

Sketchnote Components, Design Space Dimensions, and Strategies for Effective Visual Note Taking

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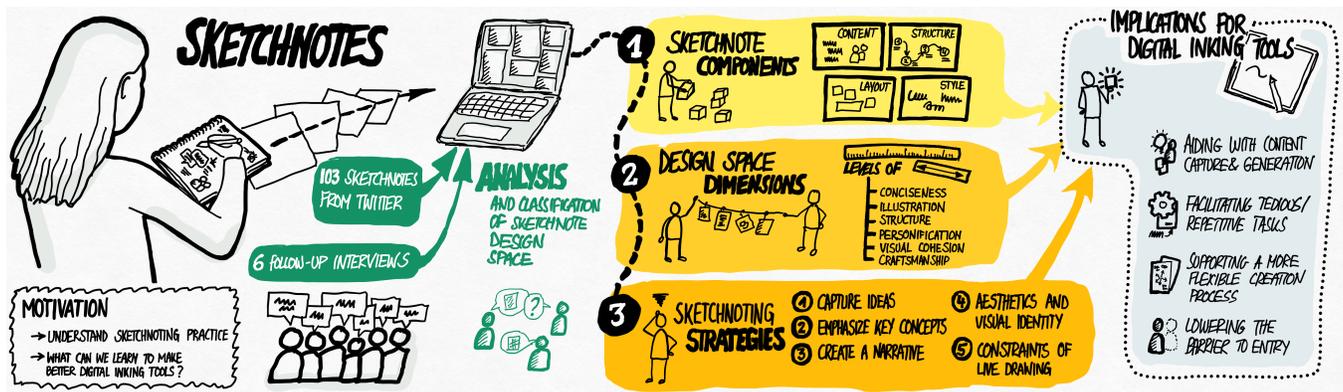


Figure 1: Visual abstract of our sketchnote research – done as a sketchnote. Summarizing analysis, core sketchnote components, design space dimensions, sketchnoting strategies, and implications for the design of digital inking tools.

ABSTRACT

Sketchnoting is a form of visual note taking where people listen to, synthesize, and visualize ideas from a talk or other event using a combination of pictures, diagrams, and text. Little is known about the design space of this kind of visual note taking. With an eye towards informing the implementation of digital equivalents of sketchnoting, inking, and note taking, we introduce a classification of sketchnote styles and techniques, with a qualitative analysis of 103 sketchnotes, and situated in context with six semi-structured follow up interviews. Our findings distill core sketchnote components (content, layout, structuring elements, and visual styling) and dimensions of the sketchnote design space, classifying levels

of conciseness, illustration, structure, personification, cohesion, and craftsmanship. We unpack strategies to address particular note taking challenges, for example dealing with constraints of live drawings, and discuss relevance for future digital inking tools, such as recomposition, styling, and design suggestions.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI).

KEYWORDS

sketchnotes; sketching; visual note taking; taxonomy; classification; graphical styles; digital sketching; digital ink

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1 INTRODUCTION

Hand-drawn sketches — in different forms and varying fidelity — can help synthesizing information and externalizing our thoughts, from scraps of paper used in brainstorming [12], scribbles on whiteboards [54], or visual notes for effective learning [7]. One particular form of sketch-based visual note taking is *sketchnoting* — notes with “visual elements added to amplify ideas” [45], where hand-written text is interwoven with a wide variety of sketched drawings so they complement each other and provide emphasis and structure (an example is shown in Figure 1). Often, sketchnotes are visual synthesis sketches from live events (such as talks, lectures, or seminars), done in *real-time* during the event. As a result, sketchnotes are more than an external copy of spoken material but a synthesis derived through an active listening and creation process, all laid out on a single page — with effective use of space for “clustering and thoughtful placement” [28]. Different to many other forms of visual note taking, which tend to be more personal, sharing sketchnotes (through social media or blogs) is very common — sketchnotes have “a life after an event” [52]. Sketchnotes are also applied as a technique in the research community, for example allowing “HCI researchers to better communicate and express their ideas” [52], as effective notes with “enhanced information recall” [19], or as a form of ideation and visual thinking [36].

With the goal of creating such sketched artefacts — sketchnotes but also other note taking — with expressive digital tools, past research investigated the design of novel software techniques for digital inking [23, 53] and new sketching hardware, for example enhanced digital pens [15, 24, 27]. Studies of sketching and note taking practices [20, 43, 54] play a critical role in informing the design of these tools. Insights from these studies can lead to concrete suggestions on how analog techniques translate to and can be extended for digital inking, such as results from Riche et al.’s study indicating benefits of supporting both drafting and crafting, or unifying heterogeneity across inking tools [43].

For sketchnoting in particular, a number of blogs [5, 52] and books [9, 45] promote the practice and teach drawing techniques, most of these rooted in a very active emerging community of sketchnoters sharing both artefacts and techniques online. And a recent study investigated the nuanced differences between analog and digital inking with sketchnotes [20]. However, the problem is we are missing a systematic analysis of sketchnote practice and an overview of the wider spectrum of the choices made while creating sketchnotes, which together could lead to further targeted implications of how to enrich digital tools to support creative expression for sketchnoting in particular, and digital sketching more generally.

Towards this goal of understanding sketchnote practice — as one specific form of visual note taking — we contribute an in-depth analysis and classification of (analog) sketchnote styles and techniques. We performed a qualitative analysis of 103 sketchnotes posted online, and situated this analysis in context of six semi-structured follow up interviews with experienced sketchnoters. In our findings, we first distill core sketchnote components: content, layout, structuring elements, and visual styling (which we illustrate in examples and put in context of existing sketchnote literature [9, 25, 45, 46]). We synthesized six further continuous dimensions of the sketchnote design space, where we map out the spectrum of

design decisions across levels of conciseness, illustration, structure, personification, visual cohesion, and craftsmanship.

Based on both these basic sketchnote components (Section 4) and the continuous dimensions for design decisions (Section 5), we identified five themes of *design strategies* (i.e., specific goals) to address particular note taking challenges. These explain strategies to: (1) capture ideas, (2) emphasize key concepts, (3) create a narrative, (4) aesthetics and visual identity, and (5) dealing with constraints of live drawing. Our findings from the follow-up sketchnoter interviews are woven throughout Sections 4–6, providing context and grounding for each the design strategies — for instance, explanations of motivation for use of particular techniques, or discussions of trade-offs. Finally, directly informed by our findings and the design space, we operationalize our insights about the sketchnote practices in a list of suggestions for the design of future digital inking tools. This includes, for example, suggestions about how digital tools might better support styling, support flexible note taking layouts and structure, or design for re-using content.

In summary, our contributions are:

- The first in-depth analysis of sketchnoting artefacts, with a synthesis of core components of content, layout, structuring elements & flow, and visual style; and the continuous dimensions of the sketchnoting design space, where we map the levels of conciseness, illustration, structure, personification, visual cohesion, and craftsmanship.
- A discussion of five themes of sketchnoting strategies to achieve particular visual note taking goals, synthesizing strategies and best practices for this kind of visual note taking.
- A list design implications for digital inking tools in four categories of (1) aiding with content capture and generation, (2) facilitating tedious/repetitive tasks, (3) supporting a more flexible creation process, and (4) lowering the barrier to entry.

Together, these contributions build knowledge on sketchnoting and inform the next generation of interactive authoring and consuming tools.

2 BACKGROUND AND RELATED WORK

In their seminal book *Myth of the Paperless Office* [49], Sellen and Harper highlighted how our digital tools often do not match many of the inherent affordances of paper (e.g., the richness of folding or manipulating paper), which still holds true almost two decades later, despite many advancements in the ways we can use digital documents, digital note taking, and inking. An important ongoing research goal remains to identify the potential of digital tools to best support current practices — beyond analog tool use — and fully embracing digital capabilities [43, 49]. In this section, we first delve into sketching and digital inking technologies, then discuss how studies can inform the design of these kinds of innovations for digital sketching, and last articulate the need for informing the design of tools specifically designed for sketchnoting with an overview of the unique characteristics of this kind of visual note taking.

2.1 Sketching and Digital Inking in HCI

Sketching and hand-drawn visual representations are important as a general method withing the HCI community, with Buxton,

Greenberg, and colleagues outlining the many diverse sketching strategies (often borrowed from disciplines such as product design or engineering) that can be applied throughout the whole process of interaction design [13, 22]. Similarly, Baskinger positioned sketching as an important method in interaction design [4], and Lewis et al. emphasized the value of sketches to support interface design, participatory design, or reflective practice [31]. Hand-drawn sketching can also “*be an integral part of focused research projects*” [50, 51], such as for studying situated visualizations [12], use of personal finance tools [30], and many other contexts.

Besides the consideration of sketching as a method for design and research, another research focus is on the design of future digital inking technologies — software and hardware. This includes, amongst many others, supporting free-form ink to support active reading on tablets [48], creative use of inking data visualizations [56], linking hand-written notes to audio recordings [55], or organizing and rearranging hand-written notes (through implicit recognition of regions) on digital whiteboards [40]. Novel designs of the sketching hardware have the potential of providing enhancing sketching and note taking capabilities, such as when using advanced forms of context sensing combining pen+touch [23], adding digital capabilities to analog notebooks [11], combining pen and paper with digital sketching tools for UML diagrams [17], and many others [21, 34, 41]. These techniques illustrate examples for augmenting the note taking process beyond the what is possible with pen and paper, by leveraging digital capabilities and enriching the note taking and hand-crafted inking experience.

2.2 Studying Analog and Digital Sketching and Note Taking to Inform Design

There are many different ways to inform the design of digital note taking and sketching tools. One way is to directly study people’s use of current digital tools, for example the use of inking on tablets [1, 43]. Studies like this help identifying factors impacting the inking experience, such as stylus accuracy, latency, stroke rendering and aesthetics, and emphasize importance of better recognition of intended and unintended touch [1]. A variation of this is the study of novel sketching prototypes, such as digital pens. For instance, there are studies comparing use of pressure, button pressing and dwelling for mode switching for digital pens [33], or different forms of audible-tactile feedback for paper-like sketching on digital screens [15].

An alternative, complementary approach is to study people’s use of analog, pen&paper, identifying techniques in the analog medium to translate to the digital, as well as friction points to overcome, as opportunities for design. For instance, Ayobi et al. [2] studied bullet journaling sketches, identifying practices of self-tracking, and derived design implications for flexible and mindful self-tracking software supporting those. Bernstein et al. [6] studied a different kind of note taking, in this case small information scraps of sketches, notes, and reminders, with implications for the design of personal information management tools. Mahyar et al. [35] characterized analog note taking strategies used during collaborative visual analytics tasks, leading to a number of suggestions for digital tools supporting in particular these forms of note taking (e.g., hybrid notes, easy transitions from private to shared notes, and facilitating

management of notes). Other strategies include contextual interviews, artefact analysis of digital note taking devices, and online surveys [11], diary studies of sketches in everyday use [43], or observational studies [20].

2.3 Sketchnoting Practice as Applied Visual Note Taking

Visual note taking, as a distinct method of “*observation, study, planning, prescription, and record-keeping of events*” [25], first emerged during the Renaissance — most known through Da Vinci’s notebooks, seen as a “*key to understanding how he thought*” [44] (though less widely known, Mariano di Taccola, born 70 years earlier, applied visual thinking in forms of sketches and visual notes [42] — a pivotal change in art and science). Through the following centuries, visual note taking became more widely used (summarized in [25]). Representing thought in such a visual form can be seen as an effective method to externalize our thinking, by using “*clustering and thoughtful placement*” in an “*effective use of space*” [28].

Sketchnoting is related to graphic recording, a particular “*visualization process that captures themes and ideas emerging from group discussions*” [18], where techniques for capturing overlap to sketchnoting, but graphic recording being more specific to mediate group conversations. A very active community emerged around sketchnoting (e.g., [47]), also reflected in a number of resources such as blogs [5, 52] and books [45, 46] promoting this practice. Many of these resources introduce a fundamental visual vocabulary for sketchnoting, combining “*handwriting, drawings, hand-drawn typography, shapes, and visual elements like arrows, boxes, and lines*” [45], and presenting practical instructions for developing a visual vocabulary with step-by-step tutoring instructions, examples, and activities [9, 10, 16, 39, 45]. It is this basis of practitioners’ resources we are in particular interested to complement and extend upon. To design better digital tools supporting rich developed practices such as in sketchnoting, we are missing a higher-level analysis of sketchnote practices and design space dimensions, similar to analysis done in other contexts such as visual narratives [38], graphical science representations [26], or data comics [3].

With our motivation of better understanding sketching practices of sketchnoting in particular, and to identify what to adapt or improve upon for the digital (akin to [1, 2, 11, 43]), our study provides a structured analysis of a large corpus of created sketchnotes, going beyond the more targeted and constrained analog vs. digital sketchnoting study [20]. Different to Ayobi et al.’s study [2], where the comments of online posts were used to determine context, we decided to complement our analysis of the sketchnote corpus with interviewing experienced sketchnoters, giving us an opportunity to follow up on issues identified in the first part of the analysis and help us understand reasons and motivation.

3 STUDY METHODOLOGY

We used a mixed-method approach to gain an understanding of sketchnoters’ strategies, which combined a thematic analysis of sketchnotes posted on Twitter with semi-structured interviews of six sketchnoters.

3.1 Phase 1: Corpus

To analyze a wide spectrum of diverse sketchnotes, we created a corpus of images that were posted under the hashtags #sketchnotes and #sketchnote on the Twitter social media platform.¹ The category *photos* was selected to further filter posts to exclusively contain photos of sketchnotes, and filter out posts that contained, for example, text or videos about sketchnotes. We excluded photos that did not show an actual sketchnote (such as showing a person while sketching), were done for commercial purpose, or were in very low quality making them illegible (but no other exclusions of sketchnotes were made). This query for the dataset was performed before beginning with the analysis.

To ensure diversity of sketchnotes in our corpus, one author conducted low-level open coding on the fly, including sketchnotes from the dataset until saturation of codes was reached (for a total of 103 sketchnotes). These codes were iteratively refined, with later axial coding and thematic analysis via a multiples discussions among the co-authors. This phase led to a refined set of codes (including merging, renaming, adding, grouping), overall themes, and dimensions of the design space. In a second round of rigorous coding, four authors independently coded 20% of the corpus, then two coders continued independently until inter-coder agreement was reached (after an additional 10% of the corpus). One author coded the remaining set of the corpus. As with any qualitative analysis, there might be instances of codes not captured in our corpus.

3.2 Phase 2: Interviews

To complement our higher-level analysis of sketchnotes, we decided to conduct a number of follow-up interviews with experienced sketchnoters. We conducted six semi-structured interviews with sketchnoters (5 female, 1 male; sketchnoting experience 4-13 years) from our corpus (1 to 3 of the sketchnotes in our corpus were created by the participants) with the goal of finding out more about their *design rationales* and the *live decision-making* processes behind their sketchnoting. The questions for the semi-structured interviews were informed by the analysis of the sketchnote corpus, with the goal of following up on decisions and strategies – for example, the layouts they use, how they created structure and visual hierarchy, selection of content, or the processes for deciding which visuals to sketch.

Due to individual preferences, the interview methods differed between participants (one via video call, four through a thread of private Twitter direct messages, and one interview conducted as an email conversation thread), but our method of conducting the semi-structured interviews remained consistent across participants, with a core set of common questions with individualized follow-up questions. Audio of interview was transcribed, and all transcripts of conversations were analyzed and in correlation to the design space dimensions and components from Phase 1. This study was approved by our institution's ethics board.

¹We compared Twitter results to images found on Instagram and Flickr, and found the results across these platforms similar to the set of sketchnotes gathered.

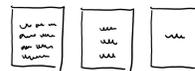
4 SKETCHNOTE COMPONENTS

This section describes the *core components* found in a sketchnotes and which we group into the following categories: *content*, *layout*, *structuring elements* and *visual styling*. This directly relates to the practical instructions and tutorials for crafting sketches and sketchnotes [9, 10, 14, 22, 32, 39, 45, 46, 52], where we provide a detailed analysis of the spectrum of components and nuanced use in *sketchnoting practice*. These components can be seen as syntactical building blocks of sketchnotes, alike to a visual repertoire and are summarized in Figure 2. For each code, we provide a general idea of their prominence in our corpus by noting the number of sketchnotes featuring it, and we provide examples of sketchnotes in Figure 2 (and refer to particular sketchnotes through their ID number, see section 'List of Sketchnotes' at the end of this paper for credits and links). Note that a visualisation of our classification is available online at <https://sketchnoting.github.io/sketchnoting>.

4.1 Content

This category describes how information (textual and visual content) is presented in a sketchnote.

Textual content. At the very basis of sketchnoting is the phenomenon where sketchnoters “*write things down in chunks instead of lines*” (P4), that is when notes are written with “*2 to 4 words per line*” (P4). These elements are also indicative of the summarization and reformulation of the content heard rather than a verbatim transcription.



Textual content is found on a spectrum from more verbose forms, i.e. fully-formed **sentences** (17), to more summarized forms such as **catchphrases** (92), and eventually very short **terms** (56) (Figure 2a). Fully formed *sentences* are capturing questions, important information, or personal annotations (S70, S76); *catchphrases* indicate very concise yet important points (“Clarity builds trust”S29); and short *terms* are used as headlines to refer to a group of content, to important concepts, or as parts of a diagram (S11, S45).



In contrast to the textual content above, likely resulting from a level of interpretation, reformulation and synthesis by the sketchnoter, **quotes** (26) are indicative of a direct transcription of what the speaker said during their presentation (bottom of Figure 2a). Quotes are often written in quotation marks and/or inside speech bubbles (23).

Visual content. What makes sketchnotes different from traditional written notes, is the presence of visual imagery and graphical content to supplement the text. Because “*we’re much faster at getting the gist out of a visual thing than by reading*” (P4), symbols, visual representations of ideas, and diagrams are omnipresent in sketchnotes to “*help make you notice important concepts*” (P3) (overview in Figure 2.1).



Symbols & Pictograms (97) such as objects, signs, or shapes are extensively found as annotations or visual expression of a key concept, in part due to their literal



figures/Figure Large Overview.pdf

Figure 2: Sketchnote components: (a) content, (b) layout, (c) structuring elements and flow, and (d) visual style. (© SKETCHNOTES USED WITH PERMISSION, SEE 'LIST OF SKETCHNOTES' FOR CREDITS AND LINKS)

embodiment of a concept: “you don’t have to think about synthesizing an image. So, it’s quick and easy to do in a live situation” (P4) (Figure 2b). Such visual annotations indicate elements of importance, actions associated with content: “If there is something like ‘attention’, ‘avoid’, ‘don’t forget’ then I use something like the exclamation mark in the triangle to draw attention to it.” (P1), whereas

symbolic representations of ideas “help make you notice important concepts” (P3).

Symbols are culturally learned visual representations with a specific meaning. In sketchnotes, symbols usually refer to abstract concepts such as attention (exclamation marks), flashes, stars and hearts or concepts otherwise hard to depict but which have specific cultural meanings (Figure 2b). Pictograms are similar to symbols



Figure 3: Graphical representations of people, inspired by McCloud’s picture plane [37]. (© SKETCHNOTES USED WITH PERMISSION, SEE ‘LIST OF SKETCHNOTES’ FOR CREDITS AND LINKS)

but with a more literal and universal meaning. Closely related, best practices include the development of *sketching vocabularies* [22], effectiveness of simple *visual metaphors* [16, 39], and *reserving spaces* for drawings to add at a later time [46].



Custom **illustrations** (56) are designed to visually express richer or more nuanced content that traditional pictograms or symbols may not be able to convey. While rather common, these unique, tailored illustrations require a higher level of interpretation and synthesis, as well as a higher level of creativity from the sketchnoter but are able to illustrate more concrete ideas (Figure 2b).



People and Characters—Given their prominence in our corpus, we added a specific code for one or multiple people (77). Figure 3 provides examples of people, ranging on two spectra. Inspired by McCloud’s picture plane [37], depictions of people and characters range from simplified (almost pictograms) to realistic illustrations of real persons (e.g., the speaker of talk) (34). Another common dimension we could find captures the amount of color we found in these designs. Characters can be found in a range of ‘roles’, e.g., actors narrating, speakers, people thinking about the content presented via speech or thought bubbles. Drawing people and emotions are core parts of sketchnoting literature, suggesting best practices of *emphasizing dominant features* [46], leveraging expressiveness of stick figures or silhouettes [16], sketching *cartoon-style faces* [39], or *effective facial expressions* [9].



Diagrams—Statistical graphics, data visualizations, and visual representations synthesizing multiple ideas in a **diagram** (bottom of Figure 2b) are also less frequent (47) than symbols & pictograms, likely due to the level of synthesis and processing that they demand. Diagrams are any schematic representations of more complex issues [16] such as processes (S94 and S17), design spaces, and part-of-the-whole ideas (pie diagram S45, or hierarchies S23).

4.2 Layout

It is a challenging task laying out information as it is taken. Several sketchnoters described their own evolution of the art over time: “The first sketchnotes were pretty organic. A complete mess, that is” (P5).

We describe in this section (Figure 2.2) the most common layouts, which relate to layouts suggested in literature [16, 39, 45, 46].



As it is rarely the case that speakers give an overview of the structure of their talk before it begins, it is difficult for sketchnoters to plan out how their sketchnotes will turn out. As a result, they just “go with the flow” (P2, P6) and let “the talk spool onto the page” (P3). This results in what we call a **freeform** layout (Figure 2c), which is the most prevalent layout in our corpus (68). Such freeform layouts are usually using additional structuring elements (see section 4.3) components to indicate related information and/or reading order. In other examples, no specific reading order is really implied.



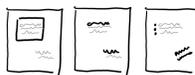
Although less frequently, it happens that the sketchnoters have an idea of how to organize and spread content out in the page, to achieve a structured, balanced layout. These are similar to layouts recommended in books teaching sketching and sketchnote practice (e.g., [9, 45, 46]). **Grid** layouts (22) exhibit structured clusters of about the same proportions (Figure 2d). They can be strictly aligned, or more loosely organized in a Voronoi-filling type of approach (other terms for grid-like layouts in literature are *modular* [39], *skyscraper* [45], or *matrix* [9]). Another method was a **radial** type structure (7) where the title of the talk was in the center of the page and the content was placed around it (Figure 2e): “I like to put the title info in the center of the page and array content around it, kind of like people around a campfire” (P3). It is often the case that the content is placed freely around the title instead of being connected to it using lines like in the classic *mindmap* format. Finally, closer to regular notes, we also found that the textual structure exhibits a clear **linear** flow (6), typically in a single column to be read from top to bottom (Figure 2f).

4.3 Structuring elements & flow

This section (Figure 2.3) describes elements contributing to make a structure emerge, organizing elements in higher level blocks, and possibly helping readers follow a particular reading order by adding “structure to an otherwise wild page” [5].



Leaving empty **space** (*white space, negative space*) between blocks of content (52), and **dividers** (33) are the most basic means to make structure emerge visually. They act as separators allowing the reader to distinguish between sections (Figure 2g).



Elements such as **containers** (44), **headers** (32) and **text formatting** (52) (Figure 2h) are commonplace in sketchnotes as a means to group content in higher level entities. While headers are more implicit forms of providing structure (in the absence of containers), they are also tools to convey information, supporting a high-level of reading: “someone who just skims over the sketchnotes of a talk structured by titles [to] quickly find the points they are most interested in” (P1). Text formatting includes lists and indentation (47), as well as particular style such as “jigsaw phrasing” (5) (i.e., alternating horizontal and vertical orientation of text), suggesting that content

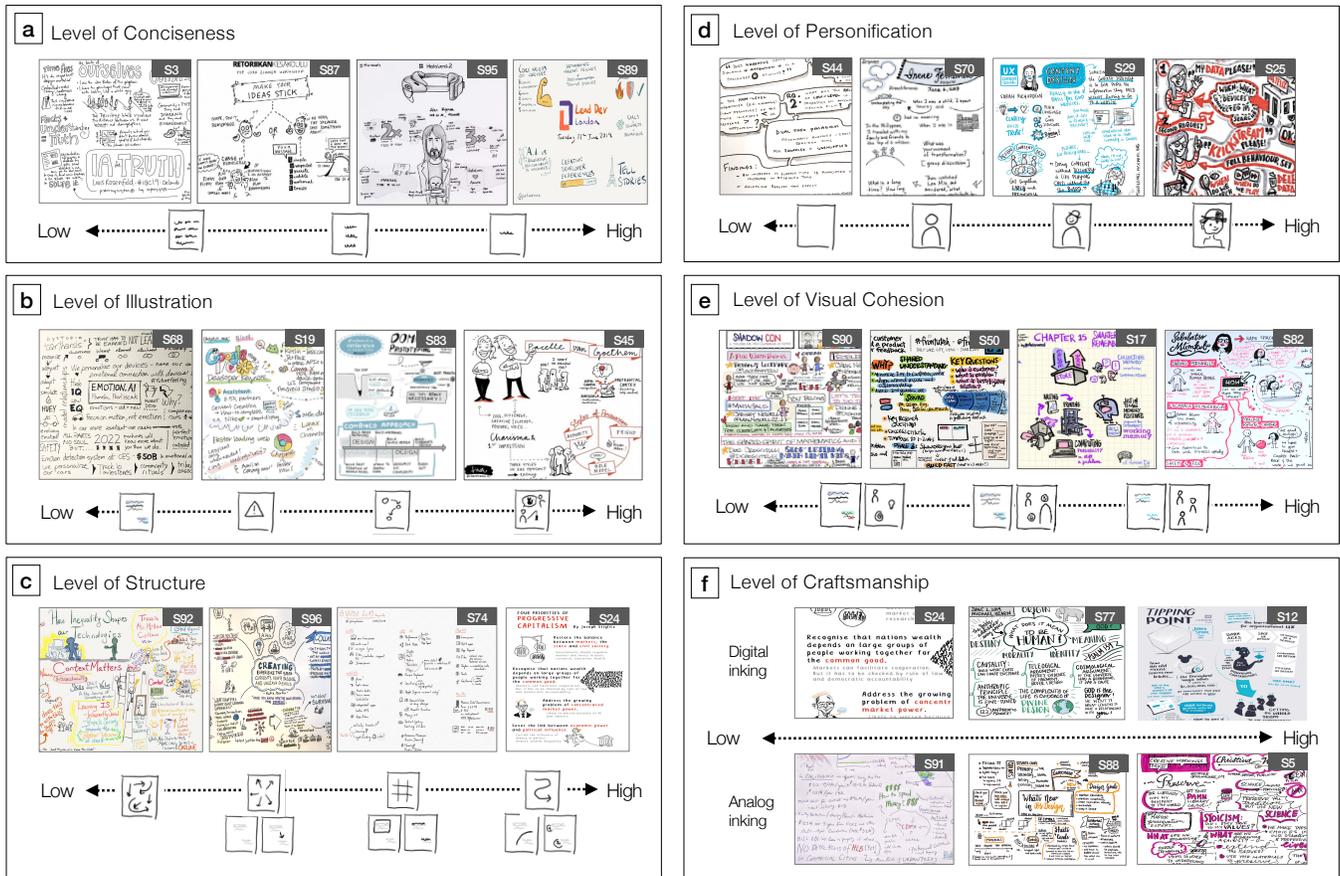


Figure 4: Levels of Sketchnote Design Space: Conciseness, Illustration, Structure, Personification, Cohesion, and Craftsmanship. (© SKETCHNOTES USED WITH PERMISSION, SEE 'LIST OF SKETCHNOTES' FOR CREDITS AND LINKS)

with the same visual identity belong to the same higher-level entity, according to the Gestalt Law of Similarity.

Connections between elements are conveyed using **links and arrows** (38), but also implicitly via the presence of **numbers** (13) indicating the sequence in which to read the different blocks of elements (Figure 2i).

4.4 Visual Style

When creating live summaries of events, sketchnoters use different strategies for bringing attention to key words and phrases, referred to as the “*principles of visual hierarchy*” (P3). These strategies involve the use of color, variations in font, and borders (overview in Figure 2.4).

Color (Figure 2j) is commonly used as a powerful way of bringing attention to content within a sketchnote, e.g. “[if] *there’s key words that resonate with me that I want to remember then I’ll use colour to draw them out more prominently*” (P6). The use of colors ranges from **monochromatic palettes**, to simple **accent palettes** containing one or two colors to highlight content, to **full color**

palette without a clear thematic association with content. Interestingly, in contrast to common best practices such as using “*only one colour to start*” [39] or choosing only “*few colours at a time*” [16], a wide color palette was more common than monochromatic or use of accent colors.

Text styling (Figure 2k) is extensively leveraged by sketchnoters to emphasize content, to group content, or simply to add a creative artistic look to the written text. We found that textual content varied in the **font family** employed (71), the **font size** (61) and **font color** (62) for emphasis, as well as **underline** (19) and **highlight or borders** (41) – most often using (one of) the accent color(s).

Containers and borders are often applied a style. **Embellished borders** (80) range from artistic lines, to repurposing an icon as a border, such as a sign post, or a banner (Figure 2l). A common instance of styling are the **speech & thoughts bubble** (42) often attached to representations of people.

5 DESIGN SPACE

This section describes interesting dimensions by which we *organize the corpus*. Each dimension situates each sketchnote with regard to specific types of components they contain or their combination (shown by the sketched symbols in Figure 4). Together, these dimensions give a broader picture of the higher-level types of sketchnoting: from high-density textual and more transcription-based content featured in traditional note taking to more visual interpretations of the content structured as a comics.

- **LEVEL OF CONCISENESS:**

Captures the general level of detail (verbosity) of the majority of the textual content of a sketchnotes (Figure 4a): lower level of conciseness on the left, often using fully formed sentences, to high level of conciseness on the right, with a sparse use of visuals and text through limited key words.

- **LEVEL OF ILLUSTRATION:**

Captures the visual-to-text ratio and the complexity of visual content of a sketchnotes (Figure 4b): from text-centric notes (left), to notes using symbols and pictograms, visualising diagrams, and incorporating advanced visual illustrations (right).

- **LEVEL OF STRUCTURE:**

Captures the clarity of the structure and suggested reading order of a sketchnotes (Figure 4c): freeform layout (left), radial layout, grid structure, and linear flow (right).

- **LEVEL OF PERSONIFICATION:**

Captures the presence and degree of anthropomorphic representations (Figure 4d): from symbolic representations to recurrent characters with recognizable traits.

- **LEVEL OF VISUAL COHESION:**

Captures the cohesion of the styling of a sketchnote (Figure 4e): from a large variety of colors, textual formatting and symbols (left) to a limited palette of recurring styles and symbols (right).

- **LEVEL OF CRAFTSMANSHIP:**

Captures the look & feel of a sketchnote, at a lower level than the components identified in section 4. This craftsmanship includes the *visual rendering* of the ink (directly related to the pen instruments used to lay it on the page) as well as the *penmanship* — the personal style and manner of handwriting. This relates to Rohde’s “*path of skill building*” [46], describing the advances in sketchnoting through practice and *skill climbs*. High craftsmanship relies on instrument delivering visually appealing strokes and clear and harmonious penmanship, as well as the effective use of layout, white space, or choice of colour palettes (Figure 4f).

Four types of sketchnotes. Different categories of sketchnotes emerged from our analysis of the corpus, differing in the type of insights they convey from the talk: Recordings, Context Maps, Stories, and Messages. Although these were the four prevalent types, a few sketchnotes in our corpus did not fall into any of these four types, and there were few hybrid cases (e.g., a ‘Recording’ incorporating a ‘Story’). We briefly present these four types and situate one example of each in our design space (Figure 5).

Recordings are close to regular notes one takes with a pen on paper. A key difference with commonly found note is the enhanced

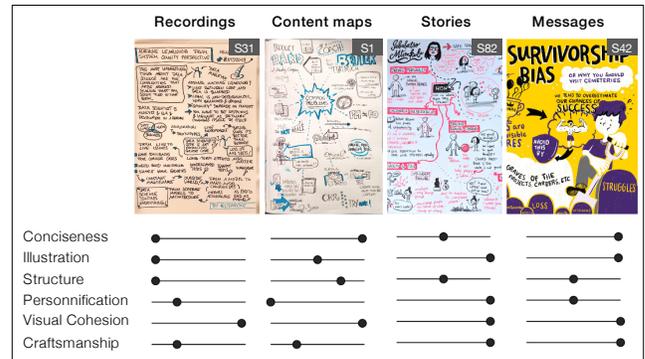


Figure 5: Types of sketchnotes. (© SKETCHNOTES USED WITH PERMISSION, SEE ‘LIST OF SKETCHNOTES’ FOR CREDITS AND LINKS)

text-to-visual ratio, interweaving textual notes with visual icons and illustrations. Sketchnotes we included in this category have a very loose structure of the information, making it difficult for a viewer to reconstruct high-level points made in the talk.

Content maps illustrate the different topics and points made in the talk akin to a visual non-linear table of content. Key concepts are often illustrated with icons or diagrams, and visually connected with lines and arrows.

Stories are akin to comics. Key points of the talks are illustrated in sequence, conveying the progression of the talk. Sketchnotes included in this category also featured visual connections across its elements, for example making use of a recurring character or visual imagery strongly connected to the talk topic.

Messages are akin to posters. Sketchnotes in this category convey the general theme or argument of the talk, without delving into details. They act more as a teaser or summary of the talk rather than depicting the multiple points of its content.

6 SKETCHNOTING STRATEGIES

This section describes a set of authoring *strategies* that sketchnoters followed to capture and communicate content in their sketchnotes. We discuss how sketchnote components (section 4) and choices along the dimensions of the design space (section 5) are leveraged to capture ideas, emphasize key concepts, and create a narrative, as well as the art that goes into crafting a cohesive, readable and visually compelling document. We also outline strategies that sketchnoters employ to cope with the unique challenges posed by live authoring of sketchnotes. We denote the most difficult, impractical, or sub-optimal strategies with a *. Compiling this list enables to build a general guidance for beginner sketchnoters, while * points to opportunities for digital tool support (section 7).

6.1 Capture Ideas

Sketchnotes act as summaries of longer talks and information materials, and aim to capture and synthesize important ideas in a more concise visual form. Because it is “*impossible to catch it all*” (P3), sketchnoters rely on strategies for content curation, “*looking for the ‘big fish’ or at least the ‘interesting’*” (P3), and rendition of ideas into a succinct form. Common strategies include:

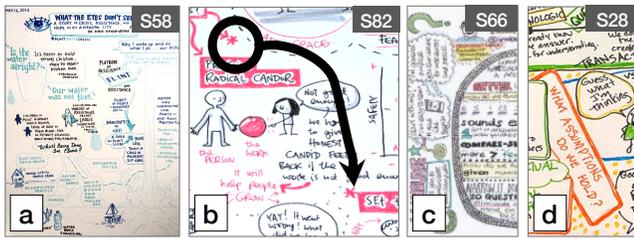


Figure 6: (a) Emerging themes, and (b-d) sketchnoting strategies for dealing with space constraints. (© SKETCHNOTES USED WITH PERMISSION, SEE 'LIST OF SKETCHNOTES' FOR CREDITS AND LINKS)

- **Use concise text**, e.g. catchphrases or terms (a generally high level of conciseness) capture ideas boiled down to their essence.
- **Add quotes** is a common strategy to make a particular thought or sentence carry weight, due to its authenticity as an already well-articulated idea from the source, transcribed as is.
- **Use visuals** in lieu or in reinforcement of an idea. Examples include drawing a wall for “you build a wall or a cathedral”, or drawing a plant to express growth. Identifying ideas for visuals quickly is challenging when drawing live; here, “*key words are the simplest way of finding images. You don’t have to think about a synthesizing image. So it’s quick and easy to do in a live situation.*” (P4)
- * **Craft explanatory illustrations** by combining, and turning more complex concepts into illustrations or diagrams.
- * **Make themes emerge** through the use of visual language with relevant semantic associations. For example, Figure 6a uses shades of blue as the color palette, as well as visual and icons related the concept of water, together with a fluid layout evoking the fluidity of liquids. It is about to “*draw what is emergent and sometimes unspoken*” (P3).

* In contrast to other strategies that involve a relatively direct transcription of important ideas, these more advanced strategies, seldom observed in our corpus, require a greater level of combining, appropriating, and reformulating (often multiple) concepts into illustrations. These also demand greater drawing skills, especially in the context of live sketchnoting. However, there are substantial advantages to incorporating these types of illustrations rather than textual content. Reformulating and externalizing ideas is a powerful mechanism to process information [29]. As the proverb “*a picture is worth a thousand words*” suggests, illustrations are a powerful communication tool which may also play a role in memorability [8].

6.2 Emphasize Key Concepts

Sketchnotes compress a lot of information onto a limited space, often with free-form or other less structured layouts. Emphasis helps highlighting key concepts and brings structure to the content, enabling selective reading: “*I think it’s important that someone who just skims over the sketchnotes of a talk structured by titles can quickly find the points he is most interested in*” (P1). Sketchnoters’ strategies to lay emphasis on content draw from traditional “*principles of visual hierarchy that can be found in graphic design*” (P3) – a skill

that comes with “*experience using these principles over time [and] helps [the sketchnoter] decide in the moment*” (P3).

- **Convey the same concept in multiple forms**, which is typically achieved by accompanying a written idea with symbols or pictograms, is a simple yet effective strategy to make key concepts visually salient: “*My style is generally to try and use an icon per main point*” (P6).
- **Use layout and structuring elements** is another simple strategy for bringing attention to particular content. Examples include making a key element occupy the central position in the page (i.e. surround layout), and building on conventions such as putting the title at the top of the document.
- * **Contrast the type of content** consists of purposefully switching from one particular level of conciseness to another, distinct one. For example, a longer sentence or a quote will stand out in a sketchnote where terms and short catchphrases are predominant, and vice versa.
- * **Contrast the visual style** consists of using distinct using color, text formatting and styled containers for select content to make it visually salient.

* Contrasting, i.e. using a form and style distinct from the main, plain content in the sketchnote requires some level of planning, as well as sufficient amount of content to identify what to emphasize. As with other communication media, the “*less is more*” rule applies to sketchnotes. It is recommended against too much emphasis, or too many types of emphasis – the right balance can be difficult to plan for in the context of live capturing of spoken information.

6.3 Create a Narrative

Sketchnotes of the stories type aim to build a narrative to deliver the captured content. Sketchnoters employed a range of strategies to construct this form of delivery.

- **Suggest a reading order** via layout and structuring elements is the most elementary approach to convey a logical sequence through which to consume the content. For example, P1 mentions how the sketchnotes link “*chunks of information connected by a ‘thread’*” (P1).



Figure 7: Emphasizing emotions (through use of emanata) to support narrative. (© SKETCHNOTES USED WITH PERMISSION, SEE 'LIST OF SKETCHNOTES' FOR CREDITS AND LINKS)

- * **Use a narrator**, i.e. literally drawing the actual speaker (or another fictional character) talking the content as in a comic [14] – which can then also be reflected in the structure of the overall sketchnote: “*it’s natural to use a comic strip kind of structure*” (P5).
- * **Feature recurring characters**, typically staged in situations embodying the ideas themselves (e.g., S82, S87). Through these recurring characters, sketchnoters personify the content, further reinforcing the notion of storytelling between humans.
- * **Use empathy to better connect with the audience** by displaying characters’ emotions may further engage the audience in the story. For example, symbolic cartoon elements can be used to externalize a character’s state of mind or emotions – often called *Emanata* (after cartoonist Mort Walker) a well-known strategy in comic making. Used in sketchnotes, for example, to express surprise, stress, fear, anger, or confusion (Figure 7).

* Incorporating a narrator or characters and conveying emotions require substantial experience not only for drawing recognizable characters but also capturing critical moments and clearly conveying actions and character intent, akin to skills acquired by comics artists. Lowering such barriers to entry could enable a much larger audience to craft visually compelling narratives while sketchnoting.

6.4 Aesthetics and Visual Identity

While the above design strategies focus on capturing and delivering content, sketchnoters also developed strategies for engaging the readers with aesthetically pleasing visuals, often conveying a unique visual identity making their style recognizable and memorable. We describe the most salient aspects of graphic design manipulated by sketchnoters to make their artifact aesthetically pleasing.

- * **Craftsmanship**: the level of craftsmanship, as described in our design space, refers to the output of the pen instruments as well as the penmanship, i.e. the shape and regularity of sketchnoters’ handwriting. This craftsmanship directly affects the perception of the sketchnote, whether it appears as a draft or a craft [43].
- * **Visual cohesion** involves the use of clear and consistent “visual identity charter” – color palette, textual formatting – throughout the document resulting in a general look-and-feel with a distinct visual identity. This implies to use visual styling (e.g. color, text formatting) meaningfully and sparingly.
- * **Composition**, akin to other visual media such as photography and painting, principles of organization that affect composition include a balanced use of space and negative space, harmony of shapes and proportions, geometry, symmetry, and so forth.

* High-level of craftsmanship requires quality instruments which may prove expensive in the analog world while easily available in digital forms. Similarly, digital technologies offer the opportunities to modify one’s penmanship. However, current digital inking often lack the authenticity of its analog counterpart, a major reason for sketchnoters to stick to the analog medium. Devising more

authentic yet “beautified” ink strokes to elevate both ink marks and penmanship remains an open problem.

* Achieving an aesthetically pleasing and harmonious visual identity and composition is extremely challenging for people not versed in the art of graphic design. It requires knowledge of the principles and acquiring what often is tacit knowledge on a large variety of topics (e.g. proportions, spacing, color schemes, stroke character, etc.). Exploring how to provide guidance to novice sketchnoters could help them develop such skill set.

6.5 Dealing With Constraints of Live Drawing

Because of the challenge of time and unknown content, sketchnoters need to budget space. Planning strategies include:

- **Translate the talk outline into a layout**: if the talk content is known in advance, space can be used in a more structured manner: “*If it’s a panel discussion, I place the topic quite often in the center. If it’s a presentation with e.g. 10 points, it’s natural to use a comic strip kind of structure*” (P5) or if the speaker says “*I’m going to talk about 4 things, then yes you make a mental grid of the page.*” (P6)
- **Leave space between elements**: allows laying out content while the overarching structure is unknown or still uncertain. Sketchnoters keep the layout and structure flexible following the mantra of “*capture first, structure later*” (P4) by “*grab[bing] keywords and phrases first, leaving pads of space around them to connect and/or embellish with additional illustration*” (P3).

When space budgeting fails, recovery strategies include:

- **Change orientation** includes changing writing/drawing orientation from horizontal to vertical (or even diagonal) can be used as a recovering strategy for fitting in content when only limited space remains (Figure 6c/d).
- * **Adjust the text formatting** such as reducing the size of the handwriting to fit content in the available space.
- * **Addendum** are content that did not fit in a particular space because of misjudgment of required space or lack of overview on the overall content. Addendum are positioned where adequate space remains in the canvas and often accompanied by a visual mark (e.g. asterisk or arrow) to indicate where the content naturally belongs (Figure 6b).

* While reducing font size remains “within the space budget”, it can hinder readability or suggest content with lesser importance. Addendum allow to maintain the same text formatting for content at the same level of importance, but imply to re-allocate space to make it fit, further adding to the uncertainty of planning.

Finally, the live nature may result in time pressure to capture content, resulting in sketchnoters having to have recourse to catching up strategies when time permits:

- **Palimpsests**: rewriting over content already laid out with a different color or a highlighter likely to avoid switching pen during the session.
- * **Grouping related content or separating unrelated content** by using structuring elements (section 4.3): “*I start by writing down information and then, when I’m halfway through the talk or so, I decide on how to connect the information.*” (P1)

* Given the general pace of live talks, sketchnoters have limited idle time. They use this time to either process and reformulate content that was just heard (e.g. formulating a diagram or illustration) or to capture and style it on the canvas (e.g. laying down ink on the page). For those sketchnoters who reported figuring out the structure halfway through the talk, it implies that the subsequent idle time is reduced as they are catching up on the styling of the sketchnote (e.g. adding structural elements). Identifying ways to speed up some of the styling with digital tools could reclaim time back for content-related processes.

7 IMPLICATIONS FOR DESIGN

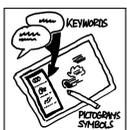
This section presents a series of suggestions for designs emerging from our analysis. These suggestions are derived from our study results, after multiple sessions of discussions and iterations between all authors, identifying occurrences of issues that could be leveraged with software, and identifying patterns that could call for novel tools or interactions. The first two sections suggest features and interaction techniques to aid with capturing/generating content on one hand and structuring/styling content on another hand. Next, we suggest more holistic implications to support a more flexible approach to sketchnoting. Finally, we identify a number of implications to jump-start beginners and open up the sketchnoting activity to a wider audience.

7.1 Aiding with Content Capture and Generation



SELECTIVE SPEECH-TO-TEXT PEN INSTRUMENT.

Live sketchnoting requires substantial listening skills and focus. Sketchnoters report developing a “listening practice. We have to quiet our own internal dialog and get into a flow state to hear and process what is happening in the room.” (P3) and a curation process “sketchnoting is necessarily curating the content flowing into your listening” (P3). Since digital technologies enable a relatively reliable live transcription, we could imagine a new type of speech-to-text pen that eliminates the need for manual transcription and facilitating the curation process. Using such a pen on a page could simply display the live transcription laid down along the pen trajectory. Different to existing speech-to-text systems, this feature would only be needed selectively, ad-hoc (e.g., for quotes, speech bubbles – section 4.1), and would need to be integrated in a way not to interfere with the overall sketchnote inking. This tool would enable to capture quotes effortlessly and facilitate selection, as it is much easier to erase portions of unnecessary text a posteriori than select what to write a priori.



SUGGESTIONS FOR REFORMULATION.

Another challenge of sketchnoting is to generate catchphrases, terms and visual content summarizing an idea or a combination of ideas (section 6.1). Finding synonyms or exact terms may be difficult, especially when often done under time pressure of live presentations. One could imagine an always-on listening feature, suggesting a list of catchphrases, terms, and visual symbols or pictograms (sections 4.1, 6.1). Surfacing visual content associated to handwritten

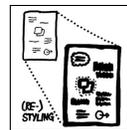
terms and catchphrases already on the page may also facilitate the incorporation of visuals (e.g., facilitating emphasis – section 6.2). Note that a key consideration when designing such feature is to minimize disruptions of an already challenging cognitive task.

7.2 Facilitating Tedious or Repetitive Sketchnoting Tasks



INTERACTIONS FOR (RE)COMPOSING.

As we described in section 6.5, planning strategies may sometime fail, resulting in sub-optimal recovery strategies. While these “failures” may add authenticity to the sketchnotes, it is likely that facilitating composition, by rearranging content or adjusting its size will be helpful to sketchnoters. Beyond direct manipulation of individual pieces of content, already available in most note taking software today, considering the composition (e.g., layout – section 4.2) of the sketchnote as a whole is interesting. Techniques could enable controlling the amount of padding between clusters of content, or automatically re-flowing content within each clusters to provide even-sized groups and space-filling compositions.



INTERACTIONS FOR (RE)STYLING.

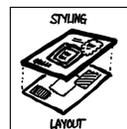
Styling is critical to emphasize key concepts (section 6.2) and provide an aesthetically pleasing and personal visual artifact (section 6.4). Providing higher-level styling objects (e.g. title style, quote style as in word documents) or mark-up (identifying a desired level of saliency) could enable an easier transfer to other elements and allow experimenting with different styles. Providing style “palettes”, including color and text formatting, as well as associated sets of visual content (with a similar look and feel) could also facilitate producing sketchnotes with a high level of visual cohesion (section 5).



INCREASING THE LEVEL OF CRAFTSMANSHIP.

Digital software has the unique ability to increase the quality of strokes laid down on the page, by smoothing out or transforming handwriting, and manipulating the look and feel of each strokes to give it harmonious curvature and thickness nuances (craftsmanship – section 5). It will be important to identify the right level of such digital ink stroke enhancements, so that they do provide desired increases of stroke quality while avoiding undesired changes that change the style of inked notes too much.

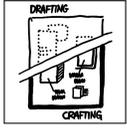
7.3 Supporting More Flexible Creation Process



MULTIPLE LAYERS FOR STYLING AND LAYOUT.

Sketchnoters working with graphical editing tools already take advantage of using multiple layout layers: “The benefit of working digital and using layers is that I’m able to change the layout if I’m not happy with the one that I begin with.” (P5). Providing both layout (section 4.2) and style (section 4.4) layers, separating them from content, could open avenues for rapid experimentation of sketchnote designs. As one of our participant noted: “if you didn’t decide to make it colourful in the first place [...] there’s many ways to add colour afterwards”

(P4) and sometimes identifying the "best" way may be challenging to envision. The additional benefit of dissociated layout and style layers is the reusability of their content.



SUPPORTING DRAFTING AND CRAFTING.

As observed in earlier studies [43], we found sketchnoters mentioning distinct phases in their note taking: from the rapid, real-time drafting of a sketchnote, to the later refinements and crafting of the final piece.

Leveraging the concepts of layers (content, structure and style layers) could surface different tools or interactions at different stages, enabling rapid back-and-forth between *drafting and crafting*.

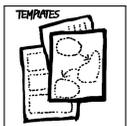


HYBRID ANALOG AND DIGITAL.

The corpus we gathered featured analog sketchnotes that were likely scanned and modified in graphical editing tools. Some of these hybrids are more obvious than others, clearly featuring the authentic hand-

crafted look-and-feel as well as the generic computer-generated content. Such analog-to-digital process requires many steps, skills and effort that few sketchnoters may be willing to take. Reflecting on a more flexible authoring process facilitating such back-and-forth is an exciting endeavor.

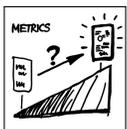
7.4 Lowering the Barrier to Entry



TEMPLATES AND DESIGN SUGGESTIONS.

One of our participants described that typically they would decide the layout ahead of time depending of the type of presentation to sketchnote: "if it's a panel discussion, I place the topic quite often in the center. If it's a presentation with e.g. 10 points, it's natural to use a comic strip" (P5).

Providing such templates as well as existing layout/styling layers (informed by the layouts of section 4.2 and the sketchnote types in section 5) could lower the barrier of entry for a more novice audience. Another avenue would be suggestions to reorganize and/or restyle existing sketchnotes (in the spirit of PowerPoint *design ideas*).



METRICS FOR "GOOD VISUAL DESIGN".

As users develop their own style, they may produce unsatisfactory designs. While it is straightforward for people to rate their satisfaction with different artifacts, it may be harder for them to discern the

particular aspects to alter or improve. Some sketchnoters are aware of general visual perception and design guidelines: "it's not an exact science, but you should look into the laws of Gestalt Theory" (P4). Providing a set of metrics and guidance or suggestion to increase these metrics based on a set of visual perception and visual design rules would certainly prove useful to a more novice audience.

8 CONCLUSION AND FUTURE WORK

Focusing on a particular, constrained part of the wide research field of note taking — as done in studies in specific contexts, from sketched information scraps [6] all the way to bullet journaling [2] — allows us to uncover nuances of people's rich practices in the analog that digital tools should not only support (bridging

the analog/digital divide), but in fact advance beyond towards expressive digital tools. With our paper the goal was to unpack the design space of *sketchnotes* — as one particular contemporary form of visual note taking — to inform the design of future digital tools supporting this creative practice for putting thoughts and ideas into rich visual artefacts. Our implications for design point into this direction; but are not an exhaustive list, and in fact we hope the detailed mapping of the identified sketchnote component building blocks, dimensions of choice in the design space, and design intents spark other thoughts for innovations on digital crafting tools.

As for next steps exploring sketchnoting practice, one promising direction is to study the dynamics of how sketches get developed over time. As most sketchnotes are done in real-time (though with possibly preparation before, and/or refinements after), this could help us finding out more about patterns and strategies for dealing with the constraints of live drawing (for which our section 6.5 could function as a lift-off point). We would also need to better understand of what makes a sketchnote effective: this could involve studying which choices of content, layout, structure, or style — as well as any of the sketchnoting strategies and positions on the continuous dimensions of the design space — work best for crafting effective sketchnotes. Similarly, future studies could investigate the applications of our suggested implications for design, and find out which of these techniques might best support sketchnoting practice. The tensions between effective note taking and creating 'art' could be another focus of future studies.

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REFERENCES

- [1] Michelle Annett, Fraser Anderson, Walter F. Bischof, and Anoop Gupta. 2014. The Pen is Mightier: Understanding Stylus Behaviour While Inking on Tablets. In *Proceedings of Graphics Interface 2014 (GI '14)*. Canadian Information Processing Society, Toronto, Ont., Canada, Canada, 193–200. event-place: Montreal, Quebec, Canada.
- [2] Amid Ayobi, Tobias Sonne, Paul Marshall, and Anna L. Cox. 2018. Flexible and Mindful Self-Tracking: Design Implications from Paper Bullet Journals. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, 28:1–28:14. <https://doi.org/10.1145/3173574.3173602> event-place: Montreal QC, Canada.
- [3] Benjamin Bach, Zezhong Wang, Matteo Farinella, Dave Murray-Rust, and Nathalie Henry Riche. 2018. Design Patterns for Data Comics. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, 38:1–38:12. <https://doi.org/10.1145/3173574.3173612> event-place: Montreal QC, Canada.
- [4] Mark Baskinger. 2008. Pencils Before Pixels: A Primer in Hand-generated Sketching. *interactions* 15, 2 (March 2008), 28–36. <https://doi.org/10.1145/1340961.1340969>
- [5] Craighton Berman. 2011. Sketchnotes 101: The Basics of Visual Note-taking. <https://www.core77.com/posts/19678/Sketchnotes-101-The-Basics-of-Visual-Note-taking>
- [6] Michael Bernstein, Max Van Kleek, David Karger, and M. C. Schraefel. 2008. Information scraps: How and why information eludes our personal information management tools. *ACM Transactions on Information Systems* 26, 4 (Oct. 2008), 24:1–24:46. <https://doi.org/10.1145/1402256.1402263>
- [7] L. Bollini. 2017. Drawing as learning enabling meta-language. using sketchnoting in the field of education. In *ICERI2017 Proceedings (Seville, Spain) (10th annual International Conference of Education, Research and Innovation)*. IATED, Spain, 8030–8036. <https://doi.org/10.21125/iceri.2017.2144>
- [8] Michelle A. Borkin, Azalea A. Vo, Zoya Bylinskii, Phillip Isola, Shashank Sunkavalli, Aude Oliva, and Hanspeter Pfister. 2013. What Makes a Visualization Memorable? *IEEE Transactions on Visualization and Computer Graphics*

- 19, 12 (Dec. 2013), 2306–2315. <https://doi.org/10.1109/TVCG.2013.234>
- [9] Willemien Brand. 2017. *Visual Thinking: Empowering People and Organisations through Visual Collaboration* (01 edition ed.). BIS Publishers, Amsterdam.
- [10] Willemien Brand. 2018. *Visual Doing: Applying Visual Thinking in your Day to Day Business: Applying Visual Thinking in your Day to Day Business* (01 edition ed.). BIS Publishers, Amsterdam.
- [11] Peter Brandl, Christoph Richter, and Michael Haller. 2010. NiCEBook: Supporting Natural Note Taking. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*. ACM, New York, NY, USA, 599–608. <https://doi.org/10.1145/1753326.1753417> event-place: Atlanta, Georgia, USA.
- [12] Nathalie Bressa, Kendra Wannamaker, Henrik Korsgaard, Wesley Willett, and Jo Vermeulen. 2019. Sketching and Ideation Activities for Situated Visualization Design. In *Proceedings of the 2019 on Designing Interactive Systems Conference (DIS '19)*. ACM, New York, NY, USA, 173–185. <https://doi.org/10.1145/3322276.3322326> event-place: San Diego, CA, USA.
- [13] Bill Buxton. 2007. *Sketching User Experiences: Getting the Design Right and the Right Design* (illustrated edition ed.). Morgan Kaufmann, Amsterdam.
- [14] Kevin Cheng. 2012. *See What I Mean: How to Use Comics to Communicate Ideas*. Rosenfeld Media, USA.
- [15] Youngjun Cho, Andrea Bianchi, Nicolai Marquardt, and Nadia Bianchi-Berthouze. 2016. RealPen: Providing Realism in Handwriting Tasks on Touch Surfaces Using Auditory-Tactile Feedback. In *Proceedings of the 29th Annual Symposium on User Interface Software and Technology (Tokyo, Japan) (UIST '16)*. Association for Computing Machinery, New York, NY, USA, 195–205. <https://doi.org/10.1145/2984511.2984550>
- [16] Ben Crothers. 2017. *Presto Sketching: The Magic of Simple Drawing for Brilliant Product Thinking and Design*. O'Reilly, Sebastopol, CA.
- [17] Raimund Dachsel, Mathias Frisch, and Eike Decker. 2008. Enhancing UML sketch tools with digital pens and paper. In *Proceedings of the 4th ACM symposium on Software visualization (SoftVis '08)*. Association for Computing Machinery, Ammersee, Germany, 203–204. <https://doi.org/10.1145/1409720.1409756>
- [18] Jara Dean-Coffey. 2013. Graphic Recording. *New Directions for Evaluation* 2013, 140 (2013), 47–67. <https://doi.org/10.1002/ev.20073>
- [19] Robert Dimeo. 2016. Sketchnoting: An Analog Skill in the Digital Age. *SIGCAS Comput. Soc.* 46, 3 (Dec. 2016), 9–16. <https://doi.org/10.1145/3024949.3024951>
- [20] Marina Fernández Camporro and Nicolai Marquardt. 2020. Live Sketchnoting Across Platforms: Exploring the Potential and Limitations of Analogue and Digital Tools. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, Honolulu, HI, USA, 1–12. <https://doi.org/10.1145/3313831.3376192>
- [21] Gene Golovchinsky, Morgan N. Price, and Bill N. Schilit. 1999. From Reading to Retrieval: Freeform Ink Annotations As Queries. In *Proceedings of the 22nd Annual International ACM SIGIR Conference on Research and Development in Information Retrieval (SIGIR '99)*. ACM, New York, NY, USA, 19–25. <https://doi.org/10.1145/312624.312637> event-place: Berkeley, California, USA.
- [22] Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt, and Bill Buxton. 2012. *Sketching User Experiences: The Workbook* (1 ed.). Morgan Kaufmann, USA.
- [23] Ken Hinckley and Bill Buxton. 2016. Inking Outside the Box: How Context Sensing Affords More Natural Pen (and Touch) Computing. In *Revolutionizing Education with Digital Ink: The Impact of Pen and Touch Technology on Education*, Tracy Hammond, Stephanie Valentine, and Aaron Adler (Eds.). Springer International Publishing, Cham, 27–47. https://doi.org/10.1007/978-3-319-31193-7_3
- [24] Ken Hinckley, Koji Yatani, Michel Pahud, Nicole Coddington, Jenny Rodenhouse, Andy Wilson, Hrvoje Benko, and Bill Buxton. 2010. Pen + Touch = New Tools. In *Proceedings of the 23rd Annual ACM Symposium on User Interface Software and Technology (UIST '10)*. ACM, New York, NY, USA, 27–36. <https://doi.org/10.1145/1866029.1866036> event-place: New York, New York, USA.
- [25] Alma R. Hoffmann. 2019. *Sketching as Design Thinking*. Routledge, London ; New York.
- [26] Jessica Hullman and Benjamin Bach. 2018. Picturing Science: Design Patterns in Graphical Abstracts. In *Diagrammatic Representation and Inference (Lecture Notes in Computer Science)*, Peter Chapman, Gem Stapleton, Amirouche Moktefi, Sarah Perez-Kriz, and Francesco Bellucci (Eds.). Springer International Publishing, Cham, 183–200. https://doi.org/10.1007/978-3-319-91376-6_19
- [27] Michael Hung, David Ledo, and Lora Oehlberg. 2019. WatchPen: Using Cross-Device Interaction Concepts to Augment Pen-Based Interaction. In *Proceedings of the 21st International Conference on Human-Computer Interaction with Mobile Devices and Services (Taipei, Taiwan) (MobileHCI '19)*. Association for Computing Machinery, New York, NY, USA, Article 11, 8 pages. <https://doi.org/10.1145/3338286.3340122>
- [28] David Kirsh. 1995. The Intelligent Use of Space. *Artif. Intell.* 73, 1–2 (Feb. 1995), 31–68. [https://doi.org/10.1016/0004-3702\(94\)00017-U](https://doi.org/10.1016/0004-3702(94)00017-U)
- [29] David Kirsh. 2010. Thinking with external representations. *AI & SOCIETY* 25, 4 (Nov. 2010), 441–454. <https://doi.org/10.1007/s00146-010-0272-8>
- [30] Makayla Lewis and Mark Perry. 2019. Follow the Money: Managing Personal Finance Digitally. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*. Association for Computing Machinery, Glasgow, Scotland UK, 1–14. <https://doi.org/10.1145/3290605.3300620>
- [31] Makayla Lewis, Miriam Sturdee, Jason Alexander, Jelle Van Dijk, Majken Kirkegård Rasmussen, and Thuong Hoang. 2017. SketchingDIS: Hand-drawn Sketching in HCI. In *Proceedings of the 2017 ACM Conference Companion Publication on Designing Interactive Systems (DIS '17 Companion)*. ACM, New York, NY, USA, 356–359. <https://doi.org/10.1145/3064857.3064863> event-place: Edinburgh, United Kingdom.
- [32] Makayla Lewis, Miriam Sturdee, and Nicolai Marquardt. 2019. Sketching in HCI: Hands-on Course of Sketching Techniques. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (CHI EA '19)*. ACM, New York, NY, USA, C04:1–C04:5. <https://doi.org/10.1145/3290607.3298805> event-place: Glasgow, Scotland UK.
- [33] Yang Li, Ken Hinckley, Zhiwei Guan, and James A. Landay. 2005. Experimental Analysis of Mode Switching Techniques in Pen-based User Interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '05)*. ACM, New York, NY, USA, 461–470. <https://doi.org/10.1145/1054972.1055036> event-place: Portland, Oregon, USA.
- [34] Min Lin, Wayne G. Lutters, and Tina S. Kim. 2004. Understanding the Micronote Lifecycle: Improving Mobile Support for Informal Note Taking. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '04)*. ACM, New York, NY, USA, 687–694. <https://doi.org/10.1145/985692.985779> event-place: Vienna, Austria.
- [35] Narges Mahyar, Ali Sarvghad, and Melanie Tory. 2012. Note-taking in co-located collaborative visual analytics: Analysis of an observational study. *Information Visualization* 11, 3 (2012), 190–204. <https://doi.org/10.1177/1473871611433713> arXiv:<https://doi.org/10.1177/1473871611433713>
- [36] Nicolai Marquardt and Saul Greenberg. 2012. Sketchnotes for Visual Thinking in HCI. In *In CHI 2012 Workshop on Visual Thinking and Digital Imagery. (Workshop held at the ACM CHI Conference)*, Vol. 5. CHI 2012, USA, 5.
- [37] Scott McCloud. 1993. *Understanding Comics: The Invisible Art* (1st harperperennial edition ed.). William Morrow Paperbacks, New York.
- [38] Scott McCloud. 2006. *Making Comics: Storytelling Secrets of Comics, Manga and Graphic Novels* (illustrated edition ed.). William Morrow Paperbacks, New York.
- [39] Emily Mills. 2019. *The Art of Visual Notetaking: A comprehensive guide to visual communication and sketchnoting: An interactive guide to visual communication and sketchnoting* (01 edition ed.). Walter Foster Publishing, USA.
- [40] Thomas P. Moran, Patrick Chiu, and William van Melle. 1997. Pen-Based Interaction Techniques for Organizing Material on an Electronic Whiteboard. In *Proceedings of the 10th Annual ACM Symposium on User Interface Software and Technology (Banff, Alberta, Canada) (UIST '97)*. Association for Computing Machinery, New York, NY, USA, 45–54. <https://doi.org/10.1145/263407.263508>
- [41] Jennifer Pearson, George Buchanan, and Harold Thimbleby. 2011. The Reading Desk: Applying Physical Interactions to Digital Documents. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 3199–3202. <https://doi.org/10.1145/1978942.1979416> event-place: Vancouver, BC, Canada.
- [42] Frank D. Prager. 1968. A Manuscript of Taccola, Quoting Brunelleschi, on Problems of Inventors and Builders. *Proceedings of the American Philosophical Society* 112, 3 (1968), 131–149. <https://www.jstor.org/stable/986159> Publisher: American Philosophical Society.
- [43] Yann Riche, Nathalie Henry Riche, Ken Hinckley, Sheri Panabaker, Sarah Fuelling, and Sarah Williams. 2017. As We May Ink?: Learning from Everyday Analog Pen Use to Improve Digital Ink Experiences. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM Press, Denver, Colorado, USA, 3241–3253. <https://doi.org/10.1145/3025453.3025716>
- [44] Irma A. Richter and Thereza Wells. 2008. *Leonardo da Vinci Notebooks* (new edition ed.). OUP Oxford, UK.
- [45] Mike Rohde. 2013. *The sketchnote handbook: the illustrated guide to visual note taking*. Peachpit Press, San Francisco, CA. OCLC: ocn796754744.
- [46] Mike Rohde. 2014. *The Sketchnote Workbook: Advanced techniques for taking visual notes you can use anywhere*. Peachpit Press, San Francisco.
- [47] Mike Rohde. 2021. Sketchnote Army Blog. <https://sketchnotearmy.com/>
- [48] Bill N. Schilit, Gene Golovchinsky, and Morgan N. Price. 1998. Beyond Paper: Supporting Active Reading with Free Form Digital Ink Annotations. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Los Angeles, California, USA) (CHI '98)*. ACM Press/Addison-Wesley Publishing Co., USA, 249–256. <https://doi.org/10.1145/274644.274680>
- [49] Abigail J. Sellen and Richard H.R. Harper. 2003. *The Myth of the Paperless Office*. MIT Press, Cambridge, MA, USA.
- [50] Miriam Sturdee, Jason Alexander, Paul Coulton, and Sheelagh Carpendale. 2018. Sketch & The Lizard King: Supporting Image Inclusion in HCI Publishing. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (Montreal QC, Canada) (CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, 1–10. <https://doi.org/10.1145/3170427.3188408>
- [51] Miriam Sturdee, Makayla Lewis, and Nicolai Marquardt. 2018. Feeling SketCHI?: The Lasting Appeal of the Drawn Image in HCI. *Interactions* 25, 6 (Oct. 2018), 64–69. <https://doi.org/10.1145/3274562>
- [52] Miriam Sturdee, Makayla Lewis, and Nicolai Marquardt. 2018. SketchBlog #1: The Rise and Rise of the Sketchnote. *Interactions* 25, 6 (Oct. 2018), 6–8. <https://doi.org/10.1145/3274562>

//doi.org/10.1145/3281661

- [53] Minghui Sun, Xiang Cao, Hyunyoung Song, Shahram Izadi, Hrvoje Benko, Francois Guimbretiere, Xiangshi Ren, and Ken Hinckley. 2011. Enhancing Naturalness of Pen-and-tablet Drawing Through Context Sensing. In *Proceedings of the ACM International Conference on Interactive Tabletops and Surfaces (ITS '11)*. ACM, New York, NY, USA, 83–86. <https://doi.org/10.1145/2076354.2076371> event-place: Kobe, Japan.
- [54] Jagoda Walny, Sheelagh Carpendale, Nathalie Henry Riche, Gina Venolia, and Philip Fawcett. 2011. Visual Thinking In Action: Visualizations As Used On Whiteboards. *IEEE Transactions on Visualization and Computer Graphics* 17, 12 (Dec. 2011), 2508–2517. <https://doi.org/10.1109/TVCG.2011.251>
- [55] Steve Whittaker, Patrick Hyland, and Myrtle Wiley. 1994. FILOCHAT: Hand-written Notes Provide Access to Recorded Conversations. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '94)*. ACM, New York, NY, USA, 271–277. <https://doi.org/10.1145/191666.191763> event-place: Boston, Massachusetts, USA.
- [56] Haijun Xia, Nathalie Henry Riche, Fanny Chevalier, Bruno De Araujo, and Daniel Wigdor. 2018. *DataInk: Direct and Creative Data-Oriented Drawing*. Association for Computing Machinery, New York, NY, USA, 1–13. <https://doi.org/10.1145/3173574.3173797>

LIST OF SKETCHNOTES

The following sketchnotes (which are a subset of the collection of 103 sketchnotes we analyzed for this taxonomy) are used as examples of sketchnoting techniques throughout this article. We thank the creators for giving us permissions to use these sketchnotes to illustrate the diverse sketchnoting strategies.

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