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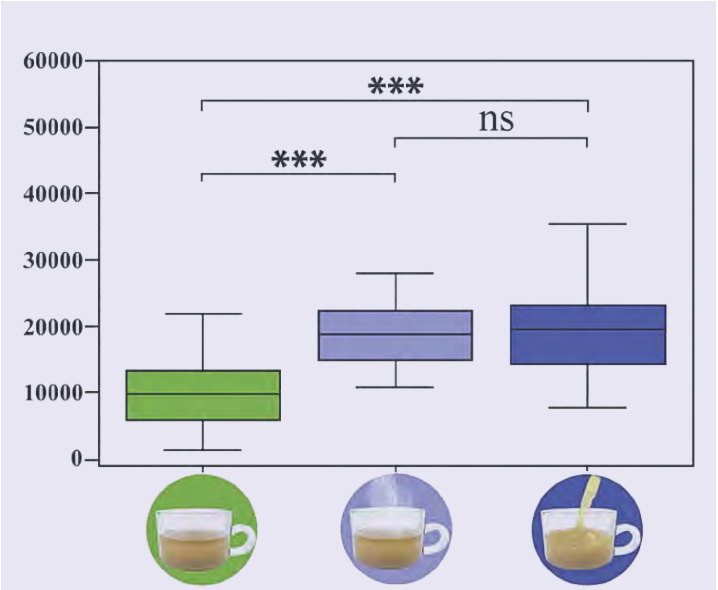

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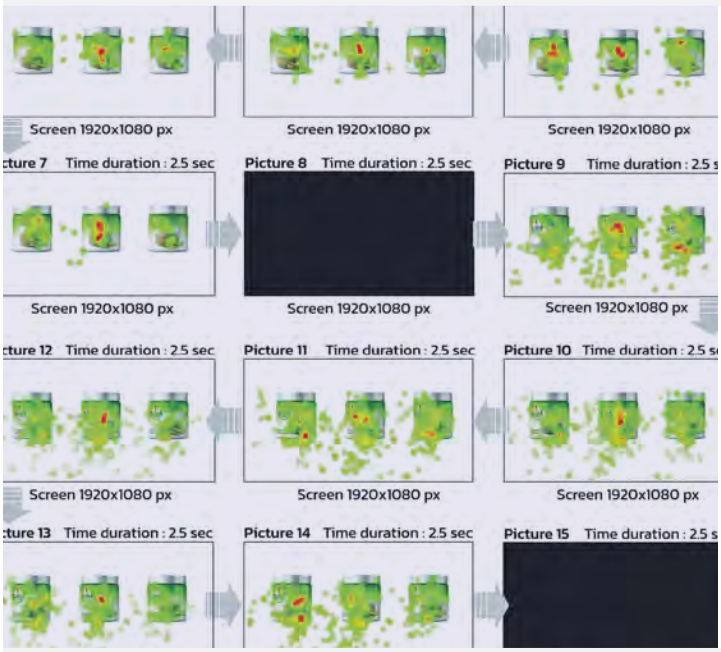

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Address:
Faculty of Technical Sciences,
Department of Graphic
Engineering and Design,

Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia

Telephone numbers:
+381 21 485 26 20
+381 21 485 26 26
+381 21 485 26 21

Fax number:
+381 21 485 25 45

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jged@uns.ac.rs

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Experiments and traditions in Ukrainian contemporary printmaking

ABSTRACT

The article covers the phenomenon of synthesis of traditions and innovations in contemporary Ukrainian printmaking. The trends of today's art of circulation graphic arts in Ukraine, novelty, tools of artists of the new generation are considered. The problem of danger of classical techniques disappearing due to strengthening of C.A.D. positions is raised. Attention is focused on ways to preserve classical traditions using the example of intaglio techniques: etching, mezzo-tint, aquatint, dry point. The main trends in the existence of these techniques and ways of their preservation in various combinations are analysed. Work of the most distinctive schools (Lviv, Kyiv, Odesa), their brightest representatives who use traditional intaglio techniques, combining them, experimenting with technology, materials, creating new variations of traditional techniques, is covered. Attention is focused on the work of the Lviv school representative Oleh Denysenko who patented a new technique he invented, "gesography", which became the most important tool in the process of preserving printmaking, in the modern artistic field and transforming it into an updated stronghold of fine arts of modern times.

KEY WORDS
printmaking, etching, art-book, gesography, levkas, aquatint, mezzo-tint

Julia Romanenkova [1]
Alla Tarannyk [2]
Yurii Yefimov [3]
Anna Myronova [3]

[1] National Academy Of Fine Arts and Architecture, Kyiv, Ukraine
[2] Kyiv Municipal Academy of Circus and Performing Arts, Kyiv, Ukraine
[3] Borys Grinchenko Kyiv Metropolitan University, Kyiv, Ukraine

Corresponding author:
Julia Romanenkova
e-mail:
juliia.romanenkova@naoma.edu.ua

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Introduction

Ukrainian art of the end of the 20th and the beginning of the 21st centuries is the territory of challenge. A challenge that traditional classical art poses to contemporary artistic process. A challenge of today's art field to its predecessors – the battle of traditions and innovations does not always lead to creation of an organic synthesis, sometimes this process results in complete destruction of one of the participants. A challenge from the part of classical heritage, in its turn, to modern experimentalism, asserting the need for classical training, education, school. But one thing is certain – today's Ukrainian art lives in an era of experiment. And one of the most striking examples of its implementation is the art of printmaking. It is the one which refers to one of the most complex forms of art that are in a borderline state today – the question of its future is being decided. Printmaking has always been difficult for a viewer as well as for an artist or a critic. For creator it's difficult in technological, economic aspects, since various graphics techniques (especially printmaking) require knowledge of materials technology, the basics of chemistry when creating sheets. Later – of the basics of pricing when selling them, since circulation graphics has many specific conditions when selling works.

Traditions and innovations in contemporary Ukrainian graphic arts

The milestone of the 20th and 21st centuries challenges specifically graphic arts, both free and printmaking. And above all this is due to emergence of new technological opportunities for artists, making it easier for themselves to create a graphics artwork, first of all – computer technologies, computer graphics. It is this technique, in all its diversity, that is rapidly pushing classical printmaking away from its leading position (Romanenkova, 2015).

It is difficult to say that these phenomena will be able to coexist – young generation gets used very quickly to innovations of C.A.D. (computer aided design), the arsenal of which can imitate watercolours, pastels, pencil drawing, many effects of printmaking techniques, artificial intelligence tools also come to help this arsenal. When looking at a work, it is impossible to determine with the help of solely primary visual examination how it was created, modern technologies challenge classical printmaking techniques imitating them. As a result, the system of values within the art field is changing radically. Among designers of the new generation there is an opinion that it is not at all obligatory to be able to draw, a necessary program, an application or an artificial intelligence will do everything what`s needed (Chyrva & Olenina, 2021).

Therefore, the foundations of art education are changing, the principles of pricing for works created in this way shift as well. Printmaking is pushed into the background much faster than free graphic arts, since mastery of its techniques requires training, professionalism is achieved by experience, skill, and scrupulous work. Today hardly anyone is able to do this or choose to do so. If one still can experiment with charcoal and pastels of different types, etch an etching, combine it with aquatint or mezzo-tint, cut an engraving on steel or do miracles on lithographic stone today is a task which not so many masters are able to comply with, mostly those of an old school, academically trained Romanenkova, Bratus & Kuzmenko (2021). Artist-printmaker masters drawing, plastic anatomy, the basics of chemistry, composition, color, he must know the properties of metals, be able to work with a burin, acid and much more. While with the help of computer graphics all this remains beyond attention, some designers do not have art education. But own computer programs and facilitate their tasks as much as possible when making what is called works of art which imitate works created using printmaking techniques. Classical techniques are being seriously challenged, they turned to be on the verge of extinction. Of course, from the point of view of value of such works, even in terms of pricing criteria, this cannot be compared with what is created by artists using free-form and printmaking techniques. It is clear that the value of a pastel or an etching, even taking into account the possibility of replicating a printmaking sheet, is undeniable. However, accessibility and ease of mastering technical skills of creating a kind of a “clone” of a printmaking work using computer graphics, do their job. Mini-print, for example, is increasingly using computer graphics in its arsenal. Ex-libris created with its help have been popularized for more than two decades, in the late 1990[ies] there already have been masters in Ukraine who switched to these techniques, like Kyiv artist R. Vygovskyi, who actively used them when creating book plates (Figure 1) or Kyiv resident Yu. Kamenetskaya who created ex-libris in C.A.D. in the 2020[ies] (Romanenkova et al., 2022) (Figure 2).

» **Figure 1:** *Vigovsky R. Ex libris P. Nesterenko. C.A.D. 1997.*

» **Figure 2:** *Kamenetskaya Yu. Ex libris I. Pavelchuk. C.A.D. 2023*

Young generation gets used to such an arsenal of technical capacities very quickly, and giving up such an ease in creating a printmaking work is hardly possible. That`s why adequate response options have to be searched for as a reaction to challenge posed to classical techniques of graphic arts, first of all, it goes about printmaking. And only experiment can be an answer. Printmaking for all its diversity would have been doomed to disappear, if masters had not experimented with techniques and had not offered something new, that could make this type of art be kept in sight of an audience and prevent it from fading away.

Only experiment may be an answer to rapid popularization of graphic works created using computer graphics techniques. And its product is a work that is difficult or impossible to imitate and replicate (Kamenetskaya, 2018).

The art of Ukrainian printmaking accepted the challenge of modern realities. Itself it challenged today's artistic processes and exploded with novelty, experiments in the field of techniques, technological innovations and not only survived in the cultural space, but also reached new horizons. In fact, this already is about a symbiosis of traditions and innovations, updated classics, demonstrating the courage and non-standard technological solutions of masters. So, the main goal of this article is to prove that the classical traditions of Ukrainian graphic arts cannot be replaced or displaced by any technological innovations, while new technologies enrich classical graphic arts and serve it.

Experiments in contemporary printmaking of Ukraine (intaglio)

Masters who presume to remain faithful to the art of printmaking always try to resort to non-standard solutions. This happens not only in printed graphics, where the field for experiments is very wide, but technically quite complex and burdensome. But that is it, which became a kind of a Rubicon, a peculiar contact zone where interesting processes take place.

An example of this is artists` appeal to the phenomenon of an artbook, an author's book. There experiments are conducted which may be called a mirror reflecting all the processes peculiar to present-day printmaking. At the same time this is a preservation, maintaining interest in a book and an attempt to introduce novelty of form, technique, technology into a traditional phenomenon, to preserve traditional techniques instilling interest in them. It is especially important to emphasize that quite often art book becomes an object of study for future artists – a task of creating an art book is quite popular in art institutions of today's Ukraine.

Such works are also created using free graphics techniques, experimenting both with the form of a book itself and with illustrative content. For example, Kyiv graphic artist Anna Myronova turns to the art book herself (and encourages design students to work with the book as well.

The works by A. Myronova most often relate to avant-garde research, studies in the field of non-objective art, free graphic arts techniques, different variations of drawing. Illustrations of a number of artbooks by this artist are abstract in content, sometimes she works on her book for quite a long time.

Sometimes an artbook becomes a symbiosis of free graphic arts and printmaking techniques, when artist synthesizes both, creating a kind of fusion of traditions and innovations in one work. An example of such experiments is the artbook by Kateryna Pirog in which letterpress techniques are used (engraving on cardboard, blind printing and free graphic arts tools – liners, drawing).

Sometimes an artbook becomes not only a work of art, but also a form of active communication, a tool that quickly and directly conveys the idea to the viewer.

This is how the art book 2023 which covers everyday life of refugees from Ukraine in 2022 was used – the project “Visual Diary of War” includes illustrations by Antonina Semenova, was presented in one of the Dnipro museums (Figure 3).

» **Figure 3:** *Semenova A. Artbook “Visual war diary”. 2023*

Young artists use liners, pencil, ink to create their artbooks, but also turns to C.A.D. experimenting in this case more with the form of an art book. This is a significant educational aspect – generation of future designers receives the basics, getting used to culture of creating a book, significance of a work which is not subject for replication, has to be unique, as it used to be with a book several hundreds years ago, when each one was created and decorated by hand.

Even if in the process of creating an artbook printmaking techniques are used, it may remain exclusive despite technical possibility of replication. In this case such exclusiveness becomes possible either thanks to the highest level of professionalism in execution of works or thanks to non-standard technological solutions. Example might be the “Ecclesiastes” artbook with illustrations by the Luhansk artist Konstantin Kalynovych (World of art, 2024).

This is the case when an artbook can be considered as a standard appeal by an artist-printmaker to the heritage of printing and a proof of traditions being maintained at the highest professional level (Romanenkova & Araya Berrios, 2021). This publishing project by Tymofei Markov and Kiril Aveliev is also a kind of challenge posed to computer technology in service of contemporary art.

Of course, it is not correct to match and counterpose these categories, but in this case we are talking about C.A.D. as personified innovations of the modern artistic field, and about classical printmaking as an epitome of traditions, so the parallel is appropriate. The “Ecclesiastes” project is a challenge to innovation from traditionalist professionals for whom the main weapon is a high level of professionalism, including technological one.

Back in the 1990ies K. Kalynovych was creating illustrations for the book “Ecclesiastes” (Belichko, 2017), as a result of which a handwritten version of the book with etchings appeared. It was created in only two copies: one, in the author’s binding, is kept in the USA (Mount Holly Oak College- 1997), the second – in Russia (collection of K. Avelev- 2002). Few more years the artist made etchings for “Ecclesiastes” in small editions, but, as a result, ten years later they were put together again (Book “Ecclesiastes” or Priacerh) (Markov & Aveliev, 2012).

» **Figure 4:** *Kalynovych K. Book «Ecclesiastes» or Preacher. Etching, calligraphy, relief stamping, hand cast paper. 2012*

Already in 2012 a printed version was created, also with illustrations using the intaglio technique (Figure 4). Several years were spent on this work, it became the fruit of collective labor. This work is created in classical traditions of the French livre d'artist with unbound sheets (Markov & Aveliev, 2012). The text was made by Dmytro Bugaienko using the silk-screen technique, German hand cast paper “Hahne Muhle” (300 g/m2) became its basis, gift box is covered in fabric with a genuine leather spine, protective case is made of acid-free cardboard (Book “Ecclesiastes…”), bookbinding and stamping were done by Alexander Barsuk. The book was published after several years of painstaking work on it (1993-1996). The circulation of this publication is only 33 copies, after offprint of the last copy was done, the artist put the stamp “Circulation closed” on printing boards, which significantly increases price of such work of book and printmaking art, since it is no longer possible to repeat it. One copy of the book on trade, at different auctions, was valued at amounts (as of today) ranging from 1,650 to 2,200 US dollars.

Eight sheets of hand cast paper, size 29.7x21 cm, with etchings, placed in parchment paper with fragments of text from the Old Testament, protected by tracing paper with the author's calligraphy, with quotations from “Ecclesiastes”, all enclosed in a folder-dust jacket with relief stamping, all together placed in a protective case. All eight etchings are monochrome, the artist does not attract attention with a flashy palette and does not combine the classical etching technique with another arsenal. In general, the author’s book synthesizes etching, calligraphy, relief stamping, highly professional examples of bookbinding, which gives the idea of professionals` capacities in this field already at the beginning of the 21st century.

New art with ancient traditions: Lviv school invention

Works by K. Kalynovych, representative of the Luhansk school of graphic arts, can be considered an outpost of of printmaking traditions in the modern art field, almost always he turns to pure etching, not combining it with other intaglio techniques, and only from time to time tinting it with watercolours by hand. Of course, there is a number of artists who work primarily in etching without adding effects of other techniques (O. Fedorenko, A. Voznyi, A. Melnykova, O. Kryvoruchko, B. Drobotiuk, etc.), there are many Lviv residents among them (Romanenkova et al., 2021). Serhii Aksinin, Yulia Protsyshyn, Bohdan Pikulyts`kyi, Serhii Ivanov, for example, can be placed among them (Shepet’, 2019). The latter works in monochrome etching, creating complex multifaceted compositions, but in pure etching, without enriching neither the technique with mistures, nor the palette with additional colours; Lviv graphic master Serhii Khrapov, whose printmaking of small forms is always monochrome, and at the same time complex both in conceptual solutions and compositional structure (Figure 5), periodically limits himself to pure etching. Vladimir Pinigin, who has experience in a variety of techniques, also often preferred etching in its pure form. Lviv graphic artist O. Dergachov demonstrates examples of high professionalism in etching technique in both monochrome and colour variants.

