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Mind-mapping in design culture: A tool for ideation in graphic design education?

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Abstract | This study focuses on mind-maps as an aspect of design culture – the conventions and practices adopted by a community of designers. The research aims to work towards establishing the effectiveness of mind-maps as a tool for ideation. It questions the extent to which mind-maps enable students to break away from the cultural frames evoked by design briefs in order for creative cross-space associations to occur. By comparing mind-map-like diagrams produced by nine undergraduate students with codes emerging from the analysis of the corresponding briefs, the study seeks to answer the question: What levels of cross-space mapping are evident in the knowledge representation diagrams produced as part of an undergraduate graphic design, practice-based project? The study found 301 cases of internal linking, as opposed to 23 instances of cross-space mapping, however it concludes that there is value in knowledge representation diagrams for ideation and makes recommendations for their use.

KEYWORDS | MIND MAPS, CREATIVITY, KNOWLEDGE REPRESENTATION, FRAME THEORY, CONCEPTUAL BLENDING

1. Context.

As lecturers, both researchers work on the BA(Hons) Graphic Design course at the XXXX XXXX XXXXXX. The project grew out of a conversation in which we both expressed a scepticism with regard to the value of mind-mapping as a method for ideation. Despite our scepticism, it was noticeable that mind-mapping was a feature of many students' work. We questioned whether this practice had become part of a "project culture" or "la cultura di progetto" (Julier, 2004, p.6) instilled through prior educational experience. Conversely, there are claims for the facility of Mind Maps™ and concept maps in the literature. Novak and Gowin (1984, p.17) state that, "concept mapping may be a creative activity and may help to foster creativity". Whereas Buzan and Buzan (2010, p.93) include being "able to create new associations from existing ideas" as a key feature of Mind Maps™.

The students' use of mind-mapping, together with such claims above, raised questions: were we undervaluing the usefulness of mind-mapping? What value did students attribute to this method? Or more simply, "What's happening here?" (Glaser, 1978).

Our conversations occurred during the assessment of fifteen submissions that were later entered for the International Society of Typographic Designers Student Assessment Scheme. These provided the sample for the research, the ISTD briefs were also included as data. Prior (cited in Charmaz (2014, p.45), notes how researchers can address what documents *do* as well as what they *contain*. These mind-maps, as part of the unit submission, and in relation to the ISTD scheme, are assessed. We should therefore acknowledge that what the mind-maps might do is present a systematic and smooth process of development in order to acquire marks. Another possibility is that they do little but are used unthinkingly; replicating previously instilled behaviour (Martin, 2006, p.262). In contrast however, there are numerous possible explanations for what mind-maps might legitimately do within a design task, including:

1. To develop lines of enquiry.
2. To scope a field of study.
3. To capture what the student already knows about the topic.
4. To break down and categorize complex words and phrases.
5. To make creative leaps.

Although students referred to their knowledge representations as "mind-maps", they are not Mind Maps™ as described by Buzan (2010). The students' diagrams did not follow the procedures advocated by Buzan (2010) in relation to Mind Maps™, or by Novak and Cañas (2006) in relation to concept maps. This project therefore analyses practices of knowledge representation as presented by undergraduate students rather than ideal examples from the literature.

The research was initially motivated by a wish to understand the reason *why* students engage with mind-mapping. A Grounded Theory, data first approach therefore seemed appropriate where concepts could emerge from the data itself. The question slowly turned

however, through the open coding stage, to questions about *what* kinds of knowledge were being used and the nature of the links made. Did these links resemble creative leaps or a more mundane filling in of the territory defined by the project brief?

2. Open coding stage

The open coding strategy follows Corbin and Strauss (2008, p.160) who describe a three-stage process, involving breaking "data into manageable pieces"; "interpreting those data"; and giving the pieces of data names that stand for the ideas they contain.

Coding schemes in the literature, are frequently based on interview transcripts (Charmaz 2014). These are essentially monomodal; using character strings to capture vocalisations stripped of intonation, physical gestures, and expressions. In contrast, the mind-maps which in part comprise the data for this project, are multimodal: involving multiple kinds of communicative resources. In the open coding phase, three different issues arose out of the dissimilarity between the coding of interview transcripts and mind-maps.

