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Designing Dynamic Logotypes to Represent Data

Jéssica Parente, CISUC - Department of Informatics Engineering, University of Coimbra, Coimbra, Portugal

Tiago Martins, CISUC - Department of Informatics Engineering, University of Coimbra, Coimbra, Portugal

João Bicker, CISUC - Department of Informatics Engineering, University of Coimbra, Coimbra, Portugal

Penousal Machado, CISUC - Department of Informatics Engineering, University of Coimbra, Coimbra, Portugal

ABSTRACT

This work explores how data can influence the design of logotypes and how they can convey information. The authors use the University of Coimbra, in Portugal, as a case study to develop data-driven logotypes for its faculties and, subsequently, for its students. The proposed logotypes are influenced by the current number of students in each faculty, the number of male and female students, and the nationality of the students. The resulting logotypes are able to portray the diversity of students in each faculty. The authors also test this design approach in the creation of logotypes for the students according to their academic information, namely the course and number of credits done. The resulting logotypes are able to adapt to the current students, evolving over time with the departure of students and admission of new ones.

KEYWORDS

Data Aesthetics, Data-Driven Design, Generative Design, Graphic Design, Information Visualisation, Logotype, Type Design, Typography

INTRODUCTION

Typography is a way of visualising language (Cheng, 2006). To designers, typography is valuable as it adds a layer of content and the choice of a typeface gives indications regarding the subject that is being addressed. In order to use typography in the best way, many designers study their anatomy and ways of categorising it.

Over time, the design of type suffered several changes. In the beginning, typographers tried to create alphabets with pure and uncorrupted letters. However, with the emergence of avant-garde movements, vision and expression aspects were overcome. Afterwards, the technological revolution created new possibilities for typographic experimentation. The design of typefaces through code helped the automation of the design process, making it possible for computers to generate new typefaces in seconds. As a result, new typefaces emerge to adapt to distinct contexts (Lehni, 2011; Knuth, 1986).

Technological advancements, along with the proliferation of the Internet, allow the exploration of new creative areas. The evolution of tools for typographic construction promotes the increase of typography creation. Moreover, in modern society, there is an insatiable need to personalise everything whenever possible.

Visual identities created nowadays are becoming more dynamic. Museums, institutions, organisations, events and media are increasingly relying on this kind of identities. A comprehensive survey on dynamic visual identities is presented, for example, by Martins et al. (2019). This type of visual identity is characterised by variability, context-relatedness, processuality, performativity and non-linearity (Felsing, 2010).

Informed by this background, the authors explore through this work the intersection of type design, visual identity and information visualisation, investigating how can data influence the design of a logotype and how can a logotype convey information. As a result, the authors develop data-driven logotypes for the faculties and students of their university — the University of Coimbra (UC), in Portugal. To do so, a computational generative process is presented to dynamically design the glyphs, or letterforms, that compose the logotype according to input data on the faculties or students. This way, the logotypes are able to adapt to the current spectrum of students of the University of Coimbra, while incorporating and unifying the faculties or students in a coherent fashion.

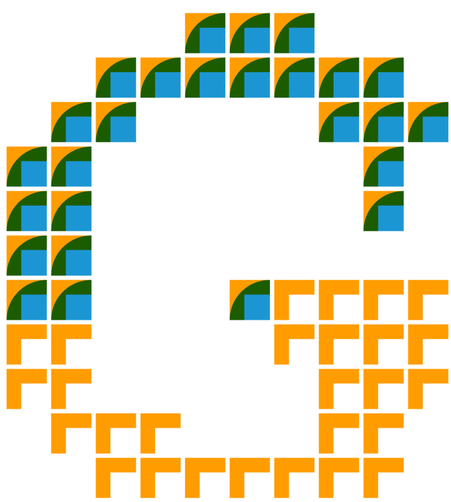
The experimental process behind this work comprises four successive iterations. In iterations I, II, and III, the authors aim to design logotypes for the faculties of the University of Coimbra. Therefore, the input data consists of the number of students in each faculty, the number of male and female students, and the nationality of the students. In iteration IV, the approach developed in iteration III is used to design logotypes for the individual students of the University of Coimbra. So, the input data consists of the course and the number of credits done by each student.

The remainder of the paper is structured as follows: Background section describes design projects where visual identities and typefaces are influenced by data; Approach section concerns the development of presented work, summarising four different iterations and their specificities; finally, Conclusion section presents some overall conclusions and discusses future work.

