Form over function: an analysis of Midjourney-generated infographics

Forma e função: uma análise de infográficos gerados por Midjourney

Sara C. Klohn Reader, Alis Iacob

infographic design, Midjourney image analysis, generative technologies

Text-to-image generative models are a topic of great discussion in design. Seeking to understand the potential impact of these technologies on graphic design, this think piece paper presents preliminary insights from an explorative study that looked at 23 infographics generated by the popular platform Midjourney in 2023. The results indicated that, while the Midjourney outputs were at first glance plausible, upon closer examination these failed to solve a design problem. The repetitive layouts, the unintelligible textual elements and the disregard for purpose, context and audience, indicated that Midjourney is not currently producing infographics as understood by the design community. While not definitive, this study intends to contribute to the ongoing discussions in the wider field of AI and graphic design.

design de infográficos, análise de imagens de Midjourney, tecnologias generativas

Modelos generativos de texto para imagem são um tema de grande discussão no design. Buscando entender o impacto potencial dessas tecnologias no design gráfico, este artigo de reflexão apresenta percepções preliminares de um estudo exploratório que analisou 23 infográficos gerados pela popular plataforma Midjourney em 2023. Os resultados indicaram que, embora os outputs do Midjourney fossem, à primeira vista, plausíveis, uma análise mais detalhada revelou que estes não resolviam um problema de design. Os layouts repetitivos, os elementos textuais ininteligíveis e o desrespeito ao propósito, contexto e público indicaram que o Midjourney não está, atualmente, produzindo infográficos como são compreendidos pela comunidade de design. Embora não definitivo, este estudo pretende contribuir para as discussões em andamento no campo mais amplo da IA e do design gráfico.

1 Introduction

Motivated by current debates around the relationship between text-to-image generative models and design, this explorative study seeks to contribute to the ongoing discussions around the implications and consequences of these technologies in the creative industries. This study aims to unpack and identify characteristics of generative imagery outputs in the context of infographic design. Taking the form of a 'think piece', this paper examines content produced by Midjourney.[1] As such, a sample of Midjourney-generated

1 Midjourney is a generative artificial intelligence program that can convert natural language prompts into images (Salkowitz, 2022).

outputs has been analysed from two perspectives: visual and information design. This study was initiated as part of wider conversations in a higher education setting and evolved into an analytical enquiry to evaluate text-to-image outputs in the form of infographics. These conversations started in September 2022 and in February 2023 a set of text-to-image generated infographics have been gathered and analysed. A year later, in February 2024, a second sample was collected from the same generative text-to-image platform to serve as a verification sample that sought to validate the relevancy of the initial study.

In the broader sense, this research intended to contribute to the growing body of knowledge within the creative sector that raises questions about the significance of using generative technology in infographic design. For this study, generative technologies and models are understood as the production of visually realistic pictures from text inputs and prompts (Ramzan, Iqbal, & Kalsum, 2022). While there are several generative image-making platforms available such as DallE[2] and Stable Diffusion,[3] this study uses Midjourney as this was an open-source and accessible platform at the time of sample collection. The authors of this paper acknowledge that there are differences between available text-to-image generative platforms but reviewing these fell outside of the remits of this paper. In addition, platforms that specifically generate infographics are often less accessible and use templates as a starting point, which limit usability. Therefore, the following sections bring an overview of Midjourney outputs.

2 DallE is a text-to-image generative system that can create realistic images and art from a description in natural language.

3 Stable Diffusion is a latent text-to-image diffusion model capable of generating photo-realistic images given any text input.

1.1 Background: The rise of Midjourney

4 Machine learning is a branch of computational algorithms designed to emulate human intelligence by learning from surrounding environments (Naga & Murphy, 2015).

5 Artificial intelligence is concerned with the development of computers able to engage in human-like thought processes such as learning, reasoning, and self-correction (Kok et al., 2009).

Until recently, the power of machine learning,[4] artificial intelligence[5] and text-to-image generative technologies have been viewed through a future-facing, almost dystopian lens (Hanna, 2023). However, the incredible development of these new technologies paired with the speed of adoption by the public, propelled debates into the present tense. Buonamici et al (2020) explain that due to the accessible application of these technologies, communities around the world have started to recognize the plausible power of artificial intelligence tools. Agkathidis (2016) noted that interesting debates could emerge when looking at the relationships between form and function, and technical application in practical disciplines.

