists.

⁵⁵ http://incom.org/code/projekte/projekt_anzeigen.php?4,154,0,0,0,158

⁵⁶ http://incom.org/code/projekte/projekt_anzeigen.php?4,135,17,0,0,156



Stickees⁵⁶ was created in the “Masterkurs Entwurf”, lead by Prof. Dr. Frank Heidman and Prof. Danijela Djokic, and explored the option of spatial organization of digital information on a virtual pinboard, which could additionally be re-organized via tags or temporal order.

Well-formed data

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Weinberger at the Well

May 31st, 2007


There is an interesting [discussion](#) with [David Weinberger](#) (author of "Everything is miscellaneous") going on at the [Well](#) about folksonomies and metadata.

folksonomies , metadata , tagging , weinberger

0 Comments

Tag maps update again

May 28th, 2007



> [Tag maps v5](#)

PS: 12 days to go, wish me luck!

ABOUT

My name is Moritz Stefaner and I use this blog to document research, experiments and outcomes of my M.A. Thesis in Interface Design at the University of Applied Sciences in Potsdam.

SEARCH

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Florian Wöhrl
Jerry Blossom
Jonathon Cancro
Marcus Specht

The progress of this thesis was continuously documented on my blog well-formed-data⁵⁷ and want to thank all readers and especially the commenters for attention and good advice. Special thanks goes to the del.icio.us users acw, bernard, aronr, avatar_1, borism, cosmo, jesus-gollonet, mikelove, mogli, norrix and philbogle for sharing their bookmark collection for my experiments.

⁵⁷ <http://well-formed-data.net>

⁵⁸ <http://www.dbworldx.di.unito.it/find07/index.html>

Elastic lists for facet browsers

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Abstract

In the context of current web and personal information management developments, we argue that facet browsing is an increasingly important interface paradigm. However, current implementations neglect two important aspects of metadata distributions: the relative proportions of metadata occurrences and the unusualness of this proportion compared to a global profile. Based on focus & context visualization techniques, we enhance facet browser user interfaces with "elastic lists" to make the resulting weighted metadata profiles visually accessible and navigable. The principle is currently developed and tested in several domains.

1 Trends in information management

1.1 Microcontent

Information presentation, storage and communication has been changed considerably by digital technologies. One

If represented in XHTML, microcontent can be structured by using microformats[1]. They allow an easy, machine-readable mark-up of microcontent items such as business cards, event announcements or reviews in a standardized way. The value of a metadata field or a microformat component, however, is a primitive type such as string or number and hence establish only flat additional metadata information.

1.2 Web feeds

Additionally, web feeds introduced a new information delivery paradigm to the Web: Instead of actively accessing web pages of interest, web feeds allow users to subscribe to frequently updated contents. To consume web feeds, usually, a dedicated feed reader application is needed, but recent browser versions also support direct display and subscription of feeds. Originally used for news teasers pointing to the original stories, web feeds are increasingly used to

- deliver structured microcontent; e.g. weather information, blog posts, or media files (so called podcasts for audio files or vodcasts for video files).

The paper "Elastic lists for facet browsers" describes the design of the elastic lists principle [Stefaner:2007]. It was accepted for presentation at the FIND07 workshop (International Workshop on Dynamic Taxonomies and Faceted Search)⁵⁸ and will be published in the workshop proceedings by IEEE CS.

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EIDESSTATTLICHE ERKLÄRUNG

Hiermit erkläre ich, dass ich die vorliegende Arbeit selbstständig verfasst habe. Ich habe keine anderen, als die angegebenen Quellen oder Hilfsmittel benutzt, sowie Zitate als solche kenntlich gemacht.

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