# Data-driven Logotype Design

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***Abstract*—This work explores the intersection of type design, visual identity, and information visualisation. We study how data can influence the logotype design, and how a logotype can convey information. To do this, we developed a data-driven logotype for each faculty of our institution, the University of Coimbra, in Portugal. The design of the glyphs, or letterforms, that compose the logotypes, is influenced by data on the current spectrum of students in each faculty. Overall, the created logotypes are able to provide a layer of information by visualising and comparing the number, gender, and nationality of the students in the different faculties. Plus, the generative process that designs the logotypes allows them to react to the input data in an automatically fashion and, this way, be alive and evolve over time.**

***Keywords*-dynamic visual identity; generative typography; type design; information visualisation; graphic design**

## I. Introduction

The way we communicate is one of the most unique characteristics that defines us as human beings. Karen Cheng [1] discusses that written language exists through the use of typography that creates messages by combining characters in words and words in sentences. In this paper we intend to create another meaning to typography and explore the intersection of type design, visual identity, and information visualisation.

Over time, type design suffered severe improvements. In the early years, typographers created alphabets built with pure and uncorrupted letters. However, the emergence of the avant-garde movements, in the beginning of the twentieth century, transformed outdated aspects of vision and expression [2]. Later on, the technological revolution created new possibilities of typographic experimentation. The use of computer code in typography helped the automation of the design process to the point where computers are able to create new unique letterforms. As a result, new fonts emerged to adapt to distinct contexts [3], [4].

Nowadays, communication takes place in different media. One of them is the digital medium. Technological advancements, along with the proliferation of the Internet, allowed designers to explore new possibilities that were not possible a generation ago. This resulted in a shift towards designing visual identities more dynamic and characterised by variability, context-relatedness, processuality, performativity, and non-linearity [5]. At the present time, many organisations, institutions, museums, and even places, are embracing this kind of identities.

In this paper, we explore how data can influence the design of a logotype, and how can a logotype convey information. We selected our education institution — the University of Coimbra (UC) — as case study and developed a data-driven logotype for its diverse faculties. The design of the proposed logotype is influenced by the current spectrum of students in each faculty. It is also able to incorporate and unify the different faculties in a coherent fashion while changing over time to adapt to the input data regarding the students. Fig. 1 shows one typical glyph generated in this work.

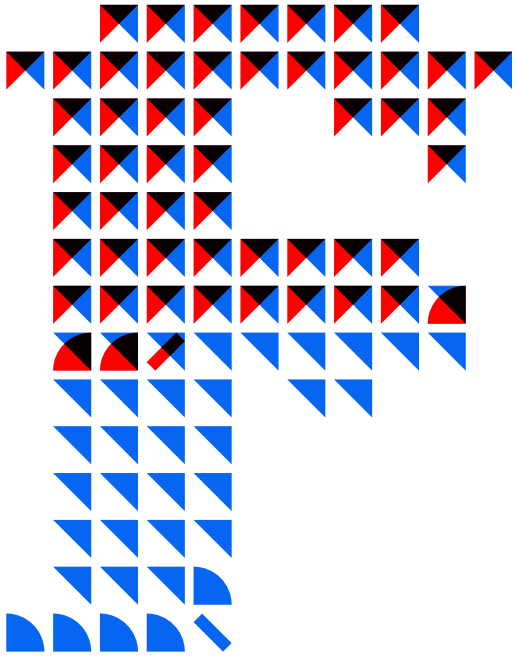

Figure 1. Typical glyph for letter `F` generated in the last iteration of the presented approach. A video that explains this approach can be visualised at `cdv.dei.uc.pt/2018/vi/data-logotypes.mov`.

The remainder of this paper is organised as follows. Section II presents related design projects in the domains of type design and visual identity. Section III describes three iterations of our experimental approach. Section IV discusses the achieved results. Finally, Section V summarises our work and presents future research directions.

## II. Related Work

This section is divided into three parts. In the first part, we present type design projects that defy traditional and take advantage of digital media. They use parameters such as the use of different layers and colours. In the second part, we describe type design projects that use generative techniques to create letterforms according to an input. In the third part, we present visual identity projects that are dynamic and informative, and somehow react to external data.

### A. Dynamic Type Design

The emergence of digital media allows the reading on the internet. With its increase the typography used in this medium becomes an influence for typographic printing. For a long time there was the possibility that typography was transposed from print to digital, however nowadays we find typographic solutions that are born in the digital medium. With them the possibility of using colour [6]. Intersect is a typographic system created by Paul McNeil and Hamish Muir [7]. This project departs from traditional typographic creation because the contrast is no longer binary (black and white, shape and counterform). Intersect fonts consist of a range of weights that creates the illusion of density. This system was designed so that 256 configurations can be combined. Intersect typefaces can have multiple layers, providing a big range of visual possibilities. Another remarkable project for the use of colourful layers is Novo Typo Color Book that is a book of typefaces created for the studio Novo Typo. The main goal is to transform a contemporary design into a historical typographic printing technique. This book is formed by a range of typefaces constructed with colourful layers.This project marks a new vision of type design directed not so much to type designers but more into the minds of type users  designers, art directors and type setters. This project moves away from traditional conventions and positive and negative forms, from the contrast of black typography to a white page, and aims to look at the potential of colour [6].

This two projects both provide a spectrum of possibilities because their use of the colour and the layers as parameters. In other hand colour is also a form of defining the hierarchy in a text. So it can be used instead of styles or weight.

### B. Data-driven Type Design

More and more start to appear processes of generative type design that are open to external inputs. In most of this projects the input turn out to be random. Irratio by Ingo Reinheimer [8] and Zwirn by Lisa Reimann [9] are some of this type of projects. They were all created in Processing and formed by the combination of random Bézier lines based in character's shape previous defined. However there are also projects where the mapping from the input (data) to the output (letterforms) is used as visualisation mechanism.

Music can be used as input for a generative system. Following are two projects that created fonts that react to sound. In 2008, Denis Klein [10], [11] developed an experimental and generative typeface in Processing named Blast. As we explained before the font is created through music and its visual appearance, shape and thickness, is directly associated with the analysis of the music, functioning as a visual interpretation of it. The music was analysed in real time and the data obtained flowed directly into the visual form of the typeface. Three years after the graphic designer Dina Silanteva [12] started a project of investigation in generative typography. In her typeface, Typography Music, the letters are formed in a basic grid and constructed by the combination of layers. Each layer is formed with a range of modules. The shape of the modules changes with the type of music. For example if it is an organic sound the modules are circles, to analogue sounds are octagons and to digital sounds are squares. The basic shapes changed according with some parameters. For instance the duration of sound influence the radius of the modules and the sampling change the way the layers intersect. In this two projects it is visible that the fact of being adaptable allows the creation of wide spectrum of possible visual variations. The great advantage it has over static fonts is that it can adjust to every sound context.

Another project that uses inputs in the creation of a typeface was made in 2009 by Michael Flückiger and Nicolas Kunz [13], [14]. The font was developed in Processing and called LAIKA. It was characterised by the variation of weight, contrast, size of the serif and slope dynamically. It was created to the screen so Flückiger and Kunz believed that it did not have to be rigid. For this reason they have made the typeface dynamic and interactive, allowing the user to change parameters in real time. It was applied in installations with audiovisual inputs, sensors or data requested on the Internet. Another advantage is the fact that LAIKA can be used in dynamic advertising texts and inspire new approaches in the use of digital types.

### C. Informative Dynamic Visual Identities

Dynamic visual identities have proliferated in the past decade (see, *e.g.*, [15] and [16]). There are several motives in adopting this kind of visual identity: the representation of collections (*e.g.* House of Visual Culture, by Edhv in 2011), programmes (*e.g.* Casa da Música, by Stefan Sagmeister in 2007), products (*e.g.* Priba, by Allied International Designers and Geoff Gibbons in 1973), sections (*e.g.* Talking Heads, by Notamedia in 2011), people (*e.g.* MIT Media Lab, by E Roon Kang and TheGreenEyl in 2011), or places (*e.g.* xwashere, by Vandejong, Fabrique in 2011); the change according to different environments (*e.g.* Visit Nordkyn, by Neue in 2010); the display of dynamism (*e.g.* MTV, by Manhattan Design in 1981), creativity (*e.g.* Lesley Moore, by Lesley Moore in 2004), or evolution (*e.g.* Evolving Logo, by

Michael Schmitz in 2006); the communication of messages (*e.g.* Google Doodles, by Dennis Hwang in 1998); and the participation of the audience (*e.g.* Get Up, by Alexis Rom Estudio in 2007).

Dynamic visual identities can be meaningful by providing information to the audience. This feature is often used to communicate messages or to identify something. The identity of TV Asahi, a leading TV broadcaster in the Japanese media industry, besides being informative is also generative. It was developed by Tomato, in 2002, and it was formed by several rectangular blocks that change their position with sounds. The staff members of the company, its programs and businesses are represented by the size of the block [15]. Eight years later, Neue Design Studio created a graphic mark to the Nordkyn peninsula. The identity created is affected by a feed of weather statistics. The shape of the logo is transformed according to the direction and velocity of the wind and it colour changes with the temperature. On the website, this graphic mark updates every five minutes, reflecting the weather conditions in the region. The system is updated by Norwegian Meteorological Institute and gives dynamism to the visual identity on the web [15], [17]. Both identities, TV Asahi and Nordkyn, have the advantage of adapting to different contexts. The fact that they change depending on the views or on the current wind conditions allows them to be in constant development.

There are however identities that are informative and dynamic but not generative. The identity for the New Prevention Technologies is an example of that. It was created in 2010 by COOEE to the Global Network of People living with HIV and AIDS. Continued development of technological prevention was the basis for the emergence of the identity. The identity was formed by the combination of different lines in a circle. Each line represents a prevent technology. The flexibility of the identity allows the accretion of new technologies, enriching it over time. Unlike campaigns associated with HIV and AIDS this identity does not use red, instead it uses its complementary colour, green, along with black. One of the advantages of this identity is that it grows with the success of developments [15], [16]. In 2011 the designer Maxim Pavlov from Notamedia developed a dynamic logo to Gogol.tv. The basis of the logo was the Gogol's head profile. To represent the different sections (politics, progress, culture, *etc.*) of the site he created seven other characters. The feature that group all them is the man's head profile inside each one of them. Progressively, these heads have become the main symbols of the website, like "gurus" [16]. In 2012, the brand consultancy Re [18] did the identity to the Shanghai Biennale, the largest international art event in mainland China. The curatorial Theme was "The Floating Eye" — an exploration of Sydney's transformation, through the lens of changing environment, demographics, history, geography and society. The language created for this project was based on symbols to describe the key concepts of the exhibition. Then, with the intertwined of these and a shifting graphical eye the identity has crossed the linguistic barrier. Basically what highlights this identity is the combination of two variables — state (Temporality, Oscillating, Observing, *etc.*) and thing (Geography, Culture, Demography, *etc.*). With this merge appears a third meaning representative of a key concept. An important aspect of this identity is the third meaning created with the combination of the two concepts.

Nowadays there is a greater demand for dynamic and representative identities of companies. The uniqueness brought about by data-driven identities in typographic designs or identities is a great advantage. This section presents only some examples of projects, but there are many more.

## III. Approach

The University of Coimbra is composed of diverse faculties, each one representing an area of study. Every faculty has multiple bachelors and master degrees, and consequently a substantial number of students. Having the diversity of the different faculties in mind, we aim to create logotypes that represents and distinguishes them. At the same time, they should incorporate and unify the different faculties in a coherent fashion. Furthermore, the logotypes should change over time to adapt according to the current spectrum of students in each faculty. This way, the main goal of this research is to develop dynamic logotypes capable of representing the different faculties of a given university. Naturally, we created stereotypes to represent each course, for example in an art bachelor degree the number of women would be bigger than men. However, sometimes the stereotypes that we create don't correspond to the reality so it could be interesting to compare this two. We decided to compile information about the number of students in each gender and nationality. Among the available data we hoped that these two variables were representative of the students of each faculty.

### A. Data

The used data refers to the year 2015 and it was collected mainly from the web page of the University of Coimbra. We decided to only use faculties with bachelor and master degrees. In the end, we considered 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). Table I shows the information collected. Regarding nationality, we found four groups corresponding to: Portuguese students (PT), students from countries with Portuguese as official language (PL), from countries in the European Union (EU), and from other countries (O).

### B. Letterforms

In University of Coimbra there is a big range of students. Under those circumstances it becomes natural to choose

Table I
COLLECTED DATA ON THE STUDENTS WHO CONSTITUTED EACH FACULTY OF THE UNIVERSITY OF COIMBRA IN 2015

| Faculty | Gender | Nationality | | | | No. students | |
|---|---|---|---|---|---|---|---|
| | | PT[a] | PL[b] | EU[c] | O[d] | | |
| FLUC | female | 1290 | 135 | 24 | 21 | 1470 | 2447 |
| | male | 857 | 90 | 16 | 14 | 977 | |
| FDUC | female | 1510 | 319 | 10 | 10 | 1850 | 2890 |
| | male | 849 | 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 | |

*a*. Portugal; *b*. Country with Portuguese as official language; *c*. Other European country; *d*. Other country.

various typefaces to represent this diversity. To achieve this, we picked four categories of typography classification — garaldes, reales, didones and linear — and for each one of them we adopted some typefaces. The next step was to combine the chosen fonts, similar to what happens in the Stefanie Oppenhäuser's project — Fontmixer [19]. Her application was developed in Processing and allows the user to select the fonts and determines if they are added or subtracted from each other.

In our project the logotype created for each faculty was developed from its acronym. For each letter of the acronym we overprinted the chosen fonts. The main goal is to uniform the group's characteristics of the chosen fonts.

### C. Iteration I

*1) Setup:* After the letterforms were produced we needed a way to fill the shapes. As previously mentioned, one of this system's principles is the use of typography as a layer of knowledge. Therefore the literal use of layers becomes straightforward. The next step was the development of a grid over the shape previously generated. We needed to represent three variables: (i) the nationality, (ii) the gender and (iii) the number of students. Evidently, we related the number of students with the density of the elements. We established a punctuation mark to each gender, but we still needed a way to represent the nationalities. Nowadays, with digital media, colour can be explored in typographic projects. In this project this fact becomes more evident so we established a colour to each nationality and punctuation mark to each gender. Given that we could combine the two variables.

In order to distinguish the elements of each gender we decided to use layers. In other words, we applied the elements in two layers with the shape of the letterforms previously created, each one for each gender. The elements were drawn from top to bottom and left to right. The layers were superimposed, but not aligned. In order to visualise all the elements we applied the multiply effect.

We determined the maximum number of students by gender and with this value we mapped the collected values. The density of elements in the logotype is associated with the number of students in each faculty relative to the remaining faculties. We also established a maximum and minimum density values.

For each faculty the maximum area occupied by the characters in each letter is associated to the maximum number of students by gender.

*2) Results:* After the various tests of colours and punctuation marks we arrive at the glyphs presented in Fig. 2. In this iteration, "|" is a representative module of the masculine gender and the "–" of the feminine gender. Red represents Portuguese students, blue represents students from countries with Portuguese as official language, green represents students from European Union and yellow represents students from other countries.

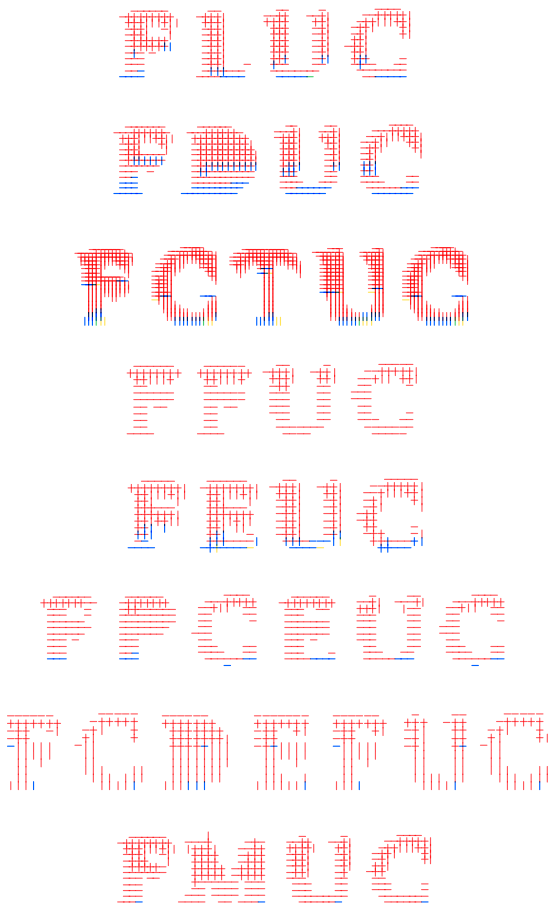

Figure 2. Logotypes generated in iteration I. The modules (punctuation marks) represent the students' genders; the colours represent the students' nationalities; and the modules' density represents the number of students.

We only take advantage of the multiply effect when we overlap different colours. In the logotypes shown in Fig. 2, one can see that the effect is not greatly noticeable since the number of Portuguese students is always much higher than the other nationalities. So, in this iteration we are not taking advantage of cross-layers. On the other hand, it is interesting to observe the pattern created by combining the two layers. The representation problems could be also related to the chosen symbols.

### D. Iteration II

*1) Setup:* In this iteration the colour is now representative of each gender and the punctuation marks are used to represent the nationalities. The layers applied to each gender will remain. The main goal of this alteration is to allow the crossing of distinct colours in different layers. This way we can identify the different nationalities and also create a third colour from their intersection. We calculated the maximum number of students by gender, as we did in the previous iteration. Thus, we make a relation with this value and the maximum density established. We have also determined the minimum, which is no longer 0. This change allows for a greater contrast between densities because it limits the range of values for density. Now, the faculty with less students has the minimum density value.

We also decided to make another change in order to make the logotypes more homogeneous. To achieve this, we insert the characters that fill each letter randomly. The elements are included randomly, but in the space reserved for the layer where they are applied.

*2) Results:* After some tests we arrive at the representation shown in Fig. 3. The colour red and blue represent the amount of women and men respectively. Regarding the punctuation marks, "|" 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. It is important to take notice into the care that was taken on the choice of elements. We had to take this aspect into account, because the number of Portuguese students is much higher than the number of students from abroad. The punctuation mark that represents the Portuguese students would have to be more discreet because it gains emphasis due to its quantity. The same problem was taken into consideration in the first iteration but by using the chosen colour instead.

Thanks to the change of the symbols the nationalities (represented by punctuation marks) are now more easy to distinguish. In this iteration the punctuation marks used are more interesting. However, at the same time the overlap of layers becomes less visible — the third colour from the intersection of the first two rarely appears. An increase of the ink area of each element may facilitate the visualisation of the intersection of the layers.

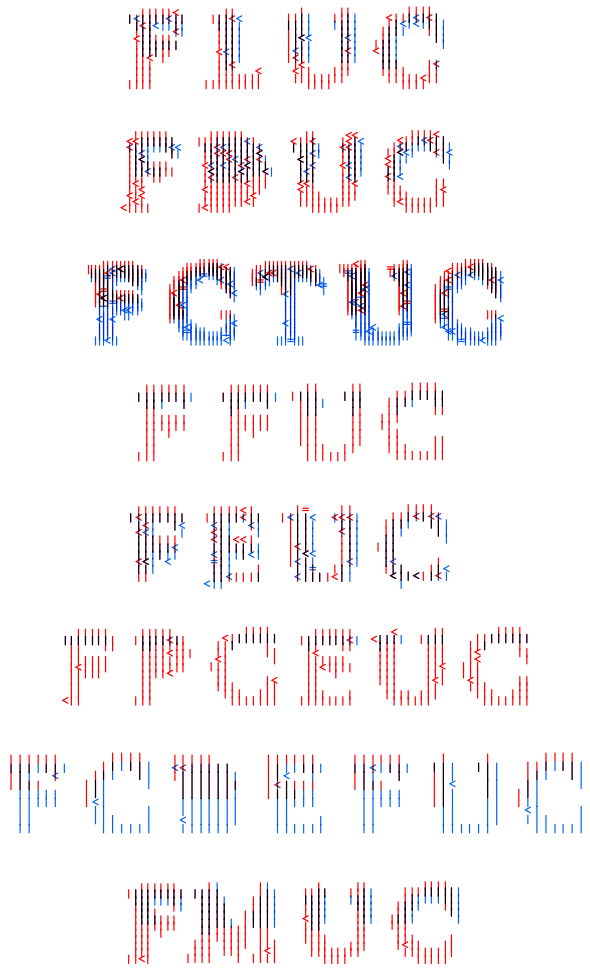

Figure 3. Logotypes generated in iteration II. The modules (punctuation marks) represent the students' nationalities; the colours represent the students' genders; and the modules' density represents the number of students.

In conclusion, this iteration presents an improvement in layer overlap, however it is not possible to distinguish where each layer begins and ends.

### E. Iteration III

*1) Setup:* In this iteration instead of using punctuation marks we have chosen to use modules previously drawn. This way, we reduce the detail and more easily visualise the intersection between layers. The symbols used in the previous iteration will be maintained (each nationality has an associated symbol and each gender is associated to a different layer with the respective colour), but we are reverting back to the ordering of the elements used in the first iteration. This is due to the fact that some nationalities have less associated modules and if they are far from each other we may not realise their existence. So, in this iteration the elements, in each layer, were drawn from left to right and from up to bottom.

After some tests we noticed that due to the fact that the layers are completely overlapping some faculties only have two colours in their logotype (a colour representative of a gender and the colour that comes from the intersection of the two layers). This is due to the higher number of Portuguese students compared to the rest of the students. Therefore, most elements of the two layers are superimposed. In order to overcome this problem we decided to apply a rotation to the modules. The rotation was applied to each element according to the layer. These modifications allowed for an easier differentiation of overlapping layers (highlighting the male and female elements).

*2) Results:* Fig. 4 shows the final results. The colours remain with the same representation as the previous iteration. For modules, the right triangle represents Portuguese students, the quarter of a circle represents students from countries with Portuguese as official language, the other triangle represents students from within the European Union and a line represents students from other countries. Now, thanks to the rotation in modules it is possible to visualise each layer and the intersection between them. Thanks to the variation of density we noticed that FCTUC is the faculty with more students and, on the other hand, FCDEFUC and FPCEUC are two of those with less. Looking at the logotypes, we can also observe that the Faculty of Psychology and Education Sciences (FPCEUC) have more women than men. Furthermore, as it was predictable, the Sports Sciences and Physical Education (FCDEFUC) are more male students. A video that illustrates this third iteration can be visualised at `cdv.dei.uc.pt/2018/vi/data-logotypes.mov`.

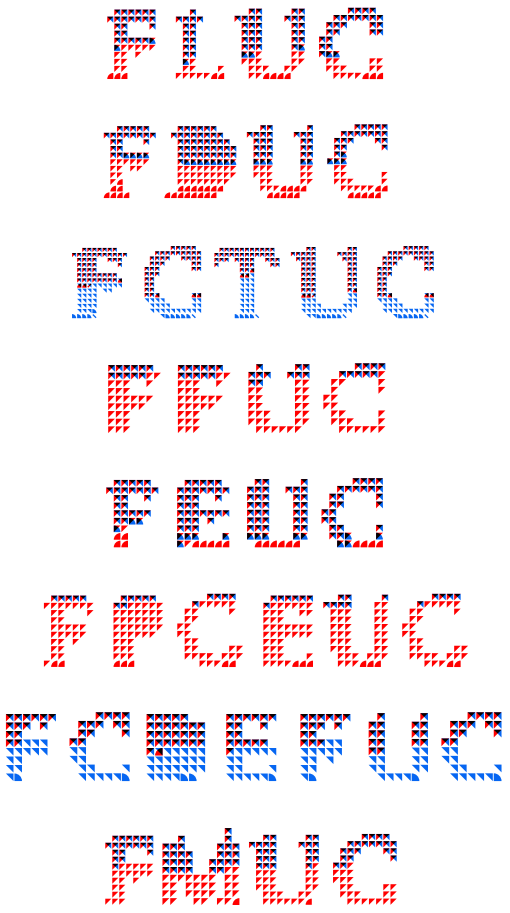

Figure 4. Logotypes generated in iteration III. The modules represent the students' nationalities; the colours represent the students' genders; and the modules' density represents the number of students.

In the development of this project we noticed the obligation to test the minimum and maximum densities. In order to reduce the detail and reduce sizes we should decrease the minimum and maximum densities. In Fig. 5, we have five different levels of density being represented. In this iteration we also tested the area that each module occupies in the grid space where it is placed. For a better understanding, some tests are shown in Fig. 6.

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

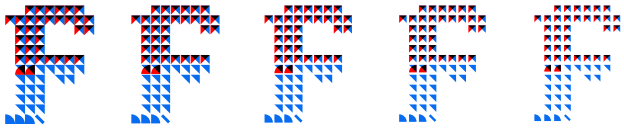

Figure 6. Glyphs for letter `F` with different modules' sizes.

## IV. Discussion

We consider the generated logotypes interesting from an experimental point of view. The experimental results demonstrate how data can influence the design of logotypes and how logotypes can convey information. Nonetheless, we think that to implement these logotypes in a real scenario, some aspects such as the legibility and other graphic details would have to be further refined. For instance, we identify one limitation of the logotypes generated with our system: legibility in very small sizes. At the moment that the characteristics of each faculty can not be visualised, the logotype loses its meaning.

We explore the use of layers and colours in the design of glyphs. The recent technological possibility of designing fonts composed of separate coloured layers allows us to use a chromatic typeface as a logotype in a visual identity. Therefore, this work opens new possibilities of exploration in the intersection of type design and dynamic data-driven visual identities.

The emerging demand for visual identities that are based on letterforms designed specifically for them, raises the potential of this research. Our generative system designs the visual elements of the logotypes autonomously. This way, we are able to create numerous variations for the logotypes from the same concept.

The proposed logotypes provide a layer of knowledge by visualising data related to the students. The data-driven process that we developed allows the logotypes to react to data input in an automatically way. Therefore, the use of real-time input data, along with the generative process that designs the logotype, allows the logotype to be alive, open-ended, adapt to different contexts, and evolve over time. As a result, the logotype is able to change throughout the year with the outgoing students and the entry of new ones. Also, the proposed approach could be adapted to enable the identification of individual students based on their data, *e.g.* number of years of study and age. This way, each student could generate a unique typeface based on his/her individual characteristics.

## V. Conclusions and Future Work

We have described and tested an experimental approach for the design of logotypes that are influenced by data. We developed a dynamic logotype for each faculty of the University of Coimbra. Each logotype is influenced by data related to the spectrum of students in the corresponding faculty, such as number of students, gender, and nationality. A series of iterations were conducted to explore and improve the proposed logotypes.

Our main contributions include: (i) a generative system capable of automatically creating logotypes based on external data; (ii) the exploration of different mappings of the characteristics of the students into visual components of the logotypes; (iii) an investigation into how logotypes can convey information; and (iv) an investigation into the interplay between information visualisation, type design, and the design of visual identities.

Future research will focus on: (i) the experimentation of other data inputs; (ii) the development of letterforms that change with the input data; (iii) the experimentation with this approach in the identification of individual students based on their academic data; and (iv) the application of this approach to other entities.

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