Practitioners and design academics, as prominent voices in the creative sector have started raising questions about the implications of using generative content within their practice. Ranging from discussions on the ethics of using text-to-image generative technologies to authorship and ownership, designers are engaging in these debates. One study points out that 'speed' and 'randomness' could be considered unique value propositions that might aid designers and their creative process by 'tickling their imagination' (Vermillion, 2022, p. 1). Another study investigated the credibility of Midjourney-generated illustrations for five popular fairy tales. The findings exposed issues around bias (stereotypical configurations) as well as 'inabilities to depict overly fantastical situations' (Ruskov, 2023, p. 2).

The exponential growth of published outputs signals a sense of urgency amongst researchers, which while palpable in the creative industry, appears to be outwardly divisive. On one side, there are concerns about the potential for fraud and misleading content (Cammer, 2023). On the other, there are positive views for the integration of AI platforms in the creative process (Hanna 2023; Mansour, 2023; Radhakrishnan, 2023). Conversely, aspects of the design practice could be revolutionised if integrated with AI and machine learning such as problem-solving and empathy (Verganti, Vendraminelli, & Iansiti, 2020), or even a complete shift in design from a problem-solving activity – as AI can generate solutions to scale – to a problem-finding one (Schleifer, 2017) which involves empathic humans.

Nonetheless, Buonamici et al (2020) note that despite these technologies, the designer's ability to solve problems, analyse, and evaluate contextual factors should still take precedence within the context of these technologies. Additionally, Agkathidis (2016) mentions that the careless use of these technologies could lead to a disconnect between the output, its context and its users which would lead to a decrease in design quality. Agkathidis (2016) highlights that without an informed understanding of the design problem, the integration of design outputs in real contexts could also result in inappropriate design applications hyper-centred on form as opposed to function. These polarising views that are apparently splitting the creative industry are a testament to discussions that need to happen.

Therefore, this study explores some of these issues by evaluating a sample of Midjourney-generated images, which will be discussed in the following sections of this document. Ong (2020) observes that, even though gathering pre-existing and found imagery is a recognised valid visual research method, caution should be exercised when generalising meaning and discussing the wider implications on the field. As such, the authors of this paper acknowledge that the conclusions of this research are particular to the sample collected and cannot be generalised. The examples collected were limited by the search terms which dictated the found visuals generated by Midjourney.

2 Methodology: visual analysis

Using what is frequently classed as a characteristic research mode within the design discipline, this paper employed a qualitative approach centred around visual methodologies. As noted by Denzin (2013, p. 71) visual research implies the ontological use of the term 'visible' and refers to the process of interpreting and sense-making of a seen object or image. The scope, therefore, of the visual inquiry is not only to analyse what these objects, artefacts or images mean but also to critique and make wider assumptions which contribute to ongoing debates. As such, to allow a close examination of the characteristics of text-to-image outputs as well as their potential implications on infographic design, Midjourney has been used to collect a series of user-generated visuals. These have been gathered over six months, from September 2022 to February 2023 by having beta-test access to Midjourney via Discord,[6] which is currently a publicly accessible channel

6 Discord: social media platform which organises discussions into topic-based channels where users can collaborate and share.

(Midjourney, 2023). The keywords 'infographic' or 'infographics' have been used on the Discord search bar as prompts to collect 23 examples that can be seen in Figure 1 (the numbers 01–23 on the left bottom corner of each example are to be used as picture indicators in various sections of this paper).

Figure 1 Midjourney Infographic Sample (*N* = 23).

Ong (2020) and Ortega-Alcazar (2012), note that the main methods of analysis of visual materials are: content, semiotic and discourse analysis. This study focused on content analysis. Consequently, the first stages of this study involved a preliminary observation of Figure 1's visual examples and classification based on literature recommendations. The visual analysis followed a funnel approach implying a broader, generic segmentation of the visuals which then aimed to lead to a secondary phase that included a specific infographic design evaluation.

The analysis and interpretation of the collected visual materials involved form-based visual observations concerning the frequency in which specific elements became instantly obvious in the sample shown in Figure 1. As mentioned by Ong (2020), the scope of content analysis is to identify immediate trends calling for a descriptive account of the defined set of visuals but without considering various possible meanings.

The next stage followed an evaluation of the Midjourney sample relative to published infographic design principles. Due to limited research in this area, it has become common practice for academics to analyse infographics by developing frameworks compiled from previous studies (Lonsdale et al., 2019; Lyra et al., 2019; Klohn & Zimmermann, 2021; Zimmermann & Klohn, 2021). In a thorough compilation of information design theories, Lonsdale (2023, pp. 60–67) set eleven general guidelines to design infographics, which were applied in the present study as a framework for analysis. These guidelines focus on how users read infographics: usually skimming; and the infographic's function: to visually communicate accurate, accessible, and clear information. Within the guidelines, the most important aspect that classes an infographic as good is its function, as 'the visual appeal of an infographic alone will not make up for poor design and content' (Lonsdale, 2023, p. 58). The eleven general guidelines set, and used here as framework principles were: (P1) clear focus and purpose; (P2) key message in a blink of an eye; (P3) visuals for attention and comprehension; (P4) comprehensible text in an appropriate typeface; (P5) deliberate colour selection; (P6) effective visual elements; (P7) appropriate data visualisation; (P8) user-friendly structured charts; (P9) accurate data presentation; (P10) uncluttered and well balanced (P11) targeted at the needs of the user (Lonsdale, 2023).

The funnelled approach to the visual analysis has been conducted independently by the two authors of this study, and their answers were compared and discussed to reach a consensus. The next section of this paper details the results agreed by the two authors.

3 Midjourney infographics sample: analysis results

The content analysis considered form-based aspects such as colours, composition and style. The infographic principles were analysed by identifying whether these could be visually recognised; not visually recognised, and not applicable.

3.1 Content analysis

The first repetitive element recognised as a visual trend was the background colours used in the sample, as shown in Figure 2. This has been identified by using a colour mapping technique which implies working with the eye dropper tool in Adobe InDesign to sample dominant colours from the background colour space. Preliminary analysis of the visual materials exposed that Midjourney generation of content resulted in a somewhat binary categorisation of output based on background colours. It has been observed that foreground objects/subjects are presented either on a light background, using a similar off-white to beige colour palette or on a dark background. It became evident that there was not much variation within the light and dark colour categories with yellow being the dominant hue. 11 out of 23 source images showed a light background featuring a similar beige colour. Similarly, 12 of 23 visuals included tonally identical dark colours.
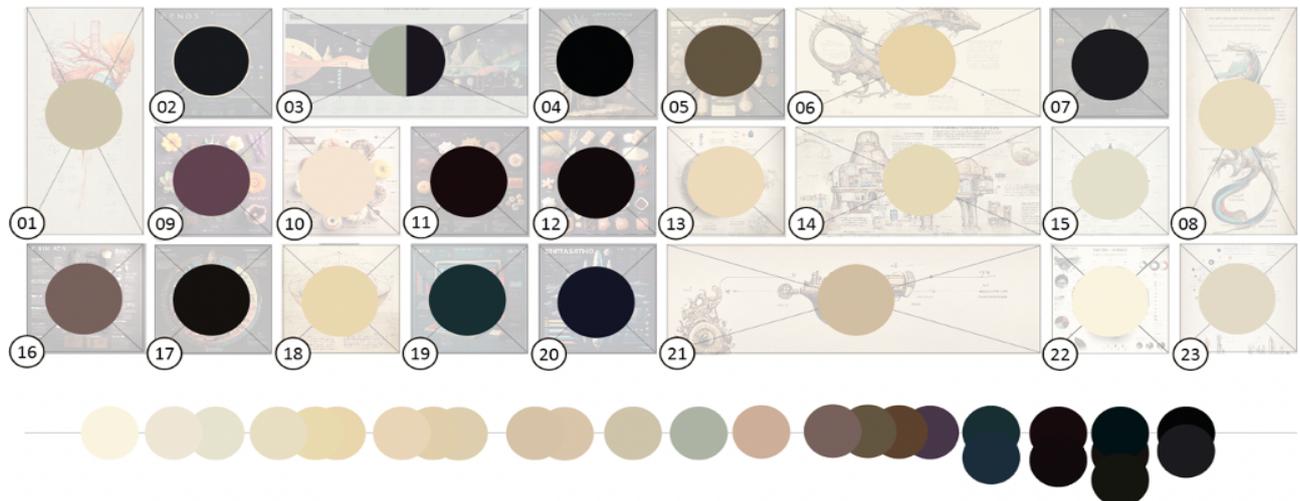

Figure 2 Content analysis of Midjourney Infographic Sample (*N* = 23): background colours. The Bottom scale demonstrated the incidence of each colour identified.

Colour mapping facilitated the discovery of a second visual trend, leading to the identification of a pattern within the compositions, specifically around the source of light. Figure 3 demonstrates that the object/ subject forms tend to be illuminated in one direction, from above. The visual on the left-hand side of the diagram below shows that within the light background images, the foreground subject is often illuminated from above and hits the forms on the top side/central part. Equally on the dark background images, the source of light hits the figure from above and illuminates the middle of the subject/object.

Visual symmetry, understood as balanced proportions in at least two sides of a composition, was a constant feature found in the Midjourney sample. Out of 23, four presented vertical symmetry; one was horizontally symmetrical; and nine were symmetrical both vertically and horizontally.

Of the nine examples that do not meticulously comply with any of these symmetry types, eight still presented a centralised dominant image. Next, Table 1 shows these results, where X indicate the type of symmetry encountered in each example.
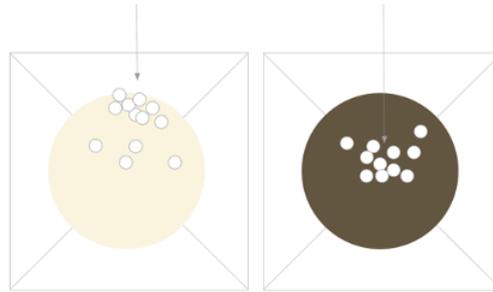

Figure 3 Content analysis of Midjourney Infographic Sample ($N = 23$): Illumination. Light and dark background illumination source top and central (light backgrounds); top middle (dark backgrounds).

Table 1 Content analysis of Midjourney Infographic Sample ($N = 23$): symmetry occurrence. The 23 examples are indicated on the left column; The heading classifies them into vertical symmetry, horizontal symmetry, combination of Vertical and horizontal symmetry, and no symmetry.

Example	Vertical	Horizontal	Vertical & Horizontal	No symmetry
01	X	—	—	—
02	X	—	—	—
03	—	X	X	—
04	—	—	—	X
05	X	—	—	—
06	—	—	—	X
07	—	—	—	X
08	—	—	—	X
09	—	—	X	—
10	—	—	X	—
11	—	—	X	—
12	—	—	X	—
13	—	—	—	X
14	—	—	—	X
15	—	—	X	—
16	—	—	X	—
17	—	—	X	—
18	X	—	—	—
19	—	—	—	X
20	—	—	X	—
21	—	—	—	X
22	—	—	X	—
23	—	—	—	X

7 Text-to-image prompts are keywords, short phrases or sentences used as inputs to generate visual responses by platforms such as Midjourney, DallE or Stable Diffusion. The prompt words that generated the outputs were not available when the sample was collected.

While colours and composition are features assessable independently of personal interpretation factors, the interpretation of the visual style was sample specific, relative to the authors' point of view, hence not generalisable. Two significant trends were immediately identified: Steam Punk (Perschon, 2012) sketch, and hyper-realistic. While these style trends are likely to have emerged from the prompt words[7] used to generate these outputs, the constancy of these two within the sample is noteworthy. This can potentially suggest a preoccupation towards aesthetics and a possible dominance of form over function. A further discussion on the importance of prompts in text-to-image generative technologies could be of value to establish a relationship between prompts and visual styles in an infographic design context, however, this was outside of the scope of this study.

3.2 Infographic principles analysis

Intentional information is essential for an infographic and, as already stated, the collected sample lacks this basic requirement (function). Therefore, they do not constitute infographics. The sample was nonetheless analysed considering *potential* informative functions where appropriate, to deepen the understanding of these text-to-image generated examples.

Four of the eleven infographic principles set in the framework were excluded from the analysis due to the absence of information or the very nature of the text-to-image generative aspects. The concept of purpose (P1) defeats, in this case, analysis as it is challenging to grasp intention within the sample. Intentionality in text-to-image generative technologies is a complex emerging field; the "deliberate colour selection" principle (P5) was not applied in this study. The user needs (P11) could not be measured in this environment; hence this principle was not analysed. Finally, it is not possible to comment on the accuracy of data presentation (P9), as the Midjourney outputs were produced without a data set.

Three of the seven remaining applicable principles were not visually recognised within the sample (P7, P8 and P9). While, from a data visualisation point of view (P7, P8) the sample included shapes that could resemble charts, none of the examples included data-informed charts which indicated that comments around accuracy and presentation (P9) were impossible. Likewise, textual-related principles (P4) were challenging to analyse as while a visual indication of text is present in the samples this is not legible, defeating the comprehension principle.

The other five applicable principles were frequently visually recognised. Nonetheless, an important caveat is needed here: as absent, the informative purpose of the sample was not considered; instead, potential recognition of the message *based on layout disposition* was considered. 15 examples depicted the key message in the blink of an eye (P2) (on this, see discussion section). All 23 Midjourney outputs use visuals for attention (P3), even though there is little use of colours to enhance potentially relevant features, which Lonsdale (2023) considers one of the key aspects of this principle. Finally, 15 out of 23 examples were considered to have effective visual

elements (P6), if only considered from a visual point of view as opposed to a communication perspective. Table 2 shows the occurrence of the principles that could be analysed. The results of this analysis need to be considered with caution and examining the following discussion.

Table 2 Midjourney sample analysis: infographic design principles (N = 92 data entries). (P2) key message in a blink of an eye; (P3) visuals for attention and comprehension; (P6) effective visual elements; (P10) uncluttered and well balanced. An 'X' indicates principle visually recognised; 'O' indicates principle not visually recognised.

Example	P2	P3	P6	P10
01	O	X	O	X
02	X	X	X	X
03	X	X	X	X
04	X	X	X	X
05	X	X	X	X
06	O	X	O	O
07	X	X	X	X
08	X	X	O	X
09	X	X	X	X
10	X	X	X	X
11	X	X	X	X
12	X	X	X	X
13	X	X	X	X
14	O	X	O	O
15	O	X	O	X
16	X	X	X	X
17	O	X	O	X
18	O	X	O	X
19	X	X	X	O
20	X	X	X	X
21	X	X	X	X
22	O	X	O	O
23	O	X	X	X

3.3 Discussion

The visual analysis conducted in this study identified trends and major issues within the sample of the so-called infographics. Visually, the Midjourney sample shows limited variety, from a restricted colour palette to repetitive layout compositions that feature a centralised image. It became evident through the different stages of analysis that the sample collected was deprived of meaning and purpose, which precluded some of the sample's aspects from analysis, and others were analysed with a caveat.

Most relevant are the infographic principles that could only be analysed with restrictions. For instance, to analyse the examples following the principle 'key message in a blink of an eye' (P2), one needs to be able to identify the title of the piece and its key elements so that the key message is communicated within five seconds (Lonsdale, 2023, p. 60). This is, however, a problematic principle to apply in the Midjourney sample, as the main element can be recognised only if it is not too abstract, and titles are formed by placeholder text with no meaning (more on this below).

Perhaps the most controversial principle analysed was attention and comprehension (P3). Typically, a good infographic uses visual elements to enhance comprehension and recall of information. Though the results indicate Midjourney's outputs have used images, colours and style to grab attention, they do little to help comprehend concepts, statistics or other information and therefore have purely ornamental purposes. As a result, Midjourney, at this point, is incapable of producing infographics.

It is noteworthy that the layout-related infographic principles were easiest to recognise as they often mimicked familiar visual elements. In this respect, the Midjourney outputs could be seen as infographics, but only on a surface level. They could be described as attention-grabbing visuals that have the *potential* to communicate a key message in a blink of an eye. This appears to be a system-one thinking (Kahneman, 2011) example as the audience can have an automatic, unconscious response to this type of content, but it can be presumed that the *infographic* categorisation happens absentmindedly. This was also true for any textual indicators as often these were purely representational elements, recognisable as written content but only in their form. No purpose such as comprehension could be accounted for. Traditional elements of infographic design: charts and data visualisation essentials were also missing from most of the samples making it difficult to identify the type of data that has been visualised (which in this case was probably null).

The Midjourney sample does not warrant conclusions around purpose, intentionality and comprehension. Accuracy, an important aspect of infographics cannot be reflected upon either as it is difficult to comment on the motivation behind the production of these visuals. It is presumed that except for the text-to-image prompts which acted as stimuli, no real dataset has been inputted to generate the Midjourney outputs. Effectiveness and appropriateness of communication are challenging to consider as the 23 examples cannot be classed as design outputs in the traditional sense. As no immediate design problem can be identified, the Midjourney "infographics" are not solutions to a target user problem.

It is notorious that as AI algorithms evolve, they become more efficient and can reproduce more graphic design technical skills (Mathews, 2023), constantly impacting the generated outputs. Hence, a second sample was selected a year apart from the first, using the same search mechanism, to verify the relevancy of the initial sample contemplating the rapid evolution of such AI platforms.

While some new outputs emerged, previous outputs were still present (examples n 07, 18, and 23), and most of the features of the first sample remained noticeable in the latest outputs, suggesting a newer analysis would

not yield new conclusions. Figure 4 exemplifies the new outputs. In brief, a new colour palette displaying green, and its shades emerged, textual features are more recognisable – but still functioning mostly as placeholder text, and perhaps a tendency to asymmetry more than previous symmetry. None of these new features however makes infographic design principles overall more distinct and recognisable.
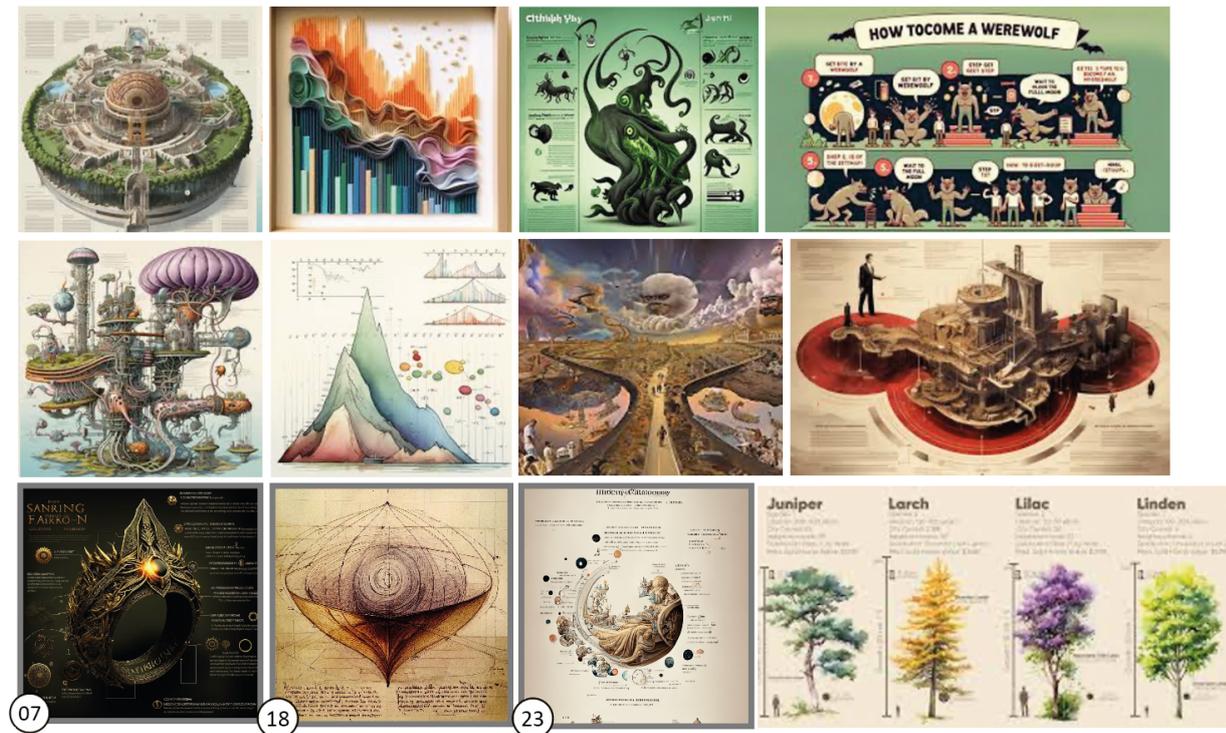

Figure 4 Verification sample 12 months later (N = 9 new data entries; N = 3 old data entries).

4 Conclusions

While it is acknowledged that conclusions based on a small collection of visual materials cannot wholly represent the reality of text-to-image processing, this paper intends to diversify and contribute to the current debates within the creative sector. Magnifying, and to some extent elaborating, on generative content and its consequences on design practice and education could contribute to the current polarising debates adding to a multifaced perspective.