BACKGROUND

This section is divided into three parts. The first part introduces type design projects that take advantage of digital media and challenge traditional typographic creation. The second part presents projects that

Figure 1. Typical glyph for letter 'G' generated in iteration IV of the present approach. More results at cdv.dei.uc.pt/data-logotype.



use generative techniques and data inputs to influence type design. The last part concerns dynamic and informative visual identities that react to external data.

Dynamic Type Design

Initially, typographic creation was restricted to the analogue medium and the reading conditioned to books and newspapers. However, with the emergence of the Internet, online reading becomes possible and new opportunities for typographic exploration arose. As a result, it becomes frequent the appearing of typographic solutions originated in the digital medium and typographic solutions that evolve from digital to analogue. Furthermore, nowadays, typefaces make use of layers and colour (Typo, 2017), and become increasingly more dynamic.

Intersect is a typographic system created by Paul McNeil and Hamish Muir. It is characterised by the fact that it does not use a binary contrast (black and white, shape and counterform). The *Intersect* typefaces have a large spectrum of weights that create the illusion of density. The system also allows a large variety of visual possibilities, the *Intersect* typefaces could have a series of layers and in total there are 256 variations (McNeil & Muir, 2014). *Novo Typo Color Book* is a typographic book developed by Novo Typo studio. This is another project related to the use of layers and application of colours. The main goal is the transformation of a contemporary design into a historical typographic printing technique. The book is constituted by a set of colourful typefaces, and it marks a new way of seeing the design of type: more targeted to the mines of designers, art directors and typesetters. This book takes advantage of the use of colours, it departs from positive and negative forms and the contrast of black typography on a white page (Typo, 2017).

Both *Intersect* and *Novo Typo Color Book* projects explore a range of opportunities created by the technological revolution regarding the use of colour and layers in typographic creation. Colour can be used along with type styles and weights to define the hierarchy in a typographic composition.

Data-Driven Type Design

The spectrum of type design projects that react to external data is growing. In most of the existing projects in this field, the input data is random. Projects such as *Irratio* by Ingo Reinheimer (Reinheimer, 2009), *Zwirn* by Lisa Reimann (Reimann, 2009) and *Pong* (Mainz, 2008a) by Kersten Stahl are some of these projects, which were all developed in Processing in 2008. *Irratio* and *Pong* are created from the combination of random Bézier lines. Irratio generates typefaces using skeletons of existing non-serifed typefaces. The generation happens by the creation of curves from an anchor point or vertex to another one successively. *Zwirn* is characterised by the interlacing of the letters of a word by drawing dots into the outline of the letters. The user could change a set of parameters, for instance, the number of lines. *Pong* is based on the metaphor of a ball that draws a line within each letter. The created typeface can be composed of lines or curves, which may vary in weight and colour. The user can also determine the text that is drawn.

Sound is also used as input in some generative type design projects. *Blast* (Mainz, 2008b) and *Typography Music* (Silanteva, 2011) are two projects that generate typefaces that react to music. In 2008, Denis Klein created *Blast*, an experimental and generative typeface developed in Processing. The visual aspect of the typeface created result from the analysis of the music; its appearance, shape and thickness act as a visual interpretation of it. The music is analysed in real-time, directly influencing the visual shape of the typeface. *Typography Music* is a typographic investigation by Dina Silanteva in 2011. The created system generates glyphs that react to music. The letters are formed from a basic grid and constructed by the combination of layers. Each layer is constituted by a range of modules and the shape of each module changes with the type of music: (i) for an organic sound the modules are circles; (ii) for an analogue sound the modules are octagons; and (iii) for digital sounds the modules are squares. Then, these modules suffer changes, for example, the radius change according to the duration of the sound. These two projects have the advantage of allowing the creation of a wide spectrum of possible visual variations. Furthermore, they created typefaces that adapt to the received data and for that reason, they create a visualisation of these data. Besides, when compared to static typefaces they stand out due to the easy adaptation to sound contexts.

Some generative type design systems use as input emotions. *Coloquy* is an example of this and it was developed by Joel Baker. The *Coloquy* system analyses a text written by the user and modifies the visual form of the glyphs in real-time. The resulting glyphs are distorted and expanded according to the text content (Baker, n.d.). *TypeFace* is another project in the same context. The authorship is associated with Mary Huang and it consists of software that translates facial expressions into generative typefaces. The OpenCV library is used to detect user expressions (Huang, 2011).

There are also typographic projects for interactive installations. In 2009, Michael Flückiger and Nicolas Kunz created *LAIKA*, a dynamic typeface that reacts to user interaction. The system is developed in Processing and is used in installations with sensors or audiovisual data fetched from the Internet. The resulting typeface dynamically changes its weight, contrast, serif size and slope. It was created to be used in the digital medium, so it did not need to be static and rigid. The system also allows the parameters alteration in real-time and it can be applied in dynamic texts. The dynamism and interactivity of *LAIKA* come to inspire new approaches to the use of digital types (Flückiger & Kunz, 2009).

Informative Dynamic Visual Identities

Over the last few years, there is an evident demand for dynamic visual identities (Martins et al., 2019). This type of visual identities is characterised by variability, context-relatedness, processuality, performativity, and non-linearity (Felsing, 2010). Many organisations, institutions, museums, and even places, are embracing dynamic visual identities to achieve different goals, including the representation of products (e.g. Priba, by Allied International Designers and Geoff Gibbons in 1973), programmes of events (e.g. Casa da Música, by Stefan Sagmeister in 2007), and collections (e.g. House of Visual Culture, by Edhv in 2011) (Nes, 2012; Lin, 2013). Martins et al. (2019) provide a comprehensive review of the state-of-the-art on dynamic visual identities as well as a model for analysing this type of visual identities.

This work concerns one particular category of dynamic visual identities — the informative. Informative dynamic visual identities provide information to the audience and are typically used to communicate messages or to identify products, services, sections, or personnel (Martins et al., 2019).

In 2002, Tomato developed the identity to TV Asahi, a TV broadcaster in the Japanese media industry. The identity is composed of several rectangular blocks that changed their position according to the sounds they "ear". The blocks' size change according to the staff members of the company, its programs and businesses. Besides being informative, the identity of the TV broadcaster is also dynamic and generative (Nes, 2012).

Another informative identity is the one created by the Neue Design Studio to Nordkyn peninsula in 2010. The identity is affected by weather statistics: (i) the colour changes with the variation of temperature; and (ii) the shape changes according to the wind's direction and velocity. The brand logo, used on the site, reflects the climatic conditions of the region and is updated every five minutes (Nes, 2012; Lin, 2013). This identity will always be in constant development, because it changes according to the wind conditions.

In 2010, COOEE created the identity for the New Prevention Technologies. The identity was developed to the Global Network of People living with HIV and AIDS. The basis for the creation of the identity was the continued development of prevention technological. The identity is composed of different lines around a circle and each line represents a prevention technology. One advantage of this identity is that it can be enriched over time with the addition of new prevention technologies (Nes, 2012; Lin, 2013).

In 2011, Maxim Pavlov developed a dynamic logotype for Gogol.tv. This logotype is based on the profile of Gogol's head. Later, seven more characters were created to represent the different sections (e.g. politics, progress, culture, etc.). Over time, the heads have become the main icons of the site. The similar factor among all the characters is the profile of the man's head within each of them (Lin, 2013).

Another example of an informative and dynamic visual identity is the Shanghai Biennale, in 2012. The identity was created by Re to the biggest event of international art in mainland China. The identity explores the transformation of the Sydney with the theme "Floating Eye". For the identity, they create a series of symbols to describe the main principles of the exposition. The main curiosity of this identity is the combination of two variables — state (Temporality, Oscillation, Observation, etc.) and thing (Geography, Culture, Demography, etc.), resulting in the creation of a third meaning. Moreover, the fact that the variables are represented by a symbol turned the identity interpretable for any language; the identity crossed the linguistic barrier (Re, 2016).

APPROACH

A university usually contains different faculties, each one representing one area of study. This diversity of areas translates into a vast spectrum of students. In this work, the authors aim to create logotypes that provide information about the students of a given university, namely the University of Coimbra, which is their university. They develop dynamic logotypes to be able to represent and distinguish the different faculties of the University of Coimbra in a coherent fashion. It is also important that the logotypes can change over time, adapting to the current students in each faculty. It is known that human beings create stereotypes. So, it is natural that people consider that in an art bachelor, the number of women is higher than the number of men. However, sometimes, the stereotypes do not correspond to reality, so it can be interesting to consider this aspect in the logotypes.

The University of Coimbra is composed of a large number of students and, consequently, a very diverse group of people. This diversity can be represented through a set of different elements, e.g. typefaces. To represent the diversity of the students the authors use four types of typographic classification — *garaldes*, *reales, didones* and *linear* — and for each of them, they select some typefaces and combine them, similarly to what happens in the project *Fontmixer* by Stefanie Oppenha (Oppenhaüser, 2009). In *Fontmixer*, the user selects a set of typefaces and determine if they are added or subtracted to each other. In the presented work the method is a bit different. The authors use the acronyms of each faculty to create the logotypes and the typefaces are only overlapped. The main goal is to standardise the characteristics of the group of the chosen typefaces.

Iteration I

The authors aim to create logotypes for the faculties of the University of Coimbra. So, after the creation of the glyphs, they find a way to add the data, through the filling of the shapes. The data was mostly collected from the website of the University of Coimbra. They use only data about bachelor and master courses from eight faculties: Arts and Humanities (FLUC), Law (FDUC), Science and Technology (FCTUC), Pharmacy (FFUC), Economics (FEUC), Psychology and Education Sciences (FPCEUC), Sports Sciences and Physical Education (FCDEFUC), and Medicine (FMUC). The collected data is represented in Table 1. For the nationality of the students four groups are used: Portuguese students (PT), students from countries with Portuguese as the official language (PL), students from countries in the European Union (EU), and students from other countries (O).

As previously mentioned, one goal of this work is the use of typography as a layer of knowledge. For that reason, the literal use of layers became natural. The logotypes represent three variables: nationality, gender and the number of students. The authors associate the density of elements present in each glyph to the number of students. In order to combine all the variables, the authors set a colour to each nationality and a punctuation mark to each gender. To distinguish each gender more easily,

Table 1. Collected data on the students who constituted each faculty of the University of Coimbra in 2015

Faculty	Gender	Nationality				Number of Students	
		PT	PL	EU	O		
FLUC	female	1290	135	24	21	1470	2447
	male	857	90	16	14	977	
FDUC	female	1510	319	10	10	1850	2890
	male	859	180	6	6	1040	
FCTUC	female	2202	166	19	49	2437	6210
	male	3410	258	30	76	3773	
FFUC	female	956	17	2	5	980	1272
	male	285	5	1	1	292	
FEUC	female	860	139	12	21	1033	1984
	male	792	128	12	20	951	
FPCEUC	female	1211	84	15	4	1314	1524
	male	193	14	2	1	210	
FCDEFUC	female	228	11	0	1	240	676
	male	413	21	0	2	436	
FMUC	female	1464	33	6	5	1507	2259
	male	730	16	3	2	752	

they create two layers, one for each gender. The layers have the shape of the glyphs previously created and they are overlapped, but not aligned.

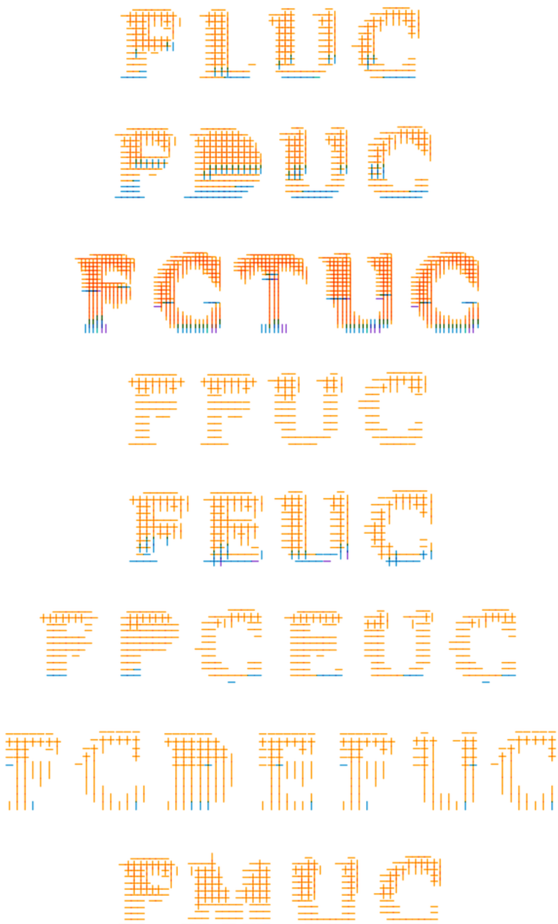
The number of students of each faculty is visually represented through the density of elements that compose the corresponding logotypes. To do this, the density of each logotype is normalised according to the maximum number of students per faculty, and the minimum and maximum density levels are also established. The positioning of the elements in each layer is constrained by a preset grid. After defining the density of the grid for each faculty logotype, the glyphs are drawn. For each letter of the acronym, the shape is traversed from the upper left corner to the lower right corner, from n to n pixels according to the corresponding density and verified whether the pixels are contained inside the shape or not.

Each glyph has two layers, each one representative of a gender. These layers are composed according to the number of female and male students. Thus, the gender with the highest number of students fills the entire layer. As a result, the layer of the gender with the lowest number of students is filled in relation to the number of students represented by another layer. In order to visualise all the elements, a multiply effect is employed.

After some tests, the authors arrive at the results presented in Figure 2. The punctuation marks “|” and “-” represent the male and the female gender respectively. Orange is used to represent Portuguese students, blue is used to represent students from countries with Portuguese as the official language, green is used to represent students from European Union, and purple is used to represent students from other countries.

In this iteration, the overlapping colours are equal, for the most part. Therefore, they do not take much advantage of the multiply effects between the layers, not producing a third colour. This happens because the colour associated with Portuguese students dominates the other colours. The chosen modules may also be creating some representation problems.

Figure 2. Logotypes generated in Iteration I. The modules (punctuation marks) represent the students' genders; the colours represent the students' nationalities and the modules' density represents the number of students.



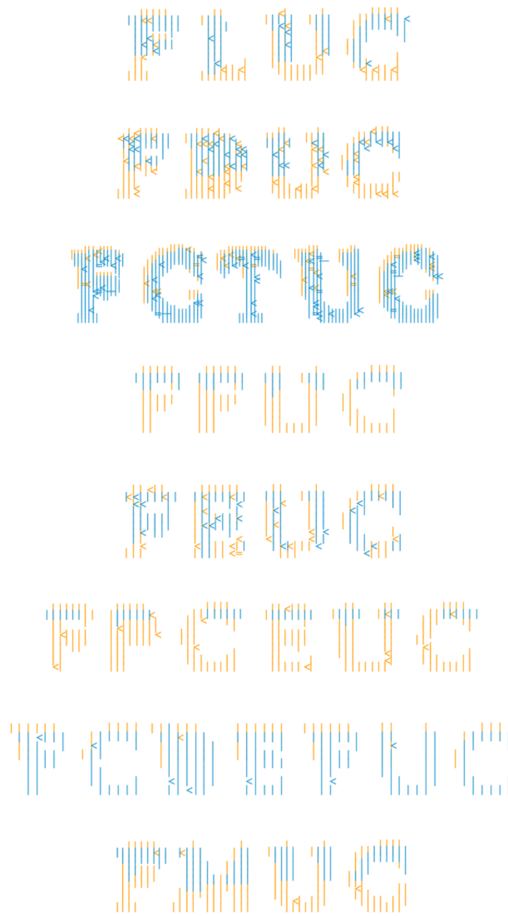
Iteration II

In this iteration, the goal is to minimise or even remove the problems of the previous one. Now, the colour represents genders and punctuation marks represent nationalities. This way, it is possible to identify the different nationalities and to create a third colour, a consequence of the overlay. The use of layers to distinct genders remains.

Similarly, to the previous iteration, the authors calculate the maximum number of students in each faculty. However, now they also determine the minimum (in the previous iteration this value was always zero). This way, they are able to increase the contrast between densities. In this iteration, the faculty with fewer students has the minimum preset density level. Moreover, the authors make another modification to make the logotypes more homogeneous; now, the elements are inserted randomly in each layer. This only changes the way the elements are positioned.

After some experimentation, the authors achieved the results presented in Figure 3. The colours orange and blue represent the female and male gender, respectively. However, in this iteration, the element "|" represents Portuguese students, "<" represents students from countries with Portuguese as official language, "–" represents students from within the European Union, and "=" represents students from other countries. They tried to use a more discreet element to represent the Portuguese students because it gains emphasis due to its quantity.

Figure 3. Logotypes generated in iteration II. The modules (punctuation marks) represent the students' nationalities; the colours represent the students' gender; and the modules' density represents the number of students.



It is possible to notice some improvements in this iteration in comparison to the previous one, for instance, the changes in the symbology helped to better distinguish the nationalities. Also, punctuation marks are now used to represent the nationalities. The presented results have an improvement in the overlapping of the layers however it is not possible distinguished where each layer begins and ends. However, the third colour originated from the overlay of the elements rarely appears. The increasing of the area of each element could minimise this problem and make it possible to see the overlay of the layers.

Iteration III

In this iteration, the authors use modules previously designed instead of punctuation marks to represent the nationalities. The goal is to facilitate the visualisation of the intersection between layers. Furthermore, with this change, the details are reduced. Relative to the remaining variables, they maintain the symbology applied in the previous iteration (an element to represent nationality; a layer and a colour to represent each gender). However, the way the elements are positioned in each layer is changed. The authors decide to make this change because if the representative elements of the nationalities with fewer students were far from each other it is possible that they will go unnoticed.

In the previous iteration, the ordering of the elements was random so this could happen. In this iteration, they decided to go back to the way they ordered the elements in the iteration I (from left to right and from top to bottom).

After some experimentation, the authors notice that sometimes some elements of the two layers are completely superimposed. This is due to the fact that the elements used are, for the most part, representative of the Portuguese students. As previously mentioned, this happens because the number of Portuguese students is much higher than the remaining nationalities. Therefore, a large part of the overlapping elements is similar, but in another colour (they belong to different genders, but they are of the same nationality). As a consequence, the logotypes of some faculties have only two colours (a representative colour of gender and a colour that comes from the intersection of the two layers). In order to overcome this problem, the authors apply a rotation to the modules according to the layer in which they are located. They expect that this alteration allows the differentiation of the overlapping layers, thus highlighting the male and female elements.

After some tests, the authors arrive at the results shown in Figure 4. As for the modules, they use the same colours as the previous iteration and the following modules: right triangle for Portuguese

Figure 4. Logotypes generated in iteration III. The modules represent the students' nationalities; the colours represent the students' gender; and the modules' density represents the number of students.

students, circle for students from countries with Portuguese as the official language, the other triangle for students from other countries in the European Union, and a line for students from other countries.

Now, with the application of different rotations to the modules, it is possible to visualise each layer and the intersections between them. Moreover, through the generated logotypes it is possible to make some conclusions regarding the students who compose each faculty. First of all, it is possible to distinguish the various faculties by observing the densities. FCTUC is the faculty with more students and, in contrast, FCDEFUC is the one with less. It is also noticeable that in the faculties do not have the same ratio of female/male students. As predicted, FCDEFUC has more male students than female, and FPCEUC has more female students.

As previously discussed, to calculate the density applied to each logotype, it is necessary to establish the minimum and maximum density levels. In the development process, the authors felt the need to test these values. After some tests, they concluded that in order to reduce the size of the logotype it is necessary to reduce the maximum and minimum density; that way the detail is reduced (Figure 5 presents five density levels). In addition, they also tested the area occupied by each module in the grid (see Figure 6).

Iteration IV

In the previous iteration, the resulting logotypes respond to the goal of this work. However, the authors believe that the system could also be applied to represent other kinds of data. In this iteration, they create another approach where they generate individual logotypes for students. They use the glyphs of the previous iterations for the same purpose — to translate the variety of the students. The name of each student is used to develop each logotype.

However, in this iteration, the authors use different data. They use academic data of the students — current course type (e.g. bachelor's degree or master's degree), done credits, and previous courses — to better identify each student. In a very large spectrum of students, there are many with this same nationality and gender so the variables used before would not work.

For this iteration, the data used is fictional, because this kind of data about the students is not publicly available. Table 2 presents the data used, they create four fictional students and establish different courses and cycles for each one of them.

Figure 5. Glyphs for letter F with different levels of modules' density

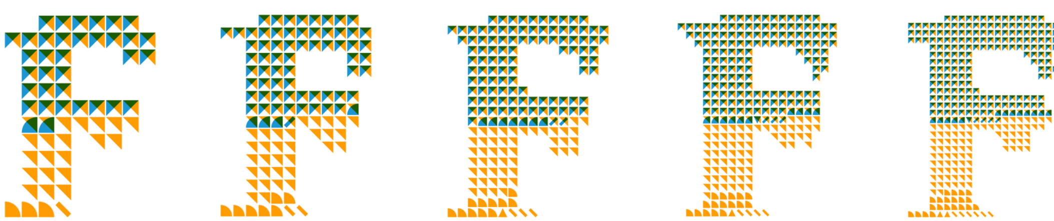


Figure 6. Glyphs for letter F with different modules' sizes

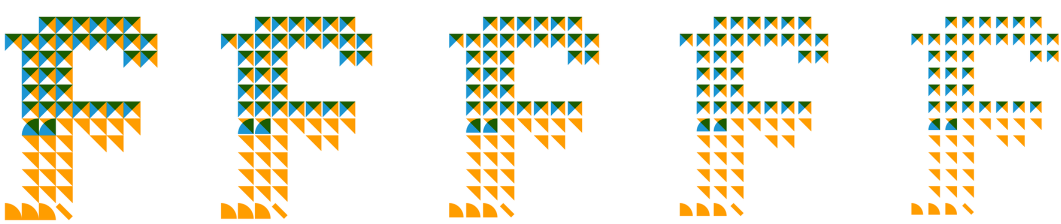


Table 2. Data used in the iteration IV

Name of the Student	Course Type	Course	Credits Done	Total Credits
Maria	bachelor's degree	Design and Multimedia	30	180
	bachelor's degree	Modern Languages	180	180
	master's degree	Modern Languages	66	120
Bruno	bachelor's degree	Design and Multimedia	50	180
	bachelor's degree	History	180	180
	master's degree	History	120	120
Alice	bachelor's degree	History	180	180
	master's degree	History	120	120
Tiago	bachelor's degree	Design and Multimedia	180	180
	master's degree	Modern Languages	60	120

In this iteration, each logotype represents three data variables related to each student. Each logotype can be explained as follows: each layer represents a course attended by the student; the colour used by each layer indicates the type of the course it represents; and the modules used in each layer identify the different courses. This way, they can combine all the variables and represent a set of courses made by the student. The density of the logotypes is calculated based on the number of credits done. The minimum density is zero, thus a student that starts studying at the university does not have any credits done and neither a logotype. The elements are positioned as in the previous iteration (from left to right and top to bottom). In this iteration, the authors create a set of modules to represent the different courses. They also apply a rotation to better distinguish them.

As previously mentioned, each layer represents a course attended by the student and each colour represents a course type. It was necessary to separate these two variables because the authors want to apply logotypes to any academic career and some students can have completed, for example: (i) two bachelor's degrees and a master degree; or (ii) a bachelor's degree, an incomplete master's degree, and a complete one.

In this iteration, the percentage filled in each layer is determined differently from the other iterations. In the iteration I, II and III the layers represent genders, so it was simple to compare which layer, or gender, has more students. In this iteration, the layers represent bachelor and master degrees, thus the maximum number of credits changes in each layer. The percentage occupied by the elements in each layer is proportional to the number of credits done (out of the total credits).

After some experiments, the authors obtained the results shown in Figure 7. As previously mentioned, the modules are representative of the courses. In this case, the module quarter of circle represents the course of Design and Multimedia, the right triangle the course of History, and the last module represents the course of Modern Languages. The orange represents the bachelor's degrees and the blue the masters' degrees.

In this iteration, the authors design the modules in order to make them more or less with the same area. That way, none of them stand out from the rest. They take this into account because two students from different courses with the same number of credits done should have a similar visual emphasis. Through the observation and comparison of the logotypes, it is possible to draw conclusions about the students of the university. By observing the density, it is noticed that Bruno is the student with more credits made. In addition, Alice and Bruno have modules in common, so they are on the same course, although Bruno has already made credits in another course.

Figure 7. Logotypes generated in iteration IV. Each logotype represents a student: each layer represents a course attended by the student; the colour used by each layer indicates the type of the course it represents; the modules used in each layer identify the different courses.

CONCLUSION

In this work, we present an experimental approach focused on the design of logotypes influenced by data. The authors explored different challenges: (i) how can the characteristics of students be translated into visual components of logotypes; (ii) how logotypes can convey information; and (iii) how one can explore the relation between information visualisation, type design, and visual identity design. The authors develop dynamic logotypes for the faculties of the University of Coimbra and for their students. One can find further information and results about this work at cdv.dei.uc.pt/data-logotype.

The authors propose generative design processes to automatically create logotypes based on external data. The logotypes created in iterations I, II, and III are influenced by data regarding the students of each faculty (gender and nationality). In these three iterations, the authors iteratively explore solutions that best describe and distinguish the different faculties. In iteration IV, the authors aim the creation of logotypes to represent each student. For that, information about the academic career of each student is used, namely the credits done, and courses attended by the student. In both approaches, the authors experiment with the use of layers and colour in type design to represent input data. Technological advances allow the creation of chromatic typefaces as well as their use in the creation of dynamic visual identities.

The obtained logotypes are able to provide a layer of knowledge about the students of the University of Coimbra. The logotypes for the faculties adapt to the entry and exit of students, while the logotypes for the students grow along with the advance of their academic career. In both approaches, the logotypes are designed automatically and adapt to data, showing the progression of the input data over time. Therefore, with the same system, the authors have different results according to the external data. The use of real-time input data allows the logotypes to be alive and adapt to different contexts.

This work explores new possibilities in type design combined with the creation of dynamic, data-driven visual identities. The search for visual identities that adapt to the context in which they are designed increases the potential of this research.

Future research will focus on: (i) the implementation of a mechanism to dynamically set the minimum and maximum density levels of the logotype depending on its target size; (ii) the development of glyphs that change their structure; (iii) the use of different data in the system; and (iv) the application of the presented approach in other types of entities.

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Jéssica Parente holds a master's degree in design and Multimedia from the University of Coimbra. Her increasing interest in typography led her to explore the subject in her master thesis. Currently, she is starting her PhD. Her interests include graphic and editorial design, web design, video and photography.

Tiago Martins is a cross-media designer who works at the convergence of design and computer science. The focus of his work lies in the development of custom tools to computationally evolve novel designs. After completing his Master in Design and Multimedia in the University of Coimbra, he enrolled in a PhD in Information Science and Technology at the same institution. He is researching and working on his thesis project Design through Automatic Evolution in the Computational and Visualization Lab. (CMS/CISUC). Recently, he started to work as invited assistant lecturer at the University of Coimbra, teaching in the field of computational graphic design in the Master of Design and Multimedia.

João Bicker is a graphic designer, educator, design writer and curator who lives and works in Coimbra, Portugal. With a degree in Biology he furthered his studies in Anthropology, later teaching Social Sciences and Cultural Anthropology at the University of Coimbra. He worked at the Anthropology Museum of the University of Coimbra, developing several projects in the fields of audio-visual arts, museology and graphic design, with particular emphasis on exhibition design and production. He is co-founder and the current creative director of FBA, a graphic design consultancy located in Coimbra, Portugal. At FBA he has developed an extensive body of work as a graphic designer, including art direction and book design for several publishing companies in Portugal and Brazil, as well as supervising several visual identity and exhibition design projects. He is currently professor at the Multimedia and Design courses of the University of Coimbra.

Penousal Machado is Associate Professor at the Department of Informatics of the University of Coimbra in Portugal. He is a deputy director of the Centre for Informatics and Systems of the University of Coimbra (CISUC), the coordinator of the Cognitive and Media Systems group and the scientific director of the Computational Design and Visualization Lab. of CISUC. His research interests include Evolutionary Computation, Computational Creativity, Artificial Intelligence and Information Visualization. He is the author of more than 200 refereed journal and conference papers in these areas, and his peer-reviewed publications have been nominated and awarded multiple times as best paper. Until 28 February 2018 his publications gathered over 1828 citations, an h-index of 21, and an i10-index of 40. He is also the chair of several scientific events, including, amongst the most recent, PPSN XV, EvoStar 2016, and EuroGP 2015; member of the Programme Committee and Editorial Board of some of the main conferences and journals in these fields; member of the Steering Committee of EuroGP, EvoMUSART and Evostar; and executive board member of SPECIES. He is the recipient of several scientific awards, including the prestigious EvoStar Award for outstanding Contribution to Evolutionary Computation in Europe, and the award for Excellence and Merit in Artificial Intelligence granted by the Portuguese Association for Artificial Intelligence. Penousal Machado has been invited to perform keynote speeches in a wide set of domains, from evolutionary computation to visualization and art. His work was featured in the Leonardo journal, Wired magazine and presented in venues such as the National Museum of Contemporary Art (Portugal) and the "Talk to me" exhibition of the Museum of Modern Art, NY (MoMA). He has been the Principal Investigator and Coordinator of several national and international projects, both at an academic and industry level.