2.1 Units of analysis

The first difference involves the breaking down of data into units of analysis. In relation to interview transcripts, Charmaz (2014, p.127) lists the following: "Word-by-word, line-by-line, segment-by-segment, and incident-with-incident". This repertoire of units is not sufficient to engage with mind-maps as data. Meanings attributed to mind-maps are also mediated by such things as placement, and scale and depend on more dynamic spatial relationships with other network elements. Figure 1a is a schematic version of the first mind-map, analysed, this is abstracted further in Figure 1b. A range of different supplementary structures are defined below:

- There are individual *elements.*
- Elements are connected by *paths*.
- Two elements connected by a path make a *binary construction*.
- *Branches* are built out of one or more binary constructions.
- There is an element in the centre of the mind-map from which branches radiate, this is the *central node*.
- Paths can have a *direction,* for example moving from the centre to the periphery of the mind-map (indicated by arrows in the data).
- Binary constructions have an *inner element* closer to the centre of the mind-map and an *outer element* further from it.
- All of the elements at the same remove from the central node are referred to as being on the same *orbital*.
- All of the elements connected to one radial element are referred to as a *radial sub-network*.

- Elements not connected by a path to any other element are referred to as *radical elements*.
- *Links* are paths that link an element in one branch to an element in a different branch.

Figure 1a

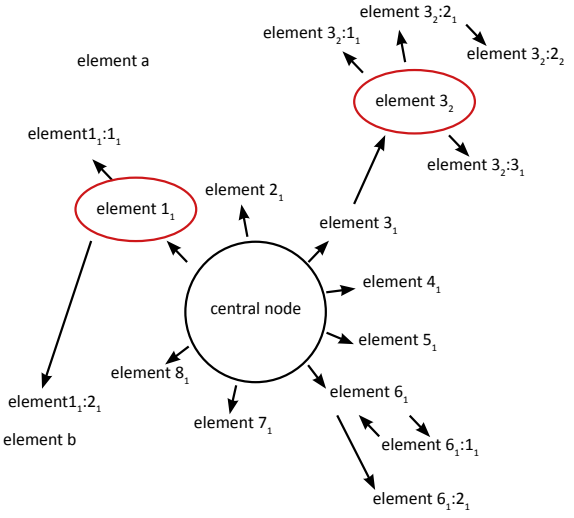

Figure1b

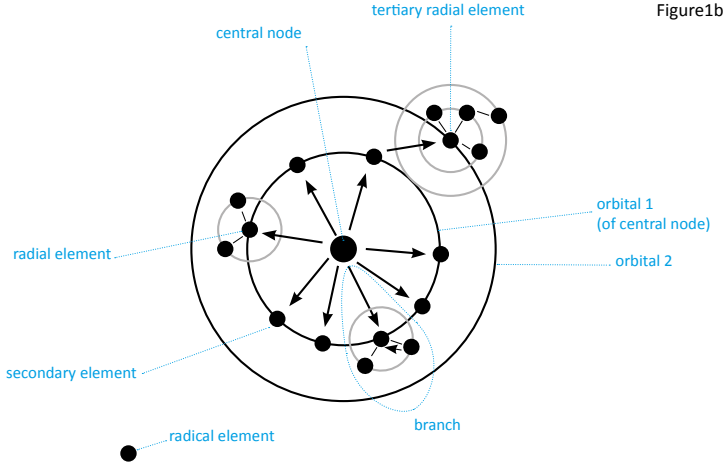

Figure 1.

In the open coding stage, it became apparent that patterns in the data are manifest in these additional units of analysis: different categories are often represented as branches for example. A focus emerged based on the links between elements. The binary construction provided the basic unit of analysis in the subsequent coding.

2.2 Reading paths

The second dissimilarity between data types arises from interview transcripts unfolding chronologically. This translates spatially into written text where each line reads from left to right, and each column from top to bottom. This same logic however does not apply to mind-maps which have any number of branches that can be read in any order.

2.3 Topics addressed by data

The topics explored in interviews are in many cases the focus of the researcher too. However, the topics explored by students in these mind-maps are not the primary focus, but rather, the relationships established by linking topics – whether the relationships are categorical or cause/effect for instance. It is at this more generalised level of analysis that we can begin to form inferences about the originality of the connections made between topics.

2.4 Coding Procedure

The coding procedure entailed starting at the central node and then moving out along one branch toward the periphery, this was then repeated for each branch. Branches included different kinds of links: chronological, categorical, etc. But these different connections frequently linked concepts directly related to the brief. This quality of the mind-maps – to remain categorically related to the central node – was emphasised when links were made to elements not circumscribed by the brief, and these appeared to be far fewer in number. This observation in the first round of coding led to the study focus, and two core concepts: *internal linking* and *cross-space mapping*.

3. Core categories: internal linking and cross-space mapping

As the first round of coding progressed it was noticeable that there were different levels of creativity in terms of the links made. One aspect of this concerned categorisation; if the outer-element was a sub-category of the inner-element this suggested a logical, straightforward association. If on the other hand, the outer-element belonged to a different category far removed from the inner-element, then this suggested a more creative association. The researchers were familiar with: conceptual blending theory (Fauconnier 1994; Fauconnier and Turner 2002), and frame semantics (Fillmore 2006), and recognised that these theories could provide useful conceptual tools for analysing the links between elements in mind-maps. Two concepts in particular were utilised: *mental spaces* and *frames*.

Mental spaces are constructed in the moment, as we think, for purposes of understanding. They are, "interconnected in working memory, can be modified dynamically as thought and discourse unfold" (Fauconnier and Turner, 2002, p.102). Many spaces can be active simultaneously enabling us to capture useful information from long-term memory and link them together in various ways.

The idea of a frame in Fillmore's theory is that words attain their meaning through the relationship they have to a structured conceptual setting. The often-cited example is the commercial event frame (Fillmore, 2006, p.378). Here a word such as "sell" is understood because of its relationship to other words such as "buy" and "seller" in the same conceptual setting.

Mental spaces can recruit elements from different frames, and whole spaces can be organised by a frame: whereby every element in the space is organised with reference to one conceptual setting.

The assumption in this article is that, within design culture, there is a familiar frame for a "brief" Although each brief is unique, there are recurring features in the way briefs are written. Analysis of the ISTD brief data yielded such recurring features (Figure 2a)

Each of these features – using the terminology of cognitive linguistics (Coulson 2001, p.19) – are *slots* that can be *filled* differently according to the brief concerned. Encountering a brief will prompt the construction of a mental space in which these slots are filled by elements. Though different elements can come from different conceptual frames they are still organised by the brief frame. We therefore think about them in terms of how they participate within the context of a brief.

An illustration is probably useful at this point. One generic feature of the brief frame listed in Figure 2a is *meanings to communicate* and such meanings can be tightly or loosely defined. The *Anniversaries* brief requires the communication of meanings about anniversaries and "Anniversaries" is therefore a filler for the slot *meanings to communicate.* Different students took this "anniversaries" filler and interpreted it at a more specific level. One, for example, focused on alcoholic spirits which introduces another frame (but this time not an organising frame): *making alcoholic spirits*. In this case, the alcoholic spirit is a cognac ready to drink on its 100th anniversary. This processing involves the construction of a mental space organised by the brief frame. The brief frame recruits those elements from the *making alcoholic spirits* frame that are relevant to the *Anniversaries* filler.

As the illustration below demonstrates there were different levels of generalisation amongst the codes emerging from the brief data. The mind-map data codes also showed different levels of generalisation, corresponding to those of the brief data (Figure 2b).

Figure 2a. Recurring codes from the brief data. All of these are potential fillers for the slot at level 3 of figure 2b.

Elements of brief frame
the product to be designed,
the audience or user,
the design problem,
the social and cultural context,
desired outcomes (deliverables),
technical and/or commercial constraints,
meanings to communicate (propositions),
tone of voice

Figure 2b. Hierarchy of different levels of frame components.

Level	Frame component	Potential instantiations of frame component	Level of generalisation
1	Frame:	Brief	High
2	Sub-frame of brief frame:	ISTD Anniversaries Brief	
3	Element of brief frame (slot): -part of frame	For example, meanings to communicate	
4	Type of meaning to communicate (filler): -part of sub-frame	For example, anniversary	
5 and below	Specific meaning to communicate: -student's response to Anniversaries Brief	For example, 100 year old cognac	Low

ISTD Brief	The 'potential meanings to communicate' element of the brief frame
Anniversaries	Anniversary, plants ('roots' used metaphorically to suggest the start of something), cyclical nature of the universe, typography.
Writing women into history	Recognising achievement, fields of endeavour, history, sexual equality, typography.
Mark my words	Abundance of language, language accretion, word history (including etymology), typography.
Food for thought	Analysing societies, distribution of dishes, history, food preparation, representation, typography.

Figure 2c. Different types of meaning to communicate as indicated by the ISTD briefs. All of these are potential fillers for the slot at level 4 of figure 2b.

Figure 2.

All of the codes in Figure 2a are potential fillers for the level 3 slot "Elements of the brief frame" in Figure 2b. The codes from the brief data related to level 4 of Figure 2b (the type of meaning to communicate) are listed in Figure 2c.

This conceptual framework of mental spaces, and frames, is used to distinguish between links that stay within the territory delineated by the brief, and those that connect to other outside elements. It is questionable as to whether it is desirable to be completely confined to the space delineated by a brief. While the brief's aims, and specifications cannot be ignored, designers often use other means such as metaphorical expressions to communicate which can involve two organising frames. Within mind-mapping this can be indicated by including two central nodes in the mind-map and by making links between these two networks.

The importance of making links to different domains is recognised by Novak and Cañas (2008) in relation to concept maps, and in "double-scope networks" described by conceptual blending theory (Fauconnier and Turner, 2002, p.340).

The idea of relating concepts from two separate and distinct domains unites the concept of *cross-space mapping* – that emerged in this study- – with: *transfer recall (*Guilford, 1967, p.214)*, bisociation* (Koestler, 1964, p.35) and *cross-domain transfer* (Pereira, 2007, p.3), described in theories of creativity. These are all forms of what Guilford (1967) termed *divergent production*. Furthermore, according to Pereira (2007, p.29) *convergent production* is also linked to creativity, if this is understood as the "creation of a *novel* and *useful* product" (emphasis in the original). Here, divergent processes provide novelty while convergent processes provide usefulness.

We should not be too dismissive of working entirely with the conceptual elements circumscribed by the brief. As we have said this mental space will contain elements from different conceptual domains and it is possible to make metaphorical or counterfactual links between these also. In mind-maps this can be represented by making links between the different branches of the mind-map.

Just as c*ross-space mapping* loosely corresponds to aspects of divergent production, *internal linking* – which concerns associations made within one mental space – suggests convergent production. The twin aspects of convergent and divergent production that are a prominent feature of theories of creativity are therefore supported by the codes emerging from the data.

4. Second stage coding

The central nodes in all the mind-map data refer to the ISTD briefs, although some more explicitly than others. The assumption is that the central node prompts for the construction of a mental space, thereby evoking an organising brief frame. Those elements of the mind-maps that form part of this mental space should therefore be coded as examples of internal linking; those on the other hand that fall outside of this mental space are candidates for cross-space mapping. This coding stage employed a two-track strategy.

This strategy involved working progressively outward through the binary constructions in each branch. If the inner and outer elements of each binary construction were deemed to be 1) in the same frame, and 2) related to the organising brief frame evoked by each brief; then the link between these elements was recorded as an internal link. If, on the other hand, one of these conditions was not met then this raised the possibility that the link was a cross-space mapping, requiring further scrutiny of the binary construction to determine which frames were involved.

At this point it is probably helpful to provide examples of different scenarios, emerging from the data.

Table 1. Internal linking using a single conceptual domain. ISTD brief, Anniversaries.

Elements from the data
Central node: “Anniversary”
Element 1_1: “Culture”
Element 1_2: “Thanksgiving”

Here the topic “anniversary” is provided by the brief’s title. Of all the yearly events that take place, some are “cultural” and within those is a particular anniversary “thanksgiving”. This involves a movement from the generic to the more specific within one frame – anniversary.

Table 2. Internal linking using two conceptual domains. ISTD brief, Writing women into history.

Elements from the data
Central node: Writing women into history
Element 1_1: Hidden figures
Element 1_2: NASA

In this example NASA is not an established sub-category of “hidden figures” in the same way that “thanksgiving” is in relation to “culture”. The label “hidden figures” is part of the “recognising achievement” frame while “NASA” belongs to the “fields of endeavour” frame (Figure 2c). Consequently, this construction requires more work from the reader to determine which part of the “NASA” frame relates to the frame “hidden figures” (workers in NASA that are “hidden” from history). Also, we are not interested in all hidden figures, only those that are women (a focus handed down from the central node). This branch therefore results in a similar movement from the generic to the specific as in example 1 but one that requires more processing since two frames are more clearly involved. However, since both frames are part of the same organising frame evoked by the brief, this is still an example of internal linking, rather than cross-space mapping.

Table 3. Cross-space mapping using two conceptual domains (two organising frames – metaphorical). ISTD brief, Mark my Words.

Central node: “C word” and typography	
Branch 1	**Branch 2**
Element 1_1: Sound	Element 2_1: Punctuation -Bullets + Ammunition
Element 1_2: Short quick →	Element 2_2: Gun shot

In this example two elements are linked suggesting the metaphor expletive is gun shot. The “short quick” sound of the “c word” linking here to “gun-shot”. This involves two different organising frames: that of words and typography (part of the brief frame), and the shooting of guns (external to the brief’s organising frame). Interestingly the recruitment of this

second frame seems to have happened in Element 2_1 where an association is made between a bullet point (a typographic glyph) and bullets/ammunition. The implicatures of this metaphor would seem to provide useful communicative potential so that swear words become *wounding* and are *fired off* in a hostile act.

Table 4. Cross-space mapping using two conceptual domains (two organising frames – counterfactual). ISTD brief, Mark my Words.

Elements from the data
Central node: "what if"
Element 1: "nice had a smell"

This central node here makes an indirect reference to an ISTD brief; the connection is only clear once the link is made between "what if" and "nice had a smell" since "nice" is explored in relation to the "Mark My Words" brief. The cognitive work involved in this "what if" processing is impressive. "Nice" is of course a word used to *describe* physical things or events and is therefore part of the language frame. But the "what if" – "nice had a smell" construction forces us to think of "nice" not as a word but as part of another frame, one of physical things. When combined with this second frame "nice" becomes itself an *object* that is available for scrutiny by our sensory organs - it has a smell. This objectified imagined manifestation of "nice" moves it outside of the language related elements listed in Figure 2c. It is an example of a counterfactual construction.

All of the data were coded on the same basis as these examples and were assessed as being a case of internal linking or cross-space mapping using the criteria discussed above. Codes were collected and analysed using NVivo 12 software.

5. Results

The sample consists of fifteen students who entered the 2018 ISTD Student Assessment Scheme. Of these entrants, ten produced mind-maps as part of their submissions and nine of these participated in the study. There were fourteen different mind-maps produced by these nine students, all of which were coded and analysed.

Database queries of the codes yielded 301 links that were assessed as being internal linking, as opposed to 23 links being assessed as cross-space mapping. Of the 23 cross-space links, twelve came from a single mind-map that labelled the central node "what-if". The other 11 cross-space mappings were distributed across two other mind-maps; of those one had a central node providing a level 3 (see Figure 2b) reference to the brief, this provided nine cross-space mappings. The remaining one was a response to the *Anniversaries* brief and the central node was labelled "whiskey + distilleries + spirits", this mind-map yielded two cross-space mappings. Overall there were 16 links which were either illegible or so vague or ambiguous that it was decided that their inclusion in the study would introduce unreliability.

With regard to examples of counterfactual thinking, there were two examples of counterfactual thinking as internal linking, and 12 cases in which it occurred across spaces.

6. Discussion

This study began with a degree of scepticism as to the efficacy of mind-mapping as a tool for idea generation. The coding results at first suggested that this scepticism was not misplaced, with comparatively few cross-space mappings in relation to the number of internal links established. The nature of the internal links is often rational, relevant but somewhat unsurprising, consisting – as many do – of categorical links stepping down from superordinate classes, to subordinate classes. Generally, the mind-maps tend not, to provide links to more distant conceptual domains suggestive of divergent thinking.

Yet there was one exception that generated twelve out of the total of 25 cross-space links. What differentiated this mind-map from the others was the placement of "what if" in the central node of the mind-map – rather than a more direct link to a brief. The "what if [x was …?]" statement prompted counterfactual scenarios to be imagined that often included concepts from domains distant from those organised by the brief in question. Further possibilities could be achieved by placing other questions at the centre of mind-maps "x as …?", or "x is …?" for example, and this could be a source for further study.

The second most productive mind-map (nine cross-space mappings) has "c**t & typography" in its central node. This expression itself involves two conceptual domains; that of typography and the body. This may explain why the mind-map constructed around this node was so prolific in terms of cross-space mappings.

A further reflection on the mind-maps concerns the way that the central node potentially frames enquiry. By starting with a superordinate class in the central node there is the question of whether this primes the creator of the mind-map to think of other categories, rather than say attributes or abstract qualities. For example, in one of the mind-maps, "Anniversaries" is placed in the central node which links to another radial element "Cyclical nature of the universe". This might have triggered an exploration of the abstract quality of cycles, building associations with domains not directly related to anniversaries such as bicycles, vinyl records, and so forth. Mapping a single revolution of a record to the year of a life, could result in surprising outcomes that highlight different aspects of anniversaries. For example, a revolution on the periphery of a record is longer than a revolution closer to the centre; which is reflective of the experience of time passing more quickly as we get older. However, it would seem that the line of reasoning set up by the superordinate category of "anniversaries" led not to the abstract quality of *cycles* but to the category of *astronomical cycles* – which is a less creative leap, since the annual cycle of the Earth around the Sun links directly to the concept of "anniversary". The question arises therefore as to whether mind-mapping constrained thinking in this case.

Pereira's observation above is worth consideration here, where he notes that a creative product should be both novel and useful, and that these attributes arise from divergent and convergent production respectively. If "usefulness" in this context is translatable as "relevance", it appears that most of the internal links made in these mind-maps have quite a high degree of relevance to the idea placed within the central node. At first glance, the cross-space mappings perhaps less so. But according to Schilperoord's (2018: 14) summation of current accounts of metaphorical meaning, the incongruity resulting from the juxtaposition of "two objects stemming from disparate domains" is an important prompt for metaphorical association. It induces the viewer/reader to do cognitive work that finds the connection between two seemingly disparate things. The importance of these cross-space mappings should not therefore be undervalued.

If there are priming effects at work in mind-maps then this might account for the disproportionate number of internal links reported in the results, since one element in the mind-map would prime the creator of the mind-map to find another element closely associated with it in memory – and this suggests convergent production. Consequently, whatever appears in the central node would frame and to some extent determine, what appears in the branches that radiate from it. It could be argued that this is precisely the point of mind-maps. But if this is the case, is there less opportunity for the divergent, cross-space mapping of which the brain is capable? It is conceivable that this potential is even suppressed, in the creation of mind-maps.

From the admittedly small number of mind-maps analysed in this article, it would seem one way to open up mind-mapping to divergent, cross-space mapping is to put questions such as "what if x was …" in the central node of the mind-map rather than simply the name of a category.

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