The analysis conducted in this paper, points towards three main findings:

- form-based surface level visuals
- lack of visual diversity
- purposeless design solutions.

The visual composition and structure of the sample enable an immediate response and lead to its superficial recognition as an infographic. However,

the visual features that elicit this response are basic in form and do not comply with the essential functional principles of infographic design. Even if the sample would have included elements of purposeful information, a central and symmetrical dominant image, surrounded by (potentially) supporting visuals would not necessarily make an infographic efficient. The main objective of an infographic is to efficiently communicate complex information in a simple, but not simplistic, manner. None of the visuals within the Midjourney sample gets near to achieving this objective as they were generated using prompt words and were not driven by a design problem. It has become evident that, while speed and variations could seem advantageous from a productivity point of view, without considering purpose, visual material generated by Midjourney cannot be truly classed as a design output.

As noted in the first pages of this paper, the starting point of the small-scale study was triggered by the rapid growth of generative technologies and the somewhat binary debates in recently published academic journals. Almost immediately noticeable, the question of whether generative technologies are a sign of progress or a mark of humanity's doom, dictated published literature. As this preliminary examination of generative outcomes showed, it is perhaps too early to subscribe to either perspective without critically scrutinising the nature of the content produced by platforms such as Midjourney.

Reflecting on the wider implications, it is difficult to discuss the cultural or educational relevancy of the imagery. Perhaps the most imperative point is that the outputs produced by generative technologies are currently inadequate and do not serve a function. These limitations are driven by the very nature of the technologies and their dependence on reference libraries/ datasets, hence the observation of the repetitive layouts and visual styles. This is most likely the reason why most visuals analysed in this study looked like infographics and included characteristically accepted visual signifiers but could not be functionally categorised as such. Ergo, it can be preliminarily speculated that while generative technologies could have a place in creative inductions and could lead to visually pleasing outputs, these should be used as secondary aid tools. It can be said with appropriate conviction, that the results of a Midjourney inquiry should not be considered standalone design outcomes. It could become beneficial to consider adding a stage within the traditional design process to allow a generative co-creation phase. Issues around context, audience, culture, or purpose could be accounted for in earlier design stages allowing generative technologies to enhance the experimentation and ideation phase. The designer, student, educator, or practitioner could then learn to embrace its mid-process capabilities as opposed to striving to arrive at a superficial, meaningless solution quickly. If this could turn into a potential way forward, the polarising aspect of the current debates around democratising creativity could perhaps be reframed from progress vs doom to a point in time.

Wider implications of using text-to-image generative technologies could also be accounted for as generated content implies a lack of consideration for authorship and ownership (Iacob, 2024). Perhaps a future strand of research should pursue appropriate applications and use of these technologies both in practice and education rather than merely criticise them.

References

Agkathidis, A. (2016). *Generative design*. Hachette, UK.

Banks, M. (2007). *Using visual data in qualitative research* (2nd ed.). SAGE. https://doi.org/10.4135/9781526445933.n4

Buonamici, F., Carfagni, M., Furferi, R., Volpe, Y., & Governi, L. (2020). Generative design: An explorative study. *Computer-Aided Design and Applications*, *18*(1), 144–155.

Cammer, M. (2023). *Too bad to be fraud, Midjourney has yet to embark in science.* bioRxiv. https://doi.org/10.1101/2023.01.28.526052

Denzin, N. (2013). *Collecting and interpreting qualitative materials*. Los Angeles: SAGE.

Iacob, A. D. (2023). Slow down! Breathe! Artificial Intelligence (AI) anxiety in design education. In D. Jones, N. Borekci, V. Clemente, J. Corazzo, N. Lotz, L. M. Nielsen, L. A. Noel (Eds.), *The 7th International Conference for Design Education Researchers* (Conference proceedings), London, UK (pp. 1–3). Design Research Society. https://doi.org/10.21606/drslxd.2024.067

Klohn, S. C., & Zimmermann, A. (2021). Framework to analyze the use of colors in informational maps related to Covid-19 data. *InfoDesign – Revista Brasileira de Design da Informação*, *18*(3), 39–52.

Kok, J. N., Boers, E. J., Kosters, W. A., Van der Putten, P., & Poel, M. (2009). Artificial intelligence: Definition, trends, techniques, and cases. *Artificial intelligence*, 1, 270–299.

Hanna, D. M. (2023). The use of artificial intelligence art generator "Midjourney" in artistic and advertising creativity. *Journal of Design Sciences and Applied Arts*, *4*(2), 42–58. https://doi.org/10.21608/jdsaa.2023.169144.1231

Lonsdale, M. dos S. (2023). *Information visualisation: From theory, to research, to practice and back*. SAGE.

Lonsdale, M. dos S., Lonsdale, D. J., Baxter, M., Graham, R., Kanafani, A., Li, A., & Peng, C. (2019). Visualizing the terror threat: The impact of communicating security information to general public using infographics and motion graphics. *Visible Language*, *53*(2), 37–71. https://doi.org/10.34314/vl.v53i2.4645

Lonsdale, M. dos S. (2023). *Information visualisation: From theory, to research, to practice... and back*. SAGE.

Lyra, K. T., Reis, R., Cruz, W. M., & Isotani, S. (2019). Um framework de classificação de complexidade para infográficos. *Revista Brasileira de Informática na Educação*, *27*(1), 196–223. https://doi.org/10.5753/rbie.2019.27.01.196

Mansour, S. (2023). Intelligent graphic design: The effectiveness of Midjourney as a participant in a creative brainstorming session. *International Design Journal*, *13*(5), 501–512. https://doi.org/10.21608/idj.2023.231684.1090

Naqa, I., Murphy, M. J. (2015). What is machine learning? In I. El Naqa, R. Li, M. Murphy (Eds.), *Machine learning in radiation oncology* (pp. 3–11). Cham: Springer. https://doi.org/10.1007/978-3-319-18305-3_1

Ong, P. A. L. (2020). Visual research methods: Qualifying and quantifying the visual. *Beijing International Review of Education*, *2*(1), 35–53. https://doi.org/10.1163/25902539-00201004

Ortega-Alcázar, I. (2012). Visual research methods. In *International Encyclopedia of Housing and Home* (pp. 249–254). https://doi.org/10.1016/B978-0-08-047163-1.00693-7

Perschon, M. D. (2012). *The steampunk aesthetic: Technofantasies in a neo-victorian retrofuture* (PhD thesis) – University of Alberta, Edmonton. https://era.library.ualberta.ca/items/af46dcb5-93c2-4562-8328-fc8b06c35d36

Ramzan, S., Iqbal, M. M., & Kalsum, T. (2022). Text-to-image generation using deep learning. *Engineering Proceedings*, *20*(1), Article 16. https://doi.org/10.3390/engproc2022020016

Ruskov, M. (2023). Grimm in Wonderland: Prompt engineering with Midjourney to illustrate fairytales. In *19th Conference on Information and Research Science Connecting to Digital and Library Science* (Conference proceedings), Bari, Italy (pp. 180–191). https://doi.org/10.48550/arXiv.2302.08961

Salkowitz, R. (2022, August 16). Midjourney founder David Holz on the impact of AI on art, imagination and the creative economy. *Forbes*. https://www.forbes.com/sites/robsalkowitz/2022/09/16/midjourney-founder-david-holz-on-theimpact-of-ai-on-art-imagination-and-the-creative-economy/

Schleifer, A. (2017). *The way we build: How rethinking the Airbnb app changed the way we approach design.* https://airbnb.design/the-way-we-build/

Verganti, R. Vendraminelli, L., & Iansiti, M. (2020). Innovation and design in the age of artificial intelligence. *Journal of Product innovation management*, *37*(3), 212–227. https://doi.org/10.1111/jpim.12523

Vermillion, J. (2022). *Iterating the design process using AI diffusion models creative collaborations.* https://digitalscholarship.unlv.edu/cfa_collaborate/9

Zimmermann, A., & Klohn, S. C. (2021). Ensino de infografia baseada em narrativas pessoais. In K. C. A. S. Smythe, R. C. Andrade, & J. Bueno (Eds.), *10º Congresso Internacional de Design da Informação e 10º Congresso Nacional de Iniciação Científica em Design* (Conference proceedings), Curitiba, Brazil (pp. 470–484). São Paulo: Blucher. https://doi.org/10.5151/cidicongic2021-036-357569-CIDI-Educacao_ac.pdf

About the authors

Sara C. Klohn Reader
s.c.k.reader@lboro.ac.uk
Loughborough University
United Kingdom

Alis Iacob
a.d.iacob@lboro.ac.uk
Loughborough University
United Kingdom