» **Figure 5:** *Hrapov S. "Semiotic phantoms". Etching. 2017*

Special place in this cohort belongs to Oleh Denysenko whose etchings are always monochrome, most often complicated with interspersing of calligraphic combinations which are multi-layered, as regards the filling of sense, and also monochrome. At the same time, many artists of Kyiv, Odesa, and Lviv schools resort to synthesis, experimenting with various combinations of techniques when creating their prints. It is almost impossible to visually determine techniques used to create a printed sheet, it may be difficult even for a professional. Viewer, naked eye, won`t distinguish pure etching from what is usually called "mixed technique". Intaglio masters experiment with a combination of different techniques using the most characteristic technological methods, combining them in one sheet, bringing complexity to perfection, achieving desired effect, creating unique textures, colour effects and character of a stroke. Etching and aquatint, etching combined with aquatint and mezzo-tint have become the most popular combinations, variations of dry point and mezzo-tint are used not so often, but there are also cases when 4-5 intaglio techniques like etching, aquatint, mezzo-tint, soft varnish, dry point can be combined in one graphic sheet.

In such sheets, of course, visual effects are much richer – depth of tone is easier to achieve, there are often variations in the palette, the texture is varied, which is more often manifested on backgrounds or large planes of compositions.

The popular combination "etching, aquatint" (C_3C_5) is not an identifying feature of a particular school – representatives of various outposts of printmaking resort to it. Such examples as sheets of Odesa artist Hennadii Vereshchagin, Lviv residents Mikhailo Drimaylo, Vasyl Fenchak, Mariana Miroshnychenko, Kyiv graphic artists Ruslan Agirba, Kostiantyn Antioukhin and others can be given as a proof of it.

Such a combination of technological experimental research, complicated by introduction of mezzo-tint, as is done, for example, by the Kyiv artist Oleh Naboka (Figure 6) is of additional interest. At the same time, sheets remain monochrome, while, for example, the works of Mykhailo Drimaylo are polychrome (Figure 7) following Roman Romanyshyn from Lviv. He works in the same combination of techniques – etching with aquatint. Introduction of additional (especially bright) colours into graphic sheets in mixed technique gives them decorativeness, in some cases – even lubok features (R. Romanyshyn, M. Drimaylo), variegation.

» **Figure 6:** *Naboka O. Ex libris J. Sliep. Etching, aquatint, mezzotint. 2007*

» **Figure 7:** *Drymaylo M. Ex libris H. Manche. Etching, aquatint. 2019*

Dominant significance of line weakens, and the emphasis shifts to spot, colour, which brings the complex of means of impact of a work of art on a viewer closer to those of painting. Quite often masters use a combination of "dry point and aquatint" which gives an interesting result, visually just as rich in texture and effects. This combination gives a synthesis of background depth and dryness, clarity of line, combination of deep saturated spot and a velvety stroke, and, if it is also enriched with colour, then the texture can resemble a pencil drawing, as, for example, by the Vinnytsia artist Serhii Kyrnyts`kyi (Figure 8), Odesa graphic artist David Bekker.

A characteristic feature of the representatives of the Lviv school, who experiment with textures combining technological tools of several techniques, is monochrome. They resort to rich palette only occasionally. While Kyiv and Odesa schools are more inclined to experiment with polychrome, without abandoning work with black and white or monochrome graphic arts created by combining mezzo-tint, aquatint and dry point.

Interesting effects are obtained from a combination of etching, dry point and mezzo-tint. In this combination Lviv graphic artist Serhii Udovychenko creates his sheets by resorting to complex technological processes combining these three techniques in one sheet, complementing it with multicolour, while the palette, unlike colour variations of Mykhailo Drimaylo or Roman Romanyshyn, is most often soft, pastel, with delicate stretches and half-tones.

Any such experiment, that generates an unusual texture, a combination of strokes of different densities and degrees of rigidity and different textures, becomes a pledge of printed graphics being still viable, competitive, having the richest potential and positioning itself as a unique, inimitable phenomenon.

But Ukrainian artistic field is known for one more representative of the Lviv school, who went even further in his technological experiments, which led to birth of a new phenomenon in contemporary art, which has no precedents (Streltsova, 2023a).

Oleh Denysenko, mentioned above in connection with the characteristics of Ukrainian etching, created an art phenomenon, the uniqueness of which is officially confirmed by being certified – the invention is patented. Sometimes this is called a new type of art, sometimes – a technique (which is closer to the truth), but the main thing is a synthetic, boundary nature of the phenomenon, which the author himself called "gesography" (Antiqvitas Nova, 2024).

There are many reasons for its emergence, and among them is the subconscious, at the genetic level, artists` desire to adopt the right of existence of classical art in its academic foundations, to preserve traditions, giving them new life through experiments with techniques and technologies. Gesography, purely technically, lies at the intersection of levkas, graphic arts and sculpture. This type of author`s art implies excellent mastery of intaglio techniques, knowledge of technological features of levkas in which Oleh Denysenko often works and of the tools of sculpture, as long as we are talking about relief, working with volume, surface texture (Streltsova, 2022a).

» **Figure 8:** *Kyrnytsky S. Ex libris Li Na Mann. Dry point, mezzotint. 2017*

Gesography is the quintessence of characteristic features of icon painting, etching, relief. It not only lies at the junction of graphics, painting and sculpture, but is also at the border of high art and craft: it is used to decorate things of an applied nature (Streltsova, 2023b; Streltsova, 2022b). Oleh and Olexandr Denysenko, father and son, using oil, levkas, wood, taking Oleh's etchings as a basis, recreate these compositions in their unique technique, not just giving them a second life, but also turning everyday objects into works of art (Mihalchuk, 2020).

Most often gesographies are author's replicas of artist's philosophically interpreted compositions, converted into another technique. Unlike etching each such work is unique. Material comes from painting, complex of visual techniques of artistic language – from graphics, work with a surface plane – from sculpture. Curious to learn is that when studying only a reproduction or a digital image of such work, it is perceived exclusively as a graphic sheet, touched up with a colour but rather a monochrome etching, with all characteristics intrinsic to it. And only when perceived "live", at studying the original, by seeing dimensions, the plane itself, its thickness, seeing and knowing the materials used, the basis, the viewer understands that he faces a symbiosis not only of techniques, but also of types of art based on several categories at the same time.

Most often gesographies as independent works of art are quite large in size, which distinguishes them from printmaking works which mostly tend to seclusion.

As an example works that were exhibited at many exhibitions can be given: “Iron Wing” (gesography: wood, levkas, oil, 114x76 cm, 2021), “Saint Christopher” (gesography: wood, levkas, oil, 111x73 cm, 2021), “The Flying Pilgrim” (gesography: wood, levkas, oil, 2021), “Elixir of Life” (gesography: wood, levkas, oil, 60x60 cm, 2022), “Euterpe” (gesography: wood, levkas, oil, 84x60 cm, 2022), “Four Elements: Water” (gesography: wood, levkas, oil, 114x84 cm, 2021), etc. Many of gesographies become a means of decorating everyday objects – according to Olexandr Denysenko, craftsmen try to return application-oriented function to high art and at the same time give an aesthetic character to everyday objects (Romanenkova & Streltsova, 2023).

Thus, compositions “Flying Pilgrim” and “Four Elements: Air” (Figure 9) have “double life”, both existing as independent gesographies as well as applied works: the image of a pilgrim became an adornment for an iPhone case and a box for it, having turned into a VIP accessory decor, and allegories of the four elements were transferred as table decor base (Figure 10) transforming the interior of the 21st century into a medieval castle or a Renaissance palace accessory, stretching red thread between eras. Thus, the master demonstrates transformation of a work being subjected to peculiar technological “mutations”, exploiting the same composition in different techniques – first as an etching, then as a gesography, and finally, as a base for decor of an applied work of art, or rather, thanks to this work, turning an everyday circulation item into an exclusive work of high art (Figure 11).

» **Figure 9:** *Denysenko O. “Four elements – air”. Gesography. Wood, levkas, oil. 2021*

» **Figure 10:** *Table with gesography by O. Denysenko “Four elements – air”*

Conclusion

All of the above examples illustrate the main trend of modern Ukrainian printmaking: experimentation as a key to survival and evolution. Many authors abandon classical printmaking techniques because they are complex, expensive and require many years of preparation, that of an artist (to create a work) and of a viewer (to perceive and read it) both. In this case preference is given to computer graphics, which is compelled to become a substitute for traditional graphic techniques, imitation thereof. Tool replaces result for creation of which it is intended to serve. First of all, this concerns the young generation, which, although prone to non-standard solutions and searching for new things, manifests it mainly by facilitating for themselves the process of creation of a printmaking work. But other masters, whom, fortunately, there is a lot, working with traditional techniques and materials, preserve life of classical printmaking, using experiment as their main tool and instrument, that allows to build a modernized object on a traditional foundation, synthesize traditions and innovations, breathe life into academic traditions, making them viable, preserving and developing them while accepting challenges of realities of the new time.

» **Figure 11:** *Denysenko O. «Flying Pilgrim»: Etching (1997), gesography (2021), IPhone in a case with geography and a mahogany case*

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References

Antiqvitas Nova. (2024) *Intaglio Amaze with narrative*. Available from: https://www.antiqvitas-nova.art/uk/grafika/ [Accessed 22nd March 2024]

Belichko, N. (2017) Graphic allegories of Kostyantyn Kalinovich. In: *Proceedings of the International Scientific and Methodological Conference for Faculty Members and Young Researchers within the Framework of the IX International Forum "Design Education 2017": Pedagogical Aspects of Teacher Training in Visual Arts and Design: Present and Future and Current Issues in Art Criticism: Challenges of the 21st Century, 9-12 October 2017, Kharkiv, Ukraine*. Kharkiv, Kharkiv State Academy of Design and Arts. p. 122.

Chyrva, O. & Olenina, S. (2021) *History and theory of graphic art: lecture notes for full-time students of the first (bachelor) level of higher education, specialty 023 – Fine art, decorative art, restoration*. Kharkiv, O. M. Beketov National University of Urban Economy in Kharkiv.

Kamenetskaya, Y. (2018) The influence of innovative technologies on the development of graphics of small forms. *Cultural Almanac*. 10, 34-36.

Markov, T. & Aveliev, K. (2012) *The Book of Ecclesiastes or the Preacher with Illustrations by Konstantin Kalinovich*. Publishing project of Timofey Markov and Kirill Aveliev. Available from: https://tmizdat.ru/books/kniga-eklessiasta-ili-propovednika/ [Accessed 22nd March 2024]

Mihalchuk, V. (2020) Oleg Denisenko's "Crusade": the individual style of the Lviv master in the context of contemporary Ukrainian art. *Scientific light*. 1 (8), 3-8.

Romanenkova, Y. (2015) Ukrainian ex-libris on the international arena of contemporary graph-ic arts. *Art Criticism of Ukraine*. 15, 111-118.

Romanenkova, Yu. & Araya Berrios, N. (2021) Motif of the time in the creative work of Ukrainian artist Kostyantyn Kalynovych. *Актуальні питання гуманітарних наук*. 45 (2), 32-37. Available from: doi: 10.24919/2308-4863/45-2-5

Romanenkova, J. & Streltsova, S. (2023) Anthology of flight in creativity of Oleh Denisenko. *Art-platforma.* 1 (7), 99-123. Available from: doi: 10.51209/platform.1.7.2023.99-123

Romanenkova, J., Bratus, I. & Kuzmenko, H. (2021) Ukrainian Ex Libris at the End of the 20th Century and the beginning of the 21st century as an instrument of the intercultural dialogue. *Agathos*. 12 (1), 125-136.

Romanenkova, J., Bratus, I., Mikhalchuk, V. & Gunka, A. (2021) Lvov ex-libris school as the traditions keeper of the intaglio printing techniques in the Ukrainian graphic arts at the turn of the XXth and XXIth centuries. Revista inclusiones. 8, 321-331. Available from: doi: 10.13140/RG.2.2.21387.82726

Romanenkova, J., Bratus, I., Varyvonchyk, A., Sharikov, D., Karpenko, O. & Tkachuk, O. (2022) Computer technologies as a method to create a contemporary ex-libris. *IJCSNS International journal computer science & network security*. 22 (6), 332-338. Available from: doi: 10.22937/IJCSNS.2022.22.6.42

Shepet', T. (2019) *Easel Graphics of Lviv in the 1990s and 2000s: National Specificity and European Artistic Context*. Phd thesis. Lviv Academy of Fine Arts.

Streltsova, S. (2022a) Graphic embodiment of the worldview of the contemporary artist Oleh Denysenko. In: *VI International Scientific and Practical Conference: Theory and Practice of Modern Science and Education, 12 December 2022, Lviv, Ukraine.* pp. 21-23.

Streltsova, S. (2022b) Artistic images of O. Denysenko's works in the technique of levkas. In: *Scientific and practical conference: Science, education and society: current scientific research, 25-26 February 2022, Kyiv, Ukraine*. Kherson, Publishing house "Young Scientists". pp. 22-25.

Streltsova, S. (2023a) Embodiment of Modern Graphic Images in the Artistic Experiments of Oleg Denysenko (ecoline). *Bulletin of Lviv National Academy of Arts*. 50, 117-124. Available from: doi: 10.37131/2524-0943-2023-50-1-12

Streltsova, S. (2023b) Symbolism of Artistic Language and Principles of Image Making in Oleh Denysenko's Art Books. Culture and Contemporaneity. 25 (1), 144-149. Available from: doi: 10.32461/2226-0285.1.2023.286798

World of art. (2024) *Artist Kalinovich Konstantin.* Available from: https://worldartdalia.blogspot.com/2013/11/blog-post_7875.html [Accessed 12th March 2024]

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Defining the parameters that determine the visual perception performance and the appearance of occupational health and safety pictograms

ABSTRACT

Originally developed as a means of transmitting information and warnings by eliminating language and cultural differences in public spaces such as airports, train stations, bus stations, hospitals, stadiums, pictograms have turned into visuals that we encounter in every aspect of our lives today. They are the visual heroes behind the harmonious movement of today's fast and complex pace of life. They deserve all kinds of praise in terms of the mission they have set out. Nowadays, which we call the digital age or the age of visual communication, visuals are produced very intensively in every field, but they are thrown into the visual landfill very quickly. However, it is necessary to keep the pictograms that will be used in a vital issue such as occupational health and safety out of this structure. For occupational health and safety, pictograms are symbols that allow employees and visitors to move safely. These pictograms are used in workplaces to indicate safety rules, instructions and warnings. These pictorams, which are of vital importance for human health and the prevention of occupational accidents, should be easily visible and quickly perception. Although pictograms for occupational health and safety have been standardized and made mandatory by legal regulations, they are produced in very different design options as a result of advanced graphic and printing capabilities. In addition, the new technologies that are being used in dynamic business life reveal the need to prepare informative, stimulating texts, signs and pictograms together with these technologies. In the field of occupational health and safety, whether it is designed for the first time or an old pictogram is revised, the form, size, composition, color and background elements that determine visual perception performance must be evaluated separately. Another important issue is that those responsible for the enterprise show the necessary sensitivity to the physical conditions that will make it easier to see the pictograms. Although it has been prepared at the highest level in terms of graphic design and printing techniques, it cannot have any function in unsuitable location and lighting conditions.

KEY WORDS
occupational health and safety, pictogram, vision, visual perception, graphic design

Engin Uğur

Bolu Abant İzzet Baysal University, Faculty of Fine Arts, Graphic Department, Bolu, Turkey

Corresponding author:
Engin Uğur
e-mail:
engin.ugur@ibu.edu.tr

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Introduction

Occupational health and safety in many industrialized and industrializing countries of the world is one of the top priorities of country administrations. All kinds of legal regulations and practices have been implemented to minimize occupational diseases and occupational accidents and are being followed up with audits.

Informative and warning signs constitute the first stage of the applications related to occupational health and safety. Informative and stimulating messages related to occupational health and safety should be prepared with simple visuals instead of written messages in order to be perceived quickly and easily. Hesitation or a full-blown situation on a vital issue cannot be allowed. Pictograms have become the main visual language of crowded spaces today, especially due to their ability to communicate with the masses instantly (Tuğcan 2016).

Warning signs and signs that are of vital importance related to occupational health and safety have been standardized by laws and regulations. In order for pictograms or signs related to occupational health and safety to be easily seen and perceived, attention should be paid to two basic elements. Firstly, it should have a design structure that an optically healthy person can see with his visual sense organ, and secondly, it should have a content that a semantically normal person can perceive. From the design stage to the use stage, it is of great importance to put forward the study in the light of objective and analytical data instead of a personal approach in order to meet the desired expectations. Pictograms are largely composed of simplified geometric structures that do not carry artistic concerns. For this reason, it is prepared according to general vision and perception principles and concepts instead of personal initiatives.

It is of great importance to show the necessary care in all matters in terms of preventive measures in high-risk business lines in terms of occupational health and occupational accidents. One of the dimensions of preventive measures is the warning pictogram plates. It is necessary to show the required sensitivities at the highest level at every stage from the design of pictograms to their use. In the revision of new pictograms or existing pictograms designed for the needs of developing and changing business areas every day, separate evaluation, discussion of parameters affecting the dimensions of "visibility" and "visual perception" and correction of deficiencies and inaccuracies will be an indicator of the importance given to occupational health and safety.

The concept of Occupational Health and Safety

Occupational health and safety activities are scientific and systematic studies carried out in order to protect against causes that may harm health caused by various reasons during the execution of works in the field of business (Eraslan & Cansaran, 2020), as shown in Figure 1. The most important element that should be in business life is the comprehensive adoption of preventive measures for occupational accidents and occupational diseases. In order for the concept of occupational safety to make sense, it should be ensured that employees benefit from their health and safety rights within the scope of the declaration of human rights and that a certain level of knowledge is formed (Karaman, Çivici & Kale, 2011).

The most important detail that should be in business life is occupational safety information. Accidents and diseases will be inevitable unless sufficient information is given about the factors that will cause occupational accidents and diseases. Occupational accidents, occupational diseases cause serious losses both financially and spiritually for all developed and developing countries all over the world. The first stage of preventive measures for occupational accidents and diseases is to take the necessary measures. It is necessary to be a follower of the uninterrupted fulfillment of these received values. Warnings should be made with the necessary warning signs to ensure that necessary measures are taken continuously without leaving it to the personal initiative of employees. The plates prepared related to occupational health and safety have an important mission in this respect.

» **Figure 1:** *Occupational health and safety, taken from Vodafone, 2024 and occupational accidents, taken from Ateş, 2023*

Pictogram

Pictograms are defined as simple, pictorial and representative symbols. They are visual symbols that represent a specific object, verb, or place in a simplified (simplified) way, as shown in Figure 2. Pictograms simply contain graphic representations of objects, concepts or actions, the meaning of which is understandable for most people (Kovačević, Brozović & Bota, 2014).

Because pictograms do not have any language, they appear as a visual language that people who speak different languages can easily understand. Pictogram; firstly, it is the name of visual images created instead of written language to describe certain contents to the general public without any language restrictions in public spaces such as airports, hospitals, stadiums, shopping malls, terminals, railway stations (Shiojiri, Nakatani & Yonezawa, 2013).

Pictograms are skeletal structures that, when examined, are either constructed in a sluet style close to reality or modularly. The main module is mainly triangle, square or circle. Other forms are created by adding to this main module. No matter what style they are produced in, pictograms are simplified abstract structures. The most important element to be considered in pictogram design is to ensure formal consistency. Computer-aided designs are used today in the adventure of pictogram design, which started by preparing with traditional methods. In computer aided design, great care is taken to ensure formal consistency starting from the first processes of pictogram construction. Formal synthesis, control of forms and dimensional coordination proceed in an analytically controlled manner with very precise values. In a visual sense, it is tried to reach the result that gives the most realistic picture of observable reality.

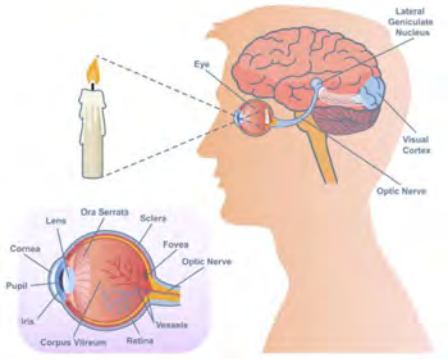
» **Figure 2:** *Examples of pictograms*

Defining the Physical Parameters that determine the Viewing Performance of Occupational Health and Safety Pictograms

In order for any object to be perceived by itself or its depiction, it is necessary to be able to see at a minimum level first. In order for the visual function to occur, the light must reach the retinal layer. The eye is a specialized organ for capturing these photons that are constantly coming from the environment, as shown in Figure 3. Light rays enter by passing through the pupil, which is the entrance area of the eye. The pupil has the function of growing and shrinking sensitively to light.

Because the light is intense in too bright environments, the pupil shrinks, while in dark environments the pupil grows so that as much light as possible enters the eye (Memetoğlu, 2022).

The light rays entering by passing through the pupil, then reaching the specialized nerve layer, their angle of arrival, intensity, etc. according to their physical properties, they are converted into electrochemical signals of various forms. These signals are transported to the brain on nerve cells and evaluated by other nerve cells specialized to read these signals in the brain. It is not our eyes that see anything; it is our brain. The only task of the eye is to provide information to the brain by converting light rays from the environment into electrochemical signals. They are transmitted and evaluated hierarchically to areas in the brain that are specialized for evaluating signals from the eye.



» **Figure 3:** *Eye and vision action stages*

For the action of vision to occur, a healthy visual organ and light are needed. Especially in order to see the pictograms in the indoor space of the workplace, the environment should be bright and within the visual angle. The perception stage cannot be passed before the act of seeing begins. Low light level or long distance are the most basic physical disadvantages that will make it difficult to see any kind of object, visual or writing. The main obstacles in front of the fact that pictograms for occupational health and safety are considered as a requirement of the responsibilities they bear must necessarily be solved.

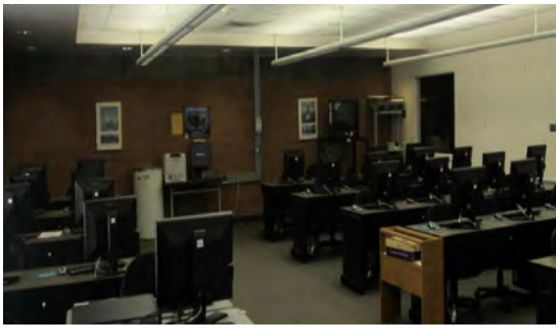
Pictograms for occupational health and safety are located in outdoor(outdoor) or indoor(indoor) spaces according to the activity structure of the workplace, as shown in Figure 4. The main parameters that affect the physical appearance of pictograms for occupational health and safety are the level of illumination and the choice of location. These two parameters interact with each other.

» **Figure 4:** *Workplace and occupational health and safety pictograms*

Level of illumination

The light stimuli that enable vision are transmitted by electromagnetic waves. The receptors located in the eye are stimulated by electromagnetic waves located within a spectrum of 400 – 700 millimicrons (Gürel, 2001). In the open air, the amount of light is more than enough for the eye to see except in very closed weather conditions during the daytime. But in order to see in a healthy way indoors, it is necessary to provide daylight with the help of windows or the level of illumination with the help of artificial lighting systems, as shown in Figure 5. Working in poorly lit environments poses risks in terms of occupational health and safety, as well as makes it difficult to see all kinds of warning signs and signs. Appropriate luminance level standards have been established by international lighting institutions for various functions and forms of activity. The purpose of these standards is to help ensure optimal conditions. A low level of illumination creates an important problem in seeing pictograms, while a high level of illumination causes negative situations such as dazzle and light reflections.

Lux (lx), which is the unit of luminous intensity, refers to the degree of luminosity that light from a candle-sized light source gives to a vertical surface at a distance of one meter (Gürel, 2001). The luminance level was characterized as 500 lx lower and 1500 lx higher than the alternatives. The most preferred lighting level. 1250 lx is the option where light is provided (Erkoç Kaplan & Dokuzer Öztürk, 2022).



» **Figure 5:** *Adequate and insufficient lighting in the workplace*

In the lighting of indoor spaces, there are lighting options with a very wide range according to the activity characteristics of the space and personal preferences. As important as it is to make the most appropriate choice among these options that will not harm the visual health of employees in the environment, it is also important to adequately illuminate the areas where there are warning signs and pictograms related to occupational health and safety. If the surface structures of pictograms and warning signs are bright, a suitable lighting system should be preferred, taking into account the unwanted light reflections of light rays coming from the lighting system. In addition, the choice of location should be made to minimize reflection. An important obstacle in front of the healthy viewing of pictograms in indoor spaces is the shadow falling on the visual, as shown in Figure 6. It is the lighting factor that significantly reduces the appearance of shadow, whether in an environment where the sun's rays illuminate the interior or in an environment with artificial light. For this reason, it is necessary to take care that the pictograms, which are of vital importance for occupational health and safety, are not located in the shadow areas caused by the structure and interior design of the space.

» **Figure 6:** *Lighting and shade in the workplace (Akay, 2015)*

Location (Location selection)

Placing the pictogram in the appropriate place is of great importance in fulfilling the expected purpose. It should be deployed according to the distance that people can easily see and the most appropriate visual angle, as shown in Figure 7. Location selection elements that make it difficult to be seen too far or too high or too low or angled positions that prevent it from being seen or make it difficult to see are those that make it difficult to be seen and visual perception along with it. The choice of a place that can be seen continuously should be made by taking into account the cases of periodic closure due to the shipment of raw materials or products or vehicle-machine mobility. Whether it is traffic or a pictogram for occupational health and safety, the necessary sensitivity should be shown when for any reason (a physical obstacle in front of it, dust, snow or mud or any substance covering it causes that pictogram to be disabled. Especially in workplaces with dust and sawdust environments, pictograms quickly become invisible due to the layer formed by particles. In such enterprises, the surface of the pictogram boards should be cleaned frequently. Due to the operating conditions of the workplace, environmental conditions such as high temperature, steam, chemical gases cause the printed parts that make up the pictogram to undergo deformation over time. Care should be taken to renew the pictogram plates in such establishments.

» **Figure 7:** *Ideal visual distances according to the visual size*

There may be a large number of pictograms in a workplace, the important thing is that it is positioned taking into account the closest and best visual point to the relevant place, as shown in Figure 8. The closest points should be selected against positions that may create a contradiction (confusion) with another pictogram or other device. For example, if there is an opening floor just below the crane and a rotating system next to it, it is not correct to position a group of collective pictograms in one place. Instead, positioning each of them separately so that they come to their own area will minimize the occurrence of confusion. If there are changes in the internal design of the enterprise or the stowage and shipment system due to new requirements that have arisen in the past time, their locations should be revised to ensure that they are visible on their pictograms.

» **Figure 8:** *Workplace and pictogram location selection application (hayalkare, 2019)*

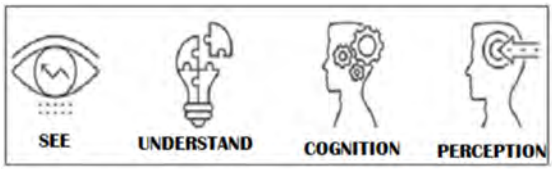
Defining the Graphic Design Parameters that determine the Visual Perception Performance of Pictograms related to Occupational Health and Safety

A person acquires an important part of the information he has about the outside world through sight. For this reason, visual perceptions are more effective on an individual's behavior than other sensory organs. "According to Carlson, perception takes place in an unconscious way (Timur & Keş 2016). A person does not become aware of the process during the perception process, he only receives the result of the perception" (Çağlayan, Korkmaz & Öktem, 2014), as shown in Figure 9. At the perception stage, the brain can interpret stimuli that do not exist in the physical world as if they were there, taking into account not only the stimulations coming from the eye, but also expectations arising from previous experiences (Crick, 1995). Everything gains meaning within its own context and turns into different objects when it is abstracted from its context. Thus, it is revealed that seeing is a comprehensive and perception-related process (Çakır, 2014). Perception is the latest stage of many pieces that have been made in our past and have gained a place in our memory.

Visual perception is the effort to be able to distinguish stimuli in a meaningful way. The ability to notice the details of an object and be able to see these details sensually. This is shaped in parallel with the knowledge gained and the experiences experienced. Perception makes a choice of its own accord from what it has seen before, and then activates the phenomenon of orientation that is outside of itself by Deciphering consciousness. For this reason, correctly acquired knowledge and expectations realized with visual knowledge will also facilitate perception (Dinçeli, 2020). In the process of visual perception, images are one of the most important elements that help visual communication. Images are a variable and organic structure.

They are images that change according to a person's perception. They are structures that are constantly affected by the external world, subjective experiences, senses, visuality and psychological states and show movement with these characteristics (Çakır, 2014).

Visual perception is an important factor that determines how easy graphic design can be understood. The more easily a graphic work can be understood, the higher its effectiveness. Regardless of the type and subject of the graphic design work, the first priority expectation is that it can be perceived by the audience.

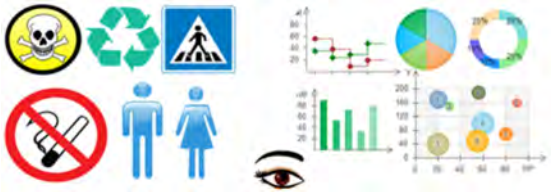


» **Figure 9:** *Visual perception processes*

Graphic Design and Visual Perception

Graphic design is the general name of the processes of designing design elements in a rational way using technological possibilities to prepare a visual communication product. The Deciency of a high level visual perception between the buyer and the design product prepared at the end of these processes is the first criterion of a successful graphic design study. In order for the design to be interpreted correctly, it must be perceived correctly (Uğur & Özsoy, 2020). The relationship between graphic design and visual perception begins with the act of seeing and is completed with the perception by Deciphering, as shown in Figure 10. At the perception stage, it perceives the Deconstructed elements that make up the holistic structure that creates the design by grouping the relationship or layout between various design elements (Timur & Keş, 2016). In other words, it perceives from the partial data transmitted by the sensory organs by transforming it into a holistic, structural meaning" (İnceoğlu, 2011: p.128). Perception is not a physiological process that depends only on the senses" (Parsil, 2012: p.28).

At the same time, the importance that an individual attaches to stimuli is the process of making sense of past experiences around certain principles by converting them into meaningful perceptual experiences by the brain. Since the pictogram is a visual communication design element, it is evaluated within the framework of graphic design concepts. In order to design pictograms in accordance with the intended use, attention should be paid primarily to the visual perception dimension. It does not matter if a pictogram that is problematic in terms of visual perception is successful in terms of design elements and design technique.



» **Figure 10:** *Visual perception and graphic design studies (Freeman, n.d.)*

In general, the visual perception process in graphic design develops through three main processes under the name of selective perception, perceptual organization and perceptual invariance (Özkirişçi, 2020). This psychological process, on which visual perception is based, is associated with Gestalt laws (Timur & Keş, 2016).

When examining the relationship between visual perception and graphic design, it is necessary to know the functioning of vision and perception mechanisms, as well as to take into account the factors affecting perception and their effects on humans. The visual perception dimension of pictograms determines how users perceive and understand pictograms. This is an element that is also taken into account during the design of pictograms.

Graphic Design Parameters that determine the Visual Perception Performance of Occupational Health and Safety Pictograms

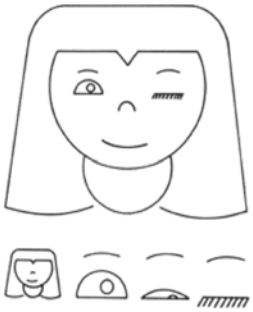
Occupational health and safety pictograms are fast-perceived visual information tools created to prevent health problems and occupational accidents that may occur in the work environment. It is very important that it does not have a complex structure for its rapid detection. The first framework of the concept of lean consists of few parts, balanced, consistent and thus covers studies that are easily followed by the eye and perceived quickly.

Thus, the user can perceive the message after a quick mental process. The second framework defined by simplicity is based on preferences for converting meaning into form. The visualization forms of a successful design should contribute to understanding and facilitate understanding (Tuğcan, 2016).

In order for pictograms to be easily understood by users, it is not enough to use only high-resolution and clear images. In addition, the design size is also important to increase the intelligibility of pictograms.

Design criteria determining the visual perception performance of a pictogram, a graphic design product; 1. form (form), 2. size (dimension), 3. composition (arrangement), 4. color and 5. the shape is the perception of the ground (background).

Form: Form semantically refers to visual clarity performance. Regardless of the means and purpose, pictograms are based on visuals produced from manipulations of formal elements. Within the scope of this manipulation process, animate and inanimate objects are simplified and transformed into stylized images. It is related to the formal representation of a visual in the design with a living- inanimate object, where it represents intelligibility. We do not describe Ivan Sutherland's “Sketchpad” simple drawing of the winking girl he drew for his system as realistic', but it is an effective visual representation of the winking girl (Uğur, 2022), as shown in Figure 11.



» **Figure 11:** *Ivan Sutherland's ”Sketchpad'” system (Sutherland, 2003)*

The format serves as a means of conveying the message in the design. The human brain tends to read and combine forms with the codes it has already created and make sense of them (Eken, 2021).
The format used in the design, on the other hand, should be used carefully and on the spot, taking into account that it can carry a meaning no matter how abstract or simple it is, as shown in Figure 12.

The most sensitive issue of the pictogram design stage related to occupational health and safety is the process of converting a complex technological device into a pictogram visual. In terms of visual representation, it is more difficult to convert a complex technology into a pictogram than to convert a simple technology into a pictogram. At the first stage of the pictogram design process, a comprehensive analysis and photographing of the relevant technology from all points of view is carried out in order to create data (knowledge accumulation) from a visual point of view. At the second stage, the details that will create the format (form) are determined. In the third stage, pictogram sketches are prepared based on these details.

At the last stage, the option that is the simplest and best representing the technology is determined from the sketches prepared. The visual perception performance of the selected form (format) is increased with graphic design applications to reach its final form. The starting point of a pictogram in terms of visual perception is the similarity of its transformed form to a pictogram with the fact of that technology, which creates a visual representation performance with another expression.

» **Figure 12:** *Examples of pictograms designed in different formats related to the same topic*

Size (Measure): Measure is the expression of the dimensions of the use of objects in design. Ratio, on the other hand, is defined as the measurement relationship of the parts of a whole with the whole (Turani, 1995: p.104). It is very important to make a harmonious and balanced measurement with each other by paying attention to the purpose and visual perception limits in graphic design, as shown in Figure 13. The determination of the dimensions of the design elements determines the level of visual perception, while at the same time determining the relationship with each other and the order of importance. The specified measurement preferences form the visual hierarchy of the design.

The priority in measurement preferences is to ensure visual perception performance at the maximum level. When aesthetic expectations get in the way of visual perception, the semantic structure of design begins to lose its importance to a large extent. In a graphic design study, visual perception and message value are directly proportional. In designs where the message value decreases and visual perception is not important, there is no harm in applying extreme (radical) preferences related to the dimensions of the design elements that make up the design, contrast levels, empty (negative) areas that are of great importance in visual perception. Measurements that are smaller than necessary create a distance effect in visual perception. The larger the necessary dimensions, on the other hand, express closeness. As much as hierarchical ordering is paid attention to when sizing design elements, maximum attention should be paid to their dimensions in order to easily perceive the characteristic (anatomical) structures of living inanimate objects included in the design. Excessive or small dimensions may cause objects to be perceived differently.

» **Figure 13:** *Different size application examples (Toma, n.d.)*

Graphic design studies are subject to measurement limitations as in different industrial production activities.

Within these limits, the design should have a maximum level of visual perception. Pictograms related to occupational health and safety are included in the group of design products that should be easily visible from a certain distance, such as posters, as shown in Figure 14. The size (measure) of each design element contained in a pictogram is very important for its mission to be determined precisely by taking into account the limits of optical perception in hierarchical order of importance.

» **Figure 14:** *Examples of pictograms with different dimensions related to forklift work safety*

Composition (Arrangement): Composition refers to how the design elements are arranged together and how they are combined Decoupled, as shown in Figure 15. The arrangement for selecting visual data is determined by Deciphering the thought it describes and coming to life in our minds, determining the distinction between right and wrong (Boydaş & Gümüş, 2022). In the perceptual organization approach, the main stimulus of perception is the way stimuli are organized, that is, their composition (Özkirişçi, 2020).

Knowing the relationship of the design elements with each other in a graphic arrangement, as well as knowing how all the components are meant in eye and mind coordination, and what they correspond to, is of vital importance for the design process and the designer (Özkirişçi, 2020). Trying to Decipher the relationship or layout between the design elements in a graphic design composition is considered to be a natural human visual perception activity. The fact that human perception has a tendency to group elements and different components in a fragmented structure within a wide structure proves this situation (Arıkan, 2008: p.24). As a result of editing, how the design will look and how it will be perceived will be shaped. The opposite of order is disorder. The complex structure resulting from a carefully unplanned arrangement makes visual perception difficult. What is important in terms of visual perception in pictogram design is to create a simple design. When the design elements that do not contribute to the design or create unnecessary repetitions are eliminated, the resulting simple (lean) structure is perceived faster and easier.

» **Figure 15:** *Examples of different compositions on the same topic*

Color: Color as a design element has an impact on the principles of graphic design. Color is the most important instrument for creating balance, emphasis, hierarchy and integrity in design as well as a means of expression for the designer (Uğur, 2021). Color is a factor that significantly affects visual perception. Color is relative and can vary according to the colors around it. This phenomenon is called simultaneous contrast. Green placed next to red will make both colors more dominant, but it will not have as strong an effect between the close shades of red as it does with green (Arntson, 2011: p.136; Eken, 2021). Carefully choosing how to combine colors with each other is very important for visual perception, as well as important for communicating your message more effectively. Color is both a design element and an editing tool in graphic design. Color serves as a tool in the creation of hierarchical structure (order of materiality).

Pictograms of importance such as occupational health and safety should be noticeable in the environment in which they are located, should be able to attract attention from long distances and should be detected quickly. In graphic design, color contrasts are used to create a remarkable design. Accents and contrasts in the design can be easily created with color contrasts. Contrast refers to the difference between two colors or the difference in brightness at two levels. Increasing the contrast makes important information more obvious and makes the image more understandable. In addition, colors with a high activity value are preferred to increase the attention attractiveness of pictograms.

According to the researches, warm colors such as yellow, red and orange are remarkable and have the priority of perception. according to the results of the study with 87 participants, the best performance was achieved with pictograms designed on a yellow background (Kovačević, Brozović & Bota, 2014), as shown in Figure 16.

» **Figure 16:** *Examples of pictograms designed in different colors on the same subject*

Shape-Ground (Background) perception: Shape is the two-dimensional state of objects. Wherever there is a shape, there is definitely a floor. In other words, the ground is needed for the appearance of the shape, as shown in Figure 17. The characteristics of the ground are also effective for the perception of the shape. The ground relationship of the shape affects the first view very much (Gezer, 2019). The human perception system makes a distinction between shape and Declivity. The shape is what a person focuses on (Uğur, 2019) While the shape is more remarkable than the ground, in some cases it can also be the opposite.

The shape makes a more impressive impression and is remembered better. We have perceptions that the shape and the ground change places with each other. While we see a form as a shape first, we can see it as a ground a little later. However, we cannot see a form as both a shape and a ground at the same time.

The basic principle in the shape-ground relationship is the independence of the shape. The first process to be performed to make it independent is to differentiate the floor very significantly according to the color of the shape (Uğur, 2019). The figure-ground law depends on the opposition (Boydaş & Gümüş, 2022).

» **Figure 17:** *Examples of visual design for ground perception of shape*

Pictograms are simplified visual structures consisting of geometric lines. The geometric space areas of these simple structures (floor) may also unwittingly evoke an undesirable visual form. This situation is also a common negative in motifs and decorative elements consisting of geometric structures, as shown in Figure 18. This situation, which creates an optical illusion, significantly complicates the perception of the pictogram.

» **Figure 18:** *Examples of shape ground perception in occupational health and safety pictograms*

Conclusion

The main priority in business life from a legal and ethical point of view should be an understanding of production that takes into account the right to life of the individual, society and nature. Taking into account even the smallest risks related to occupational health and safety and making the necessary is the priority task of both enterprises and legal institutions that follow. The basic philosophy in this regard is to take preventive steps without experiencing any negative consequences. In the fast pace of business life, the tasks of taking, implementing and supervising measures related to occupational health and safety are of such importance that they cannot be considered only as the duties of departments and corporate structures whose job definitions have been made by law.

All employees in an enterprise have responsibility directly and indirectly. The people and institutions involved in all kinds of activities related to occupational safety and occupational health have to do their best.

Although modern technologies that enter into business life every day have equipment that prioritize occupational health and safety, the reality of health problems and occupational accidents continues to maintain its place in the fast and intense pace of business life. Business environments also contain a wide variety of hazards and risks with different technologies and working structures.

Measures related to occupational health and safety should be applied at this fast and intensive pace without compromise. One of the dimensions of these measures is the warning signs, signs and visuals. Pictograms constitute the most important pillar of this group of stimuli. The simple (lean) visual structure of pictograms should give quick and clear messages to employees and people associated with the business environment.

The use of advanced graphic design technologies and knowledge is a must for the preparation of pictograms related to occupational safety and health as effective visual structures. In such designs, putting aside material concerns, working with very successful graphic designers is the first priority. Enterprises should show the sensitivity they show in promotional sales and marketing in the quality of their work on occupational safety and health.

In order for the pictograms related to occupational health and safety to perform their duties at the highest performance, they can be provided by being sensitive from the design to the high-resolution printing and the position and illumination in the environment in which they are located. Although the boundaries have been drawn with legal standards, today, when pictogram production has become commercialized, the necessary care is being taken according to the knowledge and experience of those who make these designs.

Pictograms are generally graphic design products that do not carry aesthetic concerns. The priority is that it is easily detected. From the point of view of visual perception, it is inevitable to question the reason for the existence of a problematic pictogram. Errors are unacceptable in terms of visual perception in pictograms for occupational health and safety. Since any kind of inadequacy that may occur in visual perception will have negative consequences, it is necessary to act very carefully. The visual perception dimension and message effectiveness of the pictograms designed for occupational health and safety are too important to be left to subjective evaluations.

At the design stage, it is necessary to know each element that affects visual perception performance and make preferences accordingly.

In terms of visual perception, it is important for the graphic designer to know the algorithm in the visual perception of the viewer and to make the right decisions that will increase the intensity and quality of the elements contained in the pictogram in a successful pictogram design.

The first stage in occupational health and safety and pictogram design is the transformation of technologies and actions that are the subject of warnings and information into simple symbols. The designs that were realized with artistic skills before digital technologies are now completely made with computer technologies.

Designs prepared as vector or bitmap designs sometimes have more geometric forms than necessary, so they can turn into structures that are not pleasing to the eye in order to create a simple structure. It is the lack of showing the necessary care to the degree of priority and importance in pictograms prepared with digital technologies. When the element that should be emphasized in a pictogram designed in a standard structure falls into the background, the effectiveness of the pictogram also decreases greatly. For example, the primary danger on the forklift warning sign is being crushed under the wheels of the forklift and injuries caused by the impact of the transport ends. In order to stimulate these disadvantages of the forklift, the wheels and carrier ends should be more emphatic. Or the color and temperature form used to express temperature in hot surface warning pictograms should be designed in such a way that it is perceived more in the foreground as a visual hierarchy. Occupational health and safety and pictograms need to be separated from the visuals that are constantly encountered in life.

Today, even in the user manual of a simple device, a large number of images are used. For this reason, non-highlighting visuals do not attract people's attention at all. Dynamic (moving) designs will be more effective instead of static symbols to express the negativity that may occur. For example, in the warning pictogram of a crane, instead of a fixed crane and a human symbol underneath, a falling load or a human symbol crushed under a fallen load will be more stimulating and highlighting. In today's visual intensity, the effect of visual elements that are weak in attracting attention on people is very low. For this reason, graphic designers who design occupational health and safety and pictograms should make designs that incorporate more accentuating and contrasting shapes, colors, backgrounds and compositions.

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References

Akay, G. (2015) MARKAFONİ OFİSİ ARCHDAILY. COM'DA. Available from: https://www.habifmimarlik.com/markafoni-ofisi-archdaily-comda/ [Accessed 15th December 2024].

Arıkan, A. (2008) *Grafik Tasarımda Görsel Algı*. İstanbul, Eğitim Yayınevi.

Arntson, A. E. (2011) *Graphic Design Basics*. 6th ed. Belmont, Wadsworth Publishing.

Ateş, E. (2023) *İş Kazası Nedir? İş Kazasında Ne Yapılmalıdır?*. Available from: https://www.tamamlayicisaglik.com/blog/sigorta/is-kazasi-nedir-is-kazasinda-ne-yapilmalidir [Accessed 15th December 2024].

Boydaş, O. & Gümüş, K. (2022) The Role of Visual Perception in the Design Development Process. *International Social Sciences Studies Journal.* 8 (103), 3399-3415. Available from: doi: 10.29228/sssj.64876

Crick, F. (1995) *Astonishing Hypothesis: The Scientific Search for the Soul*. New York, Scribner.

Çağlayan, S., Korkmaz, M. & Öktem, G. (2014) Evaluation of Vısual Perception in Art in Terms of Lıterature. *Journal of Research in Education and Teaching*. 3 (1). 160-173.

Çakır, M. (2014) *Vısual Culture and Global Mass Culture. [Görsel Kültür ve Küresel Kitle Kültürü]*. Ankara, Ütopya Yayınları.

Dinçeli, D. (2020) Görsel Düşünme ve Algı. İdil. 67, 545-552. Available from: doi: 10.7816/idil-09-67-11

Eken, B. (2021) Creatıng Vısual Perceptıon Usıng Desıgn Elements In Basıc Graphıc Desıgn Educatıon: A Sample of 2nd Grade Basıc Graphıc Desıgn Studıo Project. *Sanat ve Tasarım Dergisi*. 28, 241-261. Available from: doi: 10.18603/sanatvetasarim.1048655

Eraslan, E. & Cansaran, C. (2020) İş sağlığı ve güvenliği algısının eğitim bazında değerlendirilmesi. Journal of Turkish Operations Management. (4) 1, 357-368.

Erkoç Kaplan, E. & Dokuzer Öztürk, L. (2022) Aydınlatma alternatiflerinin insan odaklı aydınlatma açısından değerlendirilmesi: Büro örneği. *Gümüşhane University Journal of Science and Technology*. IOCENS'21 Konferansı Ek Sayısı, 26-38/ Available from: doi: 10.17714/gumusfenbil.999763

Freeman, J. (n.d.) *Benefits of Visual Communication*. Available from: https://www.edrawsoft.com/benefits-of-visual-communication.html [Accessed 15th December 2024].

Gezer, Ü. (2019) Vısual Desıgn Elements and Prıncıples In Contemporary Art and Desıgn Educatıon. *Ulakbilge*. 40 (2019 September). 595-614. Available from: doi: 10.7816/ulakbilge-07-40-02

Gürel, E. (2001) Çalışma Yaşamında Işık ve Aydınlatmanın Önemi. *Muğla Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. 5, 1-11.

hayalkare. (2019) *Sanayi – Kocaer Haddecilik*. Available from: https://www.hayalkare.com/kocaer-haddecilik [Accessed 15th December 2024].

İnceoğlu, M. (2011) Attitude Perception Communication. [Tutum Algı İletişim]. 6th ed. Ankara, Siyasal Kitabevi.
Karaman, E. A., Çivici, T. & Kale, S. (2011) İşçi Sağlığı ve İş Güvenliğinin İnşaat Sektöründeki Yeri ve Önemi. In: *3. İşçi Sağlığı ve İş Güvenliği Sempozyumu, 21-23 October 2011, Çanakkale, Türkiye*. Ankara, Mattek Matbaacılık. pp. 85-95.
Kovačević, D., Brozović, M. & Bota, J. (2014) Legibility of pictograms on coloured surfaces under different illuminants. *ACTA Graphica*. 25 (1-2), 1-10.
Memetoğlu, M. E. (2022) The Eyes are the Mirror of the Brain: Pupilometry and Its Applications in Psychology. *Türkiye Bütüncül Pisikoterapi Dergisi*. 5 (10), 1-8.
Özkirişçi, İ. H. (2020) Graphıc Image In Context of Perceptıon and Tıme. *Sanat ve Tasarım Dergisi*. 25, 251-273.
Parsıl, Ü. (2012) *Visual Perception*. *[Görsel Algılama]*. İstanbul, An Kitap.
Shiojiri, M., Nakatani, Y. & Yonezawa, T. (2013) Visual language communication system with multiple pictograms converted from weblog texts. In: *Consilience and Innovation in Design, IASDR 2013, 26-30 August 2013, Tokyo, Japan*. Tokyo, Shibaura Institute of Technology.
Sutherland, I. E. (2003) *Sketchpad: A man-machine graphical communication system*. University of Cambridge. Report number: 574.
Timur, S. & Keş Y. (2016) Three Dımensıonal Sense In Graphıc Desıgn. *idil*. 5 (22), 655-676. Available from: doi: 10.7816/idil-05-22-08
Toma, L. (n.d.) *How to Create an Appropriate Visual Hierarchy Design*. Available from: https://pixcut.wondershare.com/blog/how-to-create-an-appropriate-visual-hierarchy-design.html [Accessed 15th December 2024].
Tuğcan, G. (2016) The Assesment of The Functıon of Pıctograms From The Begınnıng of The Hıstory To The Contemporary World. *idil*. 5 (25), 1521-1538. Available from: doi: 10.7816/idil-05-25-10
Turani, A. (1995) *Dictionary of Art Terms .[Sanat Terimleri Sözlüğü]*. İstanbul, Remzi Kitabevi.
Uğur, E. (2019) Defining Op-Art (Optic Art) from Visual Perception and Graphic Design Concepts. *Iğdır Üniversitesi Sosyal Bilimler Dergisi*. 17, 231-258.
Uğur, E. (2021) Evaluatıon of Color Preferences In Metropolıtan Munıcıpalıty Logos In Terms of Graphıc Desıgn Prıncıples. In: Kardaşlar, A. (ed.) *2nd Internatıonal 5 Ocak Congress on Socıal Scıences and Humanıtıes, 4-5 January 2021, Adana, Türkiye*. İstanbul, ISPEC Publishing. pp. 215-227.
Uğur, E. (2022) Evaluatıon of The Changes In The Cıty Logos In Terms of Representıng The Symbols of The Cıty. *Meriç Uluslararası Sosyal ve Stratejik Araştırmalar Dergisi*. 6 (17), 280-299.
Uğur, E. & Özsoy, S. A. (2020) Description of Concepts and Cases That Affect The Visual Perception Level in Graphic Design. In: Bykova, O. and Alimgerey, Z. (eds.) *International Göbeklitepe Social and Human Sciences Congress, 5-7 June 2020, Şanlıurfa, Türkiye*. Ankara, IKSAD Publications. pp. 313-322.
Vodafone. (2024) *Vodafone'da İş Sağlığı ve Güvenliği*. Available from: https://www.vodafone.com.tr/hakkimizda/insan-kaynaklari/is-sagligi-ve-guvenligi [Accessed 15th December 2024].

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Exploring the intersection of AI and creativity in the local Indonesian graphic designers' perspective

ABSTRACT

This study examines the impact of Artificial Intelligence (AI) on creativity, focusing on the experiences of local graphic designers in Indonesia. As a rapidly evolving technology, AI has transformed various industries, including the realms of culture and entertainment. This research investigates how AI shapes the creative processes of Indonesian designers, explores the ethical concerns it raises, and evaluates its role in preserving and promoting cultural heritage. The study employs a qualitative approach, drawing insights from semi-structured interviews conducted with members of three professional graphic designer communities across Java, Indonesia. These communities, which have embraced AI tools in their work and emphasize integrating traditional Indonesian cultural elements into their designs, provided valuable perspectives on the influence of AI in their field. The findings reveal that AI technologies, particularly Generative Adversarial Networks (GANs), significantly enhance creativity by generating diverse design options and automating routine tasks, thereby freeing up time for deeper conceptual exploration and innovation. Moreover, AI's ability to digitize and archive traditional cultural motifs supports the preservation of Indonesia's artistic heritage, ensuring its accessibility for future generations. Furthermore, AI facilitates the promotion of traditional designs in modern contexts through digital platforms, thereby increasing their appreciation on both national and international levels.

Joni Agung Sudarmanto

Universitas Negeri Malang, Faculty of Letters, Malang, Indonesia

Corresponding author:
Joni Agung Sudarmanto
e-mail:
joniagung.fs@um.ac.id

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artificial intelligence (AI), creativity, Indonesian graphic designers, cultural heritage preservation, generative adversarial networks (GANs)

Introduction

Artificial Intelligence (AI) stands as one of the most monumental achievements in the technological advancements of the 21st century (Colosimo et al., 2021).

Its ability to process, analyze, and interpret data with unprecedented speed, precision, and scale has transformed various sectors of human life. In the annals of science and technology, this era will be marked as a pivotal period that radically transformed how we interact with technology, information, and ourselves. One profound aspect of the broad debate surrounding AI is its impact on popular culture and entertainment (Lyu et al., 2024).

Fundamentally, AI opens the door to creating, producing, and distributing entertainment content that is more personalized and relevant (Padovano & Cardamone, 2024). AI enables us to design entertainment experiences tailored to individual preferences, predict what we will enjoy, and automatically present customized content (Furnham et al., 2011).

A striking example is the application of AI technology in the film and television industry. Machine learning algorithms, capable of analyzing viewer preferences based on viewing patterns and history, have aided in creating more accurate content recommendations (Singh, Singh & Sharma, 2024).

AI can analyze elements within films that make them appealing to audiences, including plot, characters, and settings, thereby assisting filmmakers in designing more successful productions.

However, in the context of popular culture and entertainment, the impact of AI extends beyond enhancing viewer experiences. As a field that studies how humans think and feel, AI also has the potential to transform artistic creativity and cultural expression. Artists and content creators now have access to AI tools that can generate artworks, music, and narratives with previously unimaginable levels of complexity (Lieber-Milo et al., 2024; Reddy, 2022; Zembylas, 2023). AI characterizes a revolution in artistic creation that will spawn new forms of expression and pose philosophical challenges about creativity and artists' autonomy.

As we enter an era where AI becomes both a partner and a competitor in the creative process, questions about the boundaries between human-created and AI-created art become increasingly important (Ozmen Garibay et al., 2023). "*Can art produced by AI algorithms be considered genuine artistic expression?*" or "*Do they possess aesthetic and emotional value comparable to human creations?*" These questions stimulate deep debates about the essence of creativity and the identity of art. In a broader perspective, the application of AI in popular culture and entertainment also raises complex ethical issues. Questions about bias and control arise when machine learning algorithms influence what we watch, listen to, or read. "*How do we ensure this technology reinforces existing social biases and contributes to cultural diversity and inclusion?*" This question becomes increasingly urgent in an era where AI plays a growing role in shaping our worldview.

In this context, this research aims to meticulously and comprehensively investigate the impact of AI on popular culture and entertainment. Through deep analysis, we can understand how AI has affected the production and consumption of entertainment content, the role of AI in creating art, and the ethical implications related to AI usage in popular culture and entertainment. Thus, this research aims to understand current changes and provide insights into a future where AI will become an increasingly important partner in the world of entertainment and popular culture.

As an initial effort to answer these complex questions, this research will delve into the latest literature, conduct case studies, and analyze current trends in the application of AI in popular culture and entertainment (Bode, 2021; Lazaridis et al., 2022). Through a meticulous analytical framework and appropriate methodology, this research hopes to provide deeper insights into how AI shapes and influences our culture and how we can wisely respond to these developments in an increasingly advanced AI era. Then, this research strives to present a more profound view of the future of popular culture and entertainment in the AI era. Using AI as a creative tool is a challenge that requires a deep understanding of this technology as well as a deep understanding of art and culture. This research, focusing on the intersection of AI and designer perspectives in culture, contributes to our understanding of AI's role in shaping the increasingly complex and dynamic world of entertainment and popular culture.

Although often identified with significant changes in global entertainment, such as film and music, AI also plays a crucial role in stimulating changes in the design world, including local designers (Lieber-Milo et al., 2024; Loebbecke et al., 2024). Local designers are artists and creators who focus on developing art and design that is deeply rooted in and reflective of their cultural heritage and local traditions. They often incorporate motifs, symbols, and styles unique to their community's cultural identity into their work. AI has allowed local designers to explore their cultural roots more profoundly and align their artistic creations with their cultural heritage (Comes et al., 2019; Hta & Lee, 2020). It is important to note that local art carries unique cultural contexts and profound meanings linked to the identity and traditions of the local community. AI can play a role in enriching and rejuvenating these expressions of local art. AI can explore traditional motifs, styles, and symbols in design, helping local artists merge traditional elements with contemporary techniques (Stephenson, 2013; Wiratmoko & Sampurno, 2021).

Applying AI in local art also opens new opportunities for creating unique and innovative works. AI-based generative tools, such as Generative Adversarial Networks (GAN), can assist in creating unique artworks by combining elements from local cultural heritage. The use of GANs in local art has made it possible to create works that blend elements from multiple traditions and eras, creating more complex narratives in the form of art (Macedo, Ribeiro Vaz & Taveira Gomes, 2024).

Additionally, AI can aid in documenting, preserving, and disseminating local art and culture. With its ability to analyze, organize, and visualize data quickly, AI can be used in digital archiving and promoting local art to a broader, even international, audience (Cho, 2022). However, ethical and cultural issues become highly significant when considering AI's application in local culture. It is crucial to consider whether the use of AI in local art respects the values, beliefs, and cultural identity of the local community. Part of this issue relates to data usage, copyright, and ownership of artworks generated by AI algorithms (Björner & Aronsson, 2022). In the context of local designers, who are often linked to the traditions of the locality, it is vital to understand how the use of AI can respect and promote the cultural diversity that exists.

It relates to the componential theory, which posits that creativity requires a confluence of intrinsic motivation, domain-relevant skills, and creativity-relevant processes (Krasnoyarova, Indyukova & Garms, 2017). AI can enhance domain-relevant skills by providing designers with advanced tools and techniques, potentially increasing their creative output (Krasnoyarova, Indyukova & Garms, 2017). However, intrinsic motivation and creativity-relevant processes remain distinctly human elements that AI can complement but not replace. Cultural sustainability theory emphasizes the importance of preserving cultural heritage in the face of modernization and technological advancements (Cannon, 2018). AI tools can be utilized to sustain and revitalize traditional designs, ensuring they remain relevant and appreciated in contemporary contexts. This involves using AI to digitize and archive traditional art forms, making them accessible to future generations.

AI also intersects with Human-Computer Interaction (HCI), such as distributed cognition theory suggests that cognitive processes are distributed across individuals, objects, and technologies (Jeon et al., 2019). In the cultural or local design context, AI can act as an external cognitive tool that supports and enhances the creative process. Understanding how designers interact with AI tools and how these tools influence their creative workflows is crucial for maximizing their potential benefits. The abovementioned theory can make the research more comprehensively understand how AI influences creativity among Indonesian graphic designers. It will explore how AI tools are used to enhance traditional design practices, the ethical implications of AI in the creative process, and how AI can support preserving and promoting Indonesia's rich cultural heritage.

Methods

The study employs a qualitative research design to capture the depth and complexity of the investigated phenomena and understand the impact of AI on local Indonesian graphic designers. The participants in this study were selected using purposive sampling. This non-probability sampling method was chosen to ensure the participants were knowledgeable and experienced in using AI tools in graphic design. The criteria for inclusion were:

- Professional graphic designers who have used AI tools in their design process.
- Graphic designers with at least three years of experience in the industry.
- Designers actively work in Indonesia and participate in projects incorporating traditional Indonesian cultural elements.

A total of 3 graphic designers from different regions of Indonesia were selected to participate in the study. This sample size was sufficient to achieve data saturation in the qualitative component. The primary data collection method was semi-structured interviews with the selected graphic designers. Depending on the participants' locations and preferences, these interviews were conducted in person or via video conferencing.

The interview guide included questions on:

- Participants' experiences with AI tools in their design work.
- Specific projects where AI played a significant role.
- Perceived changes in their creative process due to AI.
- Ethical concerns and challenges encountered when using AI.
- The impact of AI on preserving and promoting Indonesian cultural heritage in their designs.

The interview transcripts were analyzed using thematic analysis, which involves identifying and interpreting patterns of meaning within qualitative data. The analysis followed Braun and Clarke's in Miles and Huberman six-step process to ensure a rigorous and systematic approach (Miles, Huberman & Saldana, 2018).

The first step, familiarization with the data, involved reading and re-reading the transcripts to become deeply acquainted with the content. This immersion allowed the researchers to gain an initial understanding of the data's breadth and depth. Next, the process of generating initial codes began. This step involved systematically coding exciting features of the data across the entire data set. Codes were assigned to text segments deemed relevant to the research questions, capturing key concepts and themes that emerged from the participants' responses.

The third step, searching for themes, entailed collating the codes into potential themes and gathering all data relevant to each potential theme. It involved looking for patterns in the codes and organizing them into broader themes that encapsulated significant aspects of the data.

Once potential themes were identified, the fourth step, reviewing themes, was undertaken. This step involved checking if the themes worked about the coded extracts and the entire data set. Themes were refined, combined, or discarded based on their coherence and relevance to the research questions. In the fifth step, defining and naming themes, the specifics of each theme were refined, and clear definitions and names for each theme were generated.

This process ensured that each theme was distinct and encapsulated a specific aspect of the data. Finally, the sixth step, producing the report, involved selecting vivid, compelling extract examples and relating the analysis to the research questions and literature.

Discussion

Ethical Implications of AI in Indonesian Graphic Design

Interviewee 1: Community A, a graphic designer community from Jakarta with 5 years of experience in using AI tools

Q: How do you feel about the use of AI in graphic design, especially regarding data usage and ownership?
A: "I find AI tools very helpful in speeding up my design process, but there are significant concerns about data usage. Many of these AI tools use large datasets, some of which include traditional designs and motifs that are part of our cultural heritage. It's important to ensure that these datasets are used ethically and that the communities from which these designs originate are acknowledged and compensated appropriately."

Q: Have you encountered any issues related to copyright when using AI tools?
A: "Yes, copyright issues are quite challenging. AI-generated designs often incorporate elements from traditional art, which makes it hard to determine ownership. There needs to be clear guidelines on how to attribute these works correctly, ensuring that both the AI developers and the communities whose cultural symbols are used are recognized and protected."

Q: What are your thoughts on respecting cultural identity in AI-generated designs?
A: "Respecting cultural identity is crucial. Our culture is diverse and rich with traditions that need to be honored. AI tools should be designed to understand and respect these cultural contexts. When using traditional motifs, it's vital to ensure that the designs are not offensive or misaligned with their cultural meanings."

Q: What ethical guidelines do you think should be developed for using AI in graphic design?
A: "Ethical guidelines should include principles for ethical data collection and usage, ensuring proper consent and attribution. There should be clear rules about copyright and ownership, and a framework for compensating communities. Continuous dialogue with local communities is essential to ensure that AI applications respect and promote cultural diversity and heritage."

Interviewee 2: Community B, a graphic designer community from Yogyakarta with 4 years of experience in using AI tools

Q: How do you perceive the use of AI in terms of data usage and ownership?
A: "AI tools are powerful, but there's a real risk of exploitation if data is used without proper regulation. Traditional designs and symbols should not be commercialized without giving credit to their cultural origins. It's essential to have clear policies on who owns the data and how it's used."

Q: Can you share your experience with copyright issues related to AI-generated designs?
A: "Determining the ownership of AI-generated designs is complicated. These tools can create designs that incorporate traditional cultural elements, and it's not always clear who holds the rights to these designs. There should be guidelines to protect the intellectual property of local artists and communities."

Q: How important is it to respect cultural identity in AI-generated designs?
A: "Very important. Indonesian culture is unique, and AI tools should be sensitive to this. When AI generates new designs based on traditional motifs, it's essential to ensure that these designs are respectful and accurate representations of the culture they originate from."

Q: What kind of ethical guidelines do you think are necessary for AI use in graphic design?
A: "We need comprehensive ethical guidelines that cover data collection, copyright, and ownership issues. These guidelines should ensure that cultural data is sourced ethically and with consent, and that AI-generated designs are attributed correctly. There should also be ongoing engagement with local communities to ensure their cultural heritage is respected."

Interviewee 3: Community C, a graphic designer community from Bandung with 4 years of experience in using AI tools

Q: How do you feel about the use of AI in graphic design, especially regarding data usage and ownership?
A: "AI tools are amazing, but the way data is used is a big concern. A lot of these datasets include culturally important designs, and it's crucial to handle that data responsibly. Communities should get credit and fair compensation for their contributions."

Q: Have you encountered any issues related to copyright when using AI tools?
A: "Yes, copyright is definitely an issue. AI blurs the lines of ownership, especially when it uses traditional cultural elements. We need clear rules to protect both developers and cultural communities."

Q: What are your thoughts on respecting cultural identity in AI-generated designs?
A: "Respecting cultural identity is non-negotiable. Our cultural heritage is incredibly rich, and AI tools should honor that. Traditional designs shouldn't be misrepresented or used disrespectfully."

Q: What ethical guidelines do you think should be developed for using AI in graphic design?
A: "There should be guidelines for ethical data sourcing, consent, and fair attribution. It's also important to engage with communities to make sure their cultural heritage is respected and celebrated."

The integration of AI into Indonesian local graphic design raises several ethical considerations, particularly regarding data usage, copyright, and ownership of AI-generated designs. The insights gathered from interviews with Indonesian graphic designers, such as Community A, Community B, and Community C, highlight the importance of managing cultural data responsibly to prevent exploitation (Morgner, 2014). Community A emphasized the necessity of ensuring that datasets, which often include traditional designs and motifs, are used ethically, with proper attribution and compensation to the originating communities (Table 1). This aligns with the componential theory of creativity, which underscores the importance of intrinsic motivation and domain-relevant skills (Badilescu & Packirisamy, 2022; Behnamnia et al., 2020). Ethical data usage and ownership policies are crucial to maintaining the integrity and value of these cultural elements.

Copyright issues complicate traditional notions of authorship in AI-generated designs (Björner & Aronsson, 2022). Designers like Community B and Community C pointed out the difficulties in determining ownership when AI tools create designs incorporating culturally significant symbols. Establishing clear copyright guidelines is essential to protect the intellectual property rights of both AI developers and the communities whose cultural elements are used. This cognitive processes are distributed across individuals, objects, and technologies (Xie, 2023).

But, respect for cultural identity is another significant ethical issue (Mayuzumi, 2021; Zhang & Stewart, 2017). Community A stressed the importance of ensuring AI-generated designs are not offensive and align with the cultural meanings of the original symbols. Community B and Community C echoed this sentiment, emphasizing that AI tools must honor and respect Indonesia's diverse cultural traditions (Table 1).

This perspective is emphasizing the preservation of cultural heritage in the face of modernization that AI tools must be designed to accurately reflect and respect the cultural context and values of the symbols they incorporate, thereby preserving the authenticity of cultural expressions (Bock & Borland, 2011; Iacono & Brown, 2016). Meanwhile, the importance of developing ethical AI applications that respect cultural diversity and heritage is needed to address the various dimensions of AI integration in graphic design.

The Role of AI in Enhancing Creativity and Preserving Indonesian Cultural Heritage

AI tools, such as Generative Adversarial Networks (GANs), have opened new avenues for creativity among Indonesian graphic designers, allowing them to create unique designs that blend traditional and contemporary elements. These tools support the documentation, preservation, and promotion of Indonesia's rich cultural heritage, making traditional designs accessible in the modern digital era.

Integrating AI into Indonesian graphic design has significantly enhanced creativity and contributed to preserving and promoting cultural heritage (Table 2).

Table 1

Ethical Considerations and Cultural Sensitivity in AI Tool Usage Among Graphic Designers

Interviewee	Key Points	Data Usage and Ownership	Copyright Issues	Respect for Cultural Identity	Ethical Guidelines Development
Community A	Graphic designer from Jakarta with 5 years of experience in using AI tools	Concerns about ethical use of cultural data and need for proper attribution and compensation	Challenges in determining ownership of AI-generated designs and the need for clear guidelines	Importance of ensuring AI-generated designs respect cultural meanings and are not offensive	Ethical guidelines should include principles for ethical data collection, copyright, and ownership, and continuous dialogue with local communities
Community B	Graphic designer from Yogyakarta with 4 years of experience in using AI tools	Risk of exploitation if data is used without regulation and importance of clear ownership policies	Complications in determining rights for AI-generated designs involving traditional elements	AI tools should be sensitive to cultural uniqueness and ensure accurate representations	Comprehensive guidelines covering data collection, copyright, ownership, and engagement with local communities are necessary
Community C	Graphic designer from Bandung with 4 years of experience in using AI tools	Importance of managing culturally significant data responsibly with proper attribution and compensation	Blurred lines of ownership with AI-generated designs and the need for clear protection of rights	AI tools must honor cultural heritage and avoid mis-representation	Ethical guidelines should ensure ethical data sourcing, fair attribution, and continuous dialogue with local communities

Interview data from Indonesian graphic designers Community A, Community B, and Community C highlights how AI tools, particularly Generative Adversarial Networks (GANs), open new avenues for creative exploration. Community A emphasizes that AI tools generate diverse design variations, which inspire new creative possibilities and enhance the efficiency of the design process. Creativity involves a confluence of domain-relevant skills and creativity-relevant processes using automating repetitive tasks to allow AI designers like Community B to focus more on ideation and experimentation, expanding their creative horizons.

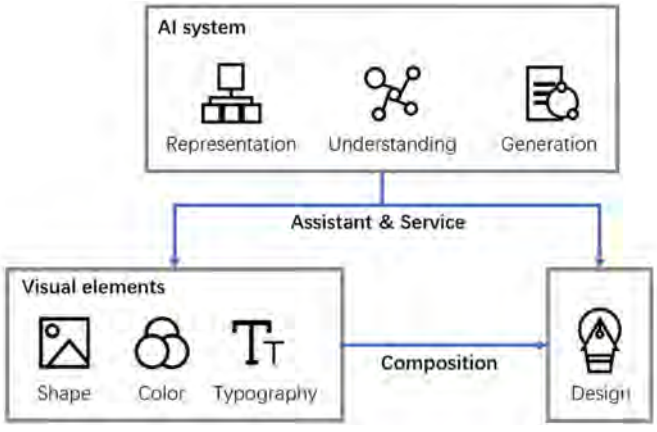
AI also plays a crucial role in documenting and preserving traditional Indonesian designs. As Community C notes, AI tools facilitate digitizing and archiving cultural data for traditional art forms preserved to time.

It underscores the importance of preserving cultural heritage in the face of modernization by analyzing and organizing vast amounts of cultural data. AI ensures that these cultural expressions are preserved and can be accessed by future generations to maintain the integrity and continuity of Indonesia's rich cultural heritage. The integration of artificial intelligence (AI) into graphic design is transforming both element-level and design-level tasks, as shown in Figure 1. At the element level, AI aids in representing, understanding, and generating visual elements. For instance, AI can recognize and categorize images based on their content, making it easier for designers to find relevant visuals quickly (Sison et al., 2023; Vakratsas & Wang, 2021). AI algorithms can also analyze these elements' emotional and aesthetic qualities, suggesting adjustments to align with the desired outcomes, such as color adjustments and contrast optimization.

Table 2

The Role of AI Tools in Enhancing Creativity and Preserving Cultural Heritage Among Graphic Designers

Interviewee	Key Points	Enhancing Creativity	Preserving Cultural Heritage	Promoting Cultural Heritage	Impact on Intrinsic Motivation and Creative Processes
Community A	Graphic designer from Jakarta with 5 years of experience in using AI tools	AI tools like GANs generate diverse design variations, inspiring new creative possibilities and enhancing design efficiency.	Digitization and archiving of traditional designs help preserve cultural expressions.	AI helps showcase traditional designs in modern contexts, making them relevant and appreciated by a broader audience.	AI complements creative processes, allowing designers to focus on ideation and maintaining the authenticity of cultural expressions.
Community B	Graphic designer from Yogyakarta with 4 years of experience in using AI tools	AI automates repetitive tasks, freeing time for experimentation and ideation, expanding creative horizons.	AI tools facilitate the documentation and organization of vast cultural data, ensuring easy retrieval and preservation of traditional designs.	AI aids in creating digital platforms for showcasing traditional and AI-enhanced designs, promoting them nationally and internationally.	AI supports creative output without replacing human insights, balancing technical capabilities with cultural authenticity.
Community C	Graphic designer from Bandung with 4 years of experience in using AI tools	AI offers new techniques that inspire innovative design solutions, enhancing the creative process.	AI ensures that traditional art forms are not lost by analyzing and organizing cultural data for future generations.	AI revitalizes traditional designs, presenting them in contemporary settings and increasing their value and appreciation.	AI enhances technical capabilities while preserving the designer's unique creative insights and cultural authenticity.



» **Figure 1:** *Graphic Design Intelligence before AI*

Moreover, AI's capability to generate new visual elements based on learned patterns and styles significantly expands the creative toolkit available to designers.

In Indonesia, local graphic designers are increasingly adopting these AI tools to enhance their creative workflows and maintain competitiveness in a rapidly evolving market (Marsudi et al., 2020). The Indonesian graphic design industry is known for its rich cultural heritage and vibrant visual language, often reflected in local designs. By integrating AI, Indonesian designers can efficiently incorporate traditional elements with modern aesthetics, creating unique and culturally resonant designs. Practical applications of AI in graphic design are evident in tools such as Adobe Sensei, Midjourney, ChatGPT, and Canva's design suggestions. Adobe Sensei integrates AI into Adobe's suite of design tools to streamline repetitive tasks, provide design suggestions, and enhance creative workflows. Similarly, Canva utilizes AI to offer design templates and element suggestions, democratizing professional design by making it accessible to non-designers. Adopting these AI tools in Indonesia is helping local designers streamline their processes and explore new creative possibilities. AI-driven tools enable Indonesian designers to create more personalized and engaging designs that cater to diverse audiences, such as analyzing local market trends and consumer preferences, allowing designers to create tailored visual content that resonates with specific target groups. This capability is precious in Indonesia's diverse cultural landscape, where design preferences vary significantly across different regions.

Moreover, AI significantly contributes to the promotion of cultural heritage. Community B highlights how AI aids in creating digital platforms where traditional and AI-enhanced designs are showcased, facilitating their dissemination and appreciation nationally and internationally. Through AI, traditional designs can be revitalized and presented in contemporary contexts, making them relevant to modern audiences. This promotional aspect suggests that cognitive processes are distributed across individuals, objects, and technologies. The impact of AI on the intrinsic motivation and creative processes of designers also enhances technical capabilities; the intrinsic motivation and creative insights of designers remain distinctly human elements. Community A and Community C both emphasize that AI is a complementary tool that augments creative output without replacing the unique creative insights of designers.

Conclusion

The integration of AI into the field of graphic design in Indonesia has introduced both opportunities and challenges, particularly concerning ethical considerations, cultural sensitivity, and the enhancement of creative processes.

The interviews with Indonesian graphic designers from Jakarta, Yogyakarta, and Bandung highlight critical concerns about the ethical use of cultural data, copyright issues, and the necessity of respecting cultural identity.

Key findings emphasize the importance of managing cultural data responsibly to prevent exploitation and ensure proper attribution and compensation to the originating communities. Clear guidelines on ownership and copyright of AI-generated designs are crucial to protect intellectual property rights and maintain the integrity of traditional cultural elements. Ethical guidelines must be developed in collaboration with local communities to address these issues comprehensively. AI tools such as Generative Adversarial Networks (GANs) have significantly enhanced creativity among Indonesian graphic designers, allowing for innovative designs that blend traditional and contemporary elements.

These tools support the documentation, preservation, and promotion of Indonesia's rich cultural heritage, ensuring that traditional designs are accessible and appreciated in the modern digital era.

The practical applications of AI in graphic design are evident in tools like Adobe Sensei, Midjourney, ChatGPT, and Canva. These tools streamline repetitive tasks, provide design suggestions, and enhance creative workflows, enabling designers to focus on ideation and maintaining the authenticity of cultural expressions. The adoption of AI tools in Indonesia is helping local designers create personalized and engaging designs that cater to diverse audiences, reflecting the country's rich cultural landscape. AI's role in promoting cultural heritage is also significant, facilitating the dissemination and appreciation of traditional and AI-enhanced designs both nationally and internationally. By revitalizing traditional designs and presenting them in contemporary contexts, AI ensures that these cultural expressions remain relevant and appreciated by modern audiences. While AI offers substantial benefits in enhancing creativity and preserving cultural heritage, it is imperative to establish ethical guidelines that address data usage, copyright, and cultural sensitivity.

Continuous dialogue with local communities is essential to ensure that AI tools are used ethically and respect the diverse cultural traditions of Indonesia. The integration of AI in graphic design should be approached with a balanced perspective that values technological advancements and cultural authenticity preservation.

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References

Badilescu, S. & Packirisamy, M. (2022) Diversity Unlocks Creativity and Innovation. *Electrochemical Society Interface*. 31 (1), 57–59. Available from: doi: 10.1149/2.F12221IF

Behnamnia, N., Kamsin, A., Ismail, M. A. B. & Hayati, A. (2020) The effective components of creativity in digital game-based learning among young children: A case study. *Children and Youth Services Review*. 116. Available from: doi: 10.1016/j.childyouth.2020.105227

Björner, E. & Aronsson, L. (2022) Decentralised place branding through multiple authors and narratives: the collective branding of a small town in Sweden. *Journal of Marketing Management*. 38 (13–14), 1587–1612. Available from: doi: 10.1080/0267257X.2022.2043415

Bock, S. & Borland, K. (2011) Exotic identities: Dance, difference, and self-fashioning. *Journal of Folklore Research*. 48 (1), 1–36. Available from: doi: 10.2979/jfolkrese.48.1.1

Bode, L. (2021) Deepfaking Keanu: YouTube deepfakes, platform visual effects, and the complexity of reception. *Convergence*. 27 (4), 919–934. Available from: doi: 10.1177/13548565211030454

Cannon, M. (2018) *Digital Media in Education: Teaching, Learning and Literacy Practices with Young Learners*. London, Palgrave Macmillan. Available from: doi: 10.1007/978-3-319-78304-8

Cho, H. (2022) Archive, digital technology, and the inheritance of the Gwangju Uprising: the affect of the post-Gwangju generation of directors in Kim-gun (2019) and Round and Around (2020). *Journal of Japanese and Korean Cinema*. 14 (1), 49–67. Available from: doi: 10.1080/17564905.2022.2065168

Colosimo, B. M., del Castillo, E., Jones-Farmer, L. A. & Paynabar, K. (2021) Artificial intelligence and statistics for quality technology: an introduction to the special issue. *Journal of Quality Technology*. 53 (5), 443–453. Available from: doi: 10.1080/00224065.2021.1987806

Comes, R., Neamțu, C., Buna, Z. & Mateescu-Suciu, L. (2019) Exploring dacian cultural heritage with dARcit augmented reality application. *Journal of Ancient History and Archaeology*. 6 (4), 71–77. Available from: doi: 10.14795/j.v6i4.506

Furnham, A., Batey, M., Booth, T. W., Patel, V. & Lozinskaya, D. (2011) Individual difference predictors of creativity in Art and Science students. *Thinking Skills and Creativity*. 6 (2), 114–121. Available from: doi: 10.1016/j.tsc.2011.01.006

Hta, A. C. Z. & Lee, Y. (2020) Interactive spatial augmented reality book on cultural heritage of Myanmar. *Journal of Information and Communication Convergence Engineering*. 18 (2), 69–74. Available from: doi: 10.6109/jicce.2020.18.2.69

Iacono, V. L. & Brown, D. H. K. (2016) Beyond Binarism: Exploring a Model of Living Cultural Heritage for Dance. *Dance Research: The Journal of the Society for Dance Research*. 34 (1), 84–105. Available from: doi: 10.3366/drs.2016.0147

Jeon, M., Fiebrink, R., Edmonds, E. A. & Herath, D. (2019) From rituals to magic: Interactive art and HCI of the past, present, and future. *International Journal of Human-Computer Studies*. 131, 108–119. Available from: doi: 10.1016/j.ijhcs.2019.06.005

Krasnoyarova, B. A., Indyukova, M. A. & Garms, E. O. (2017) The ethnocultural component of tourism development in the Altai Republic. *Geography and Natural Resources*. 38, 165–172. Available from: doi: 10.1134/S187537281702007X

Lazaridis, A., Perchanidis, C., Chovardas, D. & Vlahavas, I. (2022) AlphaBluff: An AI-Powered Heads-Up No-Limit Texas Hold'em Poker Video Game. In: *2022 International Conference on INnovations in Intelligent SysTems and Applications, INISTA, 8-12 August 2022, Biarrits, France*. New York, IEEE. pp. 1-6. Available from: doi: 10.1109/INISTA55318.2022.9894244

Lieber-Milo, S., Amichai-Hamburger, Y., Yonezawa, T. & Sugiura, K. (2024) Cuteness in avatar design: a cross-cultural study on the influence of baby schema features and other visual characteristics. *AI & Society*. Available from: doi: 10.1007/s00146-024-01878-3

Loebbecke, C., Obeng-Antwi, A., Boboschko, I. & Cremer, S. (2024) Towards AI-based thumbnail design for fostering consumption on digital media platforms. *International Journal of Information Management*. 78. Available from: doi: 10.1016/j.ijinfomgt.2024.102801

Lyu, Y., Shi, M., Zhang, Y. & Lin, R. (2024) From Image to Imagination: Exploring the Impact of Generative AI on Cultural Translation in Jewelry Design. *Sustainability*. 16 (1). Available from: doi: 10.3390/su16010065

Macedo, B., Ribeiro Vaz, I. & Taveira Gomes, T. (2024) MedGAN: optimized generative adversarial network with graph convolutional networks for novel molecule design. *Scientific Reports*. 14 (1). Available from: doi: 10.1038/s41598-023-50834-6

Marsudi, M., Sampurno, M. B. T., Wiratmoko, C. & Ratyaningrum, F. (2020) Kontribusi Desain Komunikasi Visual dalam Anti-Hoax System saat Pandemi Covid-19 di Indonesia. SALAM: *Jurnal Sosial Dan Budaya Syar-i*. 7 (10), 923-938. Available from: doi: 10.15408/Sjsbs.V7i10.15844

Mayuzumi, Y. (2021) Is meeting the needs of tourists through ethnic tourism sustainable? Focus on Bali, Indonesia. *Asia-Pacific Journal of Regional Science*. 6, 423-451. Available from: doi: 10.1007/s41685-021-00198-4

Miles, M. B., Huberman, A. M. & Saldana, J. (2018) *Qualitative Data Analysis: A Methods Sourcebook*. 4th ed. Thousand Oaks, Sage Publications.

Morgner, C. (2014) The Art Fair as Network. *The Journal of Arts Management, Law, and Society*. 44 (1), 33–46. Available from: doi: 10.1080/10632921.2013.872588

Ozmen Garibay, O., Winslow, B., Andolina, S., Antona, M., Bodenschatz, A., Coursaris, C., Falco, G., Fiore, S. M., Garibay, I., Grieman, K., Havens, J. C., Jirotka,

M., Kacorri, H., Karwowski, W., Kider, J., Konstan, J., Koon, S., Lopez-Gonzalez, M., Maifeld-Carucci, I., McGregor, S., Salvendy, G., Shneiderman, B., Stephanidis, C., Strobel, C., Holter, C. T. & Xu, W. (2023) Six Human-Centered Artificial Intelligence Grand Challenges. *International Journal of Human–Computer Interaction*. 39 (3), 391–437. Available from: doi: 10.1080/10447318.2022.2153320

Padovano, A. & Cardamone, M. (2024) Towards human-AI collaboration in the competency-based curriculum development process: The case of industrial engineering and management education. *Computers and Education: Artificial Intelligence*. 7. Available from: doi: 10.1016/j.caeai.2024.100256

Reddy, A. (2022) Artificial everyday creativity: creative leaps with AI through critical making. *Digital Creativity*. 33 (4), 295–313. Available from: doi: 10.1080/14626268.2022.2138452

Singh, V., Singh, S. K. & Sharma, R. (2024) A novel framework based on explainable AI and genetic algorithms for designing neurological medicines. *Scientific Reports*. 14 (1). Available from: doi: 10.1038/s41598-024-63561-3

Sison, A. J. G., Daza, M. T., Gozalo-Brizuela, R. & Garrido-Merchán, E. C. (2023) ChatGPT: More Than a "Weapon of Mass Deception" Ethical Challenges and Responses from the Human-Centered Artificial Intelligence (HCAI) Perspective. *International Journal of Human–Computer Interaction*. 40 (17), 4853-4872. Available from: doi: 10.1080/10447318.2023.2225931

Stephenson, N. (2013) The Past, Present, and Future of Javanese Batik: A Bibliographic Essay. *Art Documentation: Journal of the Art Libraries Society of North America*. 12 (3), 107–113. Available from: doi: 10.1086/adx.12.3.27948560

Vakratsas, D. & Wang, X. S. (2021) Artificial Intelligence in Advertising Creativity. *Journal of Advertising*. 50 (1), 39–51. Available from: doi: 10.1080/00913367.2020.1843090

Wiratmoko, C. & Sampurno, M. B. T. (2021) The Enchantment of Tiktok as Gen Z Creativity Place in SMA Negeri 2 Surabaya's Batik Motifs Online Exhibition. *Education and Human Development Journal*. 6 (2), 1–11. Available from: doi: 10.33086/ehdj.v6i2.2122

Xie, X. (2023) The cognitive process of creative design: A perspective of divergent thinking. *Thinking Skills and Creativity*. 48. Available from: doi: 10.1016/j.tsc.2023.101266

Zembylas, M. (2023) A decolonial approach to AI in higher education teaching and learning: strategies for undoing the ethics of digital neocolonialism. *Learning, Media and Technology*. 48 (1), 25–37. Available from: doi: 10.1080/17439884.2021.2010094

Zhang, L. & Stewart, W. (2017) Sustainable Tourism Development of Landscape Heritage in a Rural Community: A Case Study of Azheke Village at China Hani Rice Terraces. *Built Heritage*. 1 (4), 37–51. Available from: doi: 10.1186/bf03545656

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Application of eye-tracking technology to compare how instant lemongrass drink packaging imagery influences customer interest

ABSTRACT

The research aimed to compare how different styles of instant lemongrass drink package imagery influence consumer interest and behavior using eye-tracking technology. A total of 30 participants, aged 19 to 65, evaluated three packaging styles: style 1 Images of instant lemongrass drinks served in a cup, style 2 images of instant lemongrass drinks served in a cup with steam and style 3 images of instant lemongrass drinks being poured into a cup. To determine visual areas of interest (AOIs), we examined eye-tracking variables including number of fixations, duration of fixations, and heatmaps. To mitigate positional bias, we displayed each style at a randomly assigned screen position each time. Participants also filled out a survey to determine which style they would most likely purchase. A one-way ANOVA and Tukey HSD post-hoc testing revealed significant variations in fixation metrics among the styles. The result demonstrates style. Two images of instant lemongrass drinks served in a cup with steam had the longest average duration of fixations and were the most popular style that affected customer choice. This is due to the warm sensation they experience when they gaze at it, which is associated with their preference for hot tea over cold tea, as well as the sensation of being close to a product as if it were in front of them. The findings highlight the necessity of using dynamic emotional packaging imagery and resonant visual features in packaging. This study makes actionable ideas for packaging designers and marketers to increase customer engagement and product awareness in competitive markets.

Suchada Kuntaros Kitirochna Rattanakasamsuk Uravis Tangkijviwat Kanok Chinda

Rajamangala University of Technology Thanyaburi, Faculty of Mass Communication Technology, Pathum Thani, Thailand

Corresponding author:
Kanok Chinda
e-mail:
kanok_c@rmutt.ac.th

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eye tracking, packaging imagery, consumer interest, consumer choice, dynamic emotional, calming emotional

Introduction

The global market for ready-to-drink herbal powder products has experienced tremendous growth due to increasing consumer demand in the healthcare sector. Based on global retail data for herbal products, the Asia-Pacific region was projected to have the largest market share for these products in 2022. Based on worldwide consumer data, 70% of customers prioritize supplements that promote bodily equilibrium, with a specific emphasis on natural herbal extracts.

According to the Department of International Trade Promotion (2023), in Thailand, nearly half (47%) of consumers who want to buy healthy food choose to do so in the form of food and drinks. Out of these consumers, the majority (63%) prefer to purchase beverages. Due to the growing demand and popularity of herbal drinks, there is a heightened level of market competition. Consequently, every natural herbal powder manufacturer has introduced new items in response to the varied demands of consumers seeking pre-made herbal powder drinks.

Based on the forecast for the domestic herbal market, the expected value of the market in 2027 is 100,000 million baht. There are many well-liked herbal beverages and supplements, including those containing turmeric, fingerroot, and lemongrass. The government is actively supporting and promoting Thai herbs as a means of exerting influence in the worldwide market (Bangkokbiznews, 2024). According to the study on the state of herbs in the country by Sansanaphongpricha (2023), lemongrass is a highly coveted herb on the market. Lemongrass is cultivated and processed by farmers in Thailand as a widely grown crop, mostly because of its traditional medicinal attributes in tropical nations such as Thailand, Myanmar, Laos, Malaysia, Indonesia, and Sri Lanka (Central Laboratory and Greenhouse Complex, 2001). Lemongrass herbal products have been developed in a variety of forms which are in line with the needs of consumers. Whether they are dietary supplement products or not, there are many brands of lemongrass herb-related products on the market. In addition to factoring in product quality, consumers should be made aware of the benefits of the product.

Packaging is also one of the factors that influence consumers' purchasing decisions (Ketudom, 2022). Packaging is something that can attract consumers' attention and plays an important role in creating product and brand recognition (Köster & Mojet, 2015). Therefore, designing packaging that is suitable for consumers' interests is something that herbal entrepreneurs should focus on because packaging is the first characteristic that catches the eye of consumers and promotes their impression of the product. Packaging elements include colors, font, images, and shapes of packaging. Wästlund, Shams & Otterbring (2018) demonstrated the role of peripheral vision in the consumer product selection process by using eye-tracking technology. This can help increase a product's chances of being bought. The use of eye-tracking technology in this study leads to better understanding of consumers' visual behaviour in real world environments. Studying the impact of packaging images on consumer buying behavior is extremely important because packaging is an important part of grabbing consumers' attention and making a first impression on them. The research of Mazhar et al. (2015) showed that the image on and composition of the packaging have a direct impact on consumers' purchasing decisions. In addition, it was found that the image on the packaging can create a good perception of a product and make it appealing. This makes consumers feel more eager to buy the product. Well-designed and attention-grabbing packaging can significantly increase sales. In addition, packaging designs that clearly communicate the product's information and create the right mood also play an important role in building brand loyalty, especially through image elements, which play an important role in attracting consumers' attention because they communicate the characteristics of the product to the target audience.

They also play the most important role in creating recognition of the product because they are the elements on the packaging that consumers spend the most time looking at (Kovačević & Brozović, 2018). Therefore, when selecting a food image for the packaging, it is crucial to carefully consider the details of the image, including size and position. Nikolaus & Bendlin (2015) conducted a study on the visual appearance of various foods, including their color, shape, and size. The study's findings indicate that these factors significantly influence human eating habits (Rolls, Rowe & Rolls, 1982). However, consumers tend to focus on the product image, which can significantly influence their decision to try the product and ultimately make a purchase (Szocs & Lefebvre, 2016).

The image on the packaging of a finished instant lemongrass drink typically depicts the appearance of the product in a coffee cup, along with an arrangement of the main ingredients as they provide information about the origin of the product. With regard to the attributes of the packaging imagery, the impact of an image on a person's perception varies depending on whether it evokes calming emotions or dynamic emotions. Images are crucial in raising awareness and conveying the characteristics of a product. Hence, it is imperative to select an image for the packaging based on its intended objective in terms of communication with the target consumer. Images that calm emotions provide customers with the chance to clearly perceive the information presented in the image, while employing dynamic emotions enhances the vivacity of the consumer experience. The source of this information is a publication by Gvili et al. (2015). Assessing consumer interest by comparing packaging imagery that conveys a sense of calm and dynamic emotional packaging imagery can improve communication efficiency through alignment with the consumers' interest in the product.

Eye-tracking technology is a good tool that helps to assess the interest in the elements on the packaging (Varela et al., 2014). The use of eye-tracking technology in studying consumer shopping behavior is extremely important because it allows researchers to understand consumers' viewing and decision-making patterns in detail. Research by Mawad et al. (2015) shows that cognitive style has an impact on data processing and yoghurt label selection, which can be measured using eye-tracking technology. There are different characteristics of looking at and paying attention to the information on a label. The use of eye-tracking technology allows for the identification of areas of interest (AOI) and the number of fixations, as well as the fixation duration, which is important information in packaging design. Additionally, the combination of eye-tracking and visual recognition technology with deep learning allows for more accurate and efficient analysis of consumer behavior data (Chen et al., 2022). Because it can be used to check how consumers are interested in the image on the packaging, eye-tracking technology is also a good research tool to

suggest appropriate image design for marketing communication and creating a positive user experience (Pei, Huang & Ding, 2022). Therefore, eye-tracking technology must be used as part of this assessment of consumer interest behavior, which will be used as a guide for the development of packaging design patterns and the characteristics of choosing appropriate images to meet the needs and interests of consumers as well.

Conceptual Framework

The research evaluated consumer interest by analyzing the impact of packaging images on consumers by using eye-tracking technology. The researcher developed the theoretical framework for the investigation. The method of identifying the area of interest (AOI) was used for analyzing the sample's area of interest in terms of overall packaging components, which included logo information and image (Piqueras-Fiszman et al., 2013).

The researchers analyzed the packaging's image features by categorizing them according to the emotions and sentiments that each image's visual elements expressed. An individual uses the notion of discerning the elements of figure and ground to notice the elements of visualization, which encompass the fundamental components of line, the most prominent visual aspect. The horizontal line evokes feelings of tranquility, stillness, quietness, and serenity when noticed, while the descending curve, undulating straight line, and circular curve communicate a sense of motion that is soft and comfortable.

Line vision (Tathaisong, 2003) is the primary factor that differentiates each image. It is classified under two separate characteristics:

1. Dynamic emotional packaging imagery
2. Calming emotional packaging imagery

The researchers conducted a survey on instant lemongrass drink packaging imagery in the market, which led to the classification of image characteristics for consumer interest testing. The imagery was classified under three styles:

1. Images of instant lemongrass drinks served in a cup.
2. Images of instant lemongrass drinks served in a cup with steam.
3. Images of instant lemongrass drinks being poured into a cup. Figure 1 presents the three styles used to classify the imagery.

The researchers conducted visual perception testing to assess consumers' interest when looking at the area of interest (AOI) on the packaging by using screen-based eye-tracking technology.

Analysis of the consumer's interest in the area of interest, including the number of fixations and duration of fixations (Andrychowicz-Trojanowska, 2018), was performed in accordance with the following:

1. The packaging imagery that the consumer most frequently saw was defined as the highest “number of fixations,” as an average total (times).
2. The packaging imagery that captured the consumer's attention for the longest was defined as the “duration of fixation" (ms.) and was found by utilizing “heatmaps.”
3. In the survey of packaging imagery styles, the participants had a choice of three styles.

» **Figure 1:** *Styles of instant lemongrass drink packaging imagery for consumer interest testing*

Method

Population and Sample Groups

The research population comprised consumers who were working-age women and men aged 19–65 years old (Ministry of Public Health, 2024) because they are the main target group for buying instant lemongrass drink products (Pijitbanjong, 2015). The consumer group, which was made up of people who had drunk instant lemongrass drinks, comprised female and male individuals at Rajamangala University of Technology Thanyaburi, was calculated by determining a power analysis =.80; the sample size was calculated from an effect size = 0.5, and the value (= 0.05) was calculated by the G*Power software.

The resulting number of participants was 27 people, and in order to account for the loss of participants during the test, three more participants were added, for a total sample size of 30 people.

Research Tools

The research tools comprised Tobii Pro Glasses 3 eye-tracking device, and screen to model the packaging of the instant lemongrass drink, which was a 27-inch LG UHD 4K monitor (27UP600-W) with a 16:9 (width: height) aspect ratio and a 1920x1080 pixel image size.

Three styles of packaging images were created for screen-based testing with eye-tracking technology. The packaging modeled on the screen for the participants to see comprised 12 images. A computer-aided software package was used to sequence and time the images in this research. Each image appeared for 2.5 seconds because that represents the average time that consumers use to search for products in a store. The first page displayed was an introduction to the testing, with the text "Each set of packaging images will appear on the screen for 2.5 seconds; you can look at each one freely, for a total of 12 images." This was done by switching between the left, right, and middle on-screen positions of the series A and series B packages. Figure 2 presents examples of model packaging images for series A and series B.

» **Figure 2:** *Model packaging images series: A and series B*

A survey of packaging imagery styles was performed to analyze the participant's choices. We divided the questionnaire into three parts. Part 1 was used to collect general information about the participants, including their age and gender. In part 2, a close-ended question was used to evaluate the packaging imagery styles that influenced the participant's choices. We asked participants to select the packaging style that most influenced their purchase decisions. Part 3 asked participants to provide reasons for their choices through an open-ended question. The research questionnaire was examined by experts using the index of item-objective congruence (IOC), and it was found that the accuracy of the questionnaire, or the consistency between the question and the objective or content, was 1.00, which indicated that it was a valid questionnaire.

Experiment

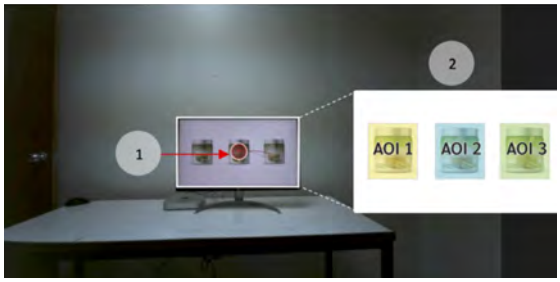
The researcher provided a screen for the participants in the experimental group to view the Ishihara test strip. The researcher then used a web browser simulator (https://www.colourlitelens.com/ishiharatest.html) to process and display the test result as a percentage. Then, the researcher moved on to the next step of the test.

The participants wore Tobii Pro Glasses 3. The participants had to sit 90 centimeters away from the computer screen with their glasses and equipment; the operator had to hold the calibration card, stretch his arm 50 to 100 centimeters away from the participants, and let the participants look at the black dot until a green circle appeared, indicating that the calibration process has been completed; finally, the participants had to look at the screen again. After that, the instructions for the test appeared on the screen, and the images displayed on the screen automatically changed until the viewer had seen the required number of images.

After removing their glasses, the participants responded to the packaging imagery styles survey form. The simulated packaging of three styles was presented on the monitor. The participants could select only one style which they had decided to buy.

Data Analysis

The packaging imagery of an instant lemongrass drink was compared by using eye-tracking technology. The analysis of the results of the eye-tracking test used with the participants was performed to determine the number of fixations and duration of fixations of each packaging in a total of 30 participants.



» **Figure 3:** *Analysis of eye-tracking test results with the Tobii Pro Glasses 3 Controller*

In figure 3, number 1 represents the gaze overlay, and the red circle indicates the subject's focus on a specific area of interest on the monitor. In the image, the gaze overlay appears on the screen when the participants look at a given style of model packaging, where the diameter of the gaze overlay covers the graphic elements on each style of packaging. In this study, we conducted the test by assessing the comprehensive image of the entire package, concentrating on the variables that aligned with the image's changing style.

Number 2 indicates the determination of the area of interest (AOI); the results of each participant's eye-tracking test were analyzed to distinguish which AOI the person was looking at on the monitor, where AOI 1 refers to the area that covers packaging style 1 (images of instant lemongrass drinks served in a cup), AOI 2 refers to the area covering packaging style 2 (images of instant

lemongrass drinks served in a cup with steam), and AOI 3 refers to the area covering packaging style 3 (images of instant lemongrass drinks being poured into a cup), where the positions of each format were switched on the screen every time so that the placement on the screen did not affect the attention of the participants.

Analysis of data on consumer interest in packaging was performed to obtain findings about the packaging imagery that the consumer most frequently saw, which was defined as the highest “number of fixations," namely, the average total (times) number of fixations on the three styles that were switched between positions on the screen so that each participant saw 12 images.

The total number of fixations in each area of interest (AOI 1 /AOI 2 /AOI 3) from a total of 30 participants, who viewed 12 images, was averaged to summarize the number of packaging views with regard to the elements in each of the three styles.

Analysis of data on consumer interest in packaging was performed to obtain findings about the packaging imagery that captured the consumer's attention for the longest, which was defined as the “duration of fixation" (ms.) and was found by utilizing “heatmaps” in the areas of interest on the screen.

There were three styles of packaging that were switched between positions on the screen so that each participant saw 12 images. The total duration of fixation in each area of interest (AOI 1/AOI 2/AOI 3) from a total of 30 participants who viewed 12 images was averaged to summarize the time spent looking at the packaging imagery models in each of the three styles. A one-way analysis of variance (ANOVA) was used to assess statistical differences at a significance threshold of 0.05, succeeded by Tukey HSD post-hoc testing to evaluate pairwise differences among styles. The survey of packaging imagery styles produced evaluation results from the 30 participants on the selection of packaging imagery styles as percentage scores.

Results

The results of the data analysis comparing consumer interest in the packaging imagery of an instant lemongrass drink found by using eye-tracking technology were as follows.

The descriptive data on the number of fixations and fixation durations in the imagery of three designs of instant lemongrass drink packaging is presented in Table 1. Images of instant lemongrass drinks being poured into a cup of style 3. The consumer's most frequent viewing and the diversity of interest levels among participants are reflected in the highest average number of fixations, 35.23 (SD = 16.48). The consumer's attention is held for the longest by Style 2, which depicts images of instant lemongrass drinks served in a cup with steam. The average duration of fixations is 19,545.26 ms. (SD = 7,433.17), and the duration of fixations is highly variable. The shortest fixation duration of 10,003.06 ms. (SD = 4,999.09) and the lowest average number of fixations of 23.57 (SD = 10.44) are indicative of the fact that Style 1, which depicts static images of instant lemongrass drinks served in a cup, elicited the least visual engagement from participants.

The standard deviations for Styles 2 and 3 indicate a significant degree of variability in the frequency and duration of fixations, which implies a range of consumer engagement and interest. These distinctions are additionally underscored by the 95% confidence intervals: The number of fixations in Style 3 varied from 29.08 to 41.39, while the duration of those fixations in Style 2 varied from 16,769.67 ms. to 22,320.86 ms. In contrast, Style 1 consistently exhibited the lowest performance across all metrics, suggesting that it has limited allure in terms of capturing and maintaining visual attention.

These findings underscore the significance of dynamic and atmospheric visual elements in capturing and maintaining consumer attention, which are essential factors in the development of effective packaging.

Table 1

Descriptive Statistics of the number of fixations and duration of fixations for the three styles of packaging imagery (N=30)

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Number of fixations (times)	[1]	23.57	10.44	1.90	19.67	27.47	5	47
	[2]	32.87	16.11	2.94	26.85	38.89	8	83
	[3]	35.23	16.48	03.01	29.08	41.39	9	92
Duration of fixations (ms.)	[1]	10003.06	4999.09	912.70	8136.37	11869.75	1495.00	21976.00
	[2]	19545.26	7433.17	1357.10	16769.67	22320.86	10841.00	49738.00
	[3]	18929.66	6832.78	1247.48	16378.26	21481.06	7800.00	35487.00

To evaluate the visual engagement of consumers with the three styles of instant lemongrass drink packaging imagery, statistical analysis was performed to compare the number of fixations and fixation durations across these styles. By using ANOVA, the study aimed to identify whether significant differences exist in these metrics, reflecting variations in consumer attention. The analysis focused on understanding how each style of packaging imagery influenced visual behavior, providing key insights into which design elements are most effective in capturing and sustaining consumer interest. This comparison lays the foundation for the detailed results presented in Table 2, which highlights the significant differences in the number of fixations and fixation durations among the three styles.

Table 2

ANOVA results on the number of fixations and duration of fixations for the three styles of packaging imagery

ANOVA				
		df	**F**	**Sig.**
Number of fixations (times)	Between groups	2	5.34	.006
	Within groups	87		
	Total	89		
Duration of fixations (ms.)	Between groups	2	20.22	.000
	Within groups	87		
	Total	89		

Table 2 shows the results of the ANOVA analysis, highlighting significant differences in the average number of fixations and fixation duration among the three styles of packaging imagery. The analysis revealed that the number of fixations differed significantly across at least one packaging style, with an F-value of 5.34 and a p-value of 0.006, which is below the significance threshold of 0.05. Similarly, fixation duration also showed significant differences among the styles, with an F-value of 20.22 and a p-value of less than 0.001, indicating highly significant variation. These findings confirm that the packaging styles influence both the frequency and duration of visual engagement. Specifically, the significant p-values indicate that the differences in fixation metrics are unlikely to have occurred by chance.

A post-hoc Tukey HSD test was conducted to compare the average number of fixations across the three forms of packaging imagery in order to further investigate the significant differences identified through the ANOVA analysis. This test enables a pairwise comparison of the styles, which offers a more comprehensive understanding of the differences in consumer visual engagement between each packaging design. The results of this analysis illuminate the styles that are significantly distinct and emphasize the design elements that most effectively attract attention. Table 3 provides the following information.

Table 3

Tukey HSD Analysis of Average Number of Fixations for Different the three styles of packaging imagery

Number of fixations			
Tukey HSD[a]			
Classification of instant lemongrass drink packaging imagery	N	Subset for alpha = 0.05	
		1	2
[1] Images of instant lemongrass drinks served in a cup	30	23.57	
[2] Images of instant lemongrass drinks served in a cup with steam	30		32.87
[3] Images of instant lemongrass drinks being poured into a cup	30		35.23
Sig.		1.00	.80

Table 3 shows the Tukey HSD post-hoc tests, confirming significant differences between the number of fixations in style 1 and styles 2 and 3 (p-value = 1.00). However, the subset analysis for alpha = 0.05 revealed non significant difference between style 2 and style 3 (p-value = 0.80).

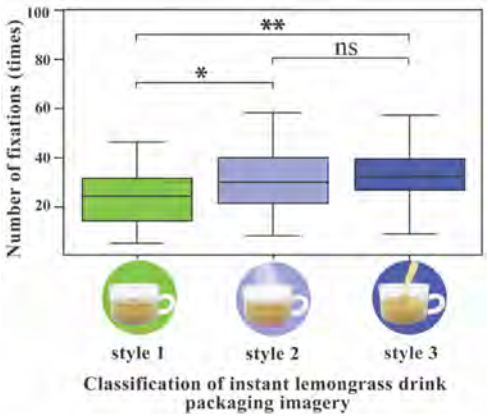
Table 4 shows the Tukey HSD post-hoc tests, confirming significant differences between the Duration of fixations in Style 1 and Styles 2 and 3 (p-value = 1.00). However, the subset analysis for alpha = 0.05 revealed non-significant difference between Style 2 and Style 3 (p-value = 0.92).

To present the data distribution and model variations in a comprehensible packaging imagery style. Consequently, a box plot illustrates the data in figure 4 and figure 5.

Table 4

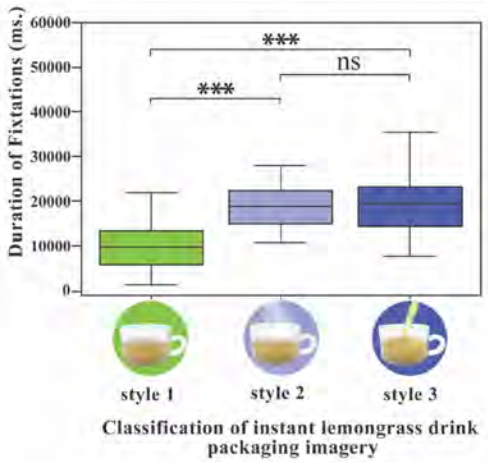
Tukey HSD Analysis of Average Duration of fixations for Different the three styles of packaging imagery

Duration of fixations			
Tukey HSD[a]			
Classification of instant lemongrass drink packaging imagery	N	Subset for alpha = 0.05	
		1	2
[1] Images of instant lemongrass drinks served in a cup	30	10003.07	
[2] Images of instant lemongrass drinks served in a cup with steam	30		19545.27
[3] Images of instant lemongrass drinks being poured into a cup	30		18929.67
Sig.		1.00	.92



» **Figure 4:** *Turkey HSD Result: Total Number of Fixations by classification of instant lemongrass drink packaging imagery*

Figure 4 shows the three styles of instant lemongrass drink packaging imagery: style 1 (images of instant lemongrass drinks served in a cup), style 2 (images of instant lemongrass drinks served in a cup with steam), and style 3 (images of instant lemongrass drinks being poured into a cup). The box plot indicates that style 3 had the highest average number of fixations, with significant differences compared to style 1 ($p < 0.01$), indicating that the dynamic pouring action effectively captures consumer attention. style, featuring a steam effect, also performed well, with a comparable number of fixations to style 3, though the difference between them was not statistically significant (ns). In contrast, Style 1, which displayed the drink in a static cup without additional dynamic or emotional elements, had the lowest fixation count and differed significantly from both style 2 ($p < 0.05$) and style 3 ($p < 0.01$). These results suggest that packaging imagery incorporating dynamic or appealing visual elements, such as pouring actions or steam effects, is more effective at attracting and maintaining consumer interest, while simpler designs may not engage as effectively.



» **Figure 5:** *Turkey HSD Result: Duration of Fixations by classification of instant lemongrass drink packaging imagery*

Figure 5 shows the three styles of instant lemongrass drink packaging imagery: style 1 (images of instant lemongrass drinks served in a cup), style 2 (images of instant lemongrass drinks served in a cup with steam), and style 3 (images of instant lemongrass drinks being poured into a cup). The box plot indicates the duration of fixation (ms.) for each style, revealing that style 2 (the steam effect) had the highest average fixation duration, with significant differences from style 1 ($p < 0.001$) and style 3 ($p < 0.001$). style 3 (pouring effect) showed a slightly shorter duration; however, it was not significantly different from style 2 (ns). style 1, the simplest imagery, had the shortest average fixation duration, with it significantly lower than both style 2 ($p < 0.001$) and style 3 ($p < 0.001$). These findings suggest that packaging imagery featuring dynamic or emotionally engaging elements, such as a cup with steam (style 2) or drinks being poured into a cup (style 3), can capture consumer attention for longer, while simpler designs (style 1) are less effective in maintaining engagement. This emphasizes the importance of incorporating visually compelling features to enhance consumer interest in product packaging.

In order to augment statistical and graphical assessments of consumer interest in three packaging imagery styles, it is imperative to investigate the spatial distribution of attention across design elements. The "duration of fixation" (ms.) of packaging styles that captivated consumers was depicted in heat maps. These heat maps suggest that the participants is paying attention to the areas of interest (AOIs) in packaging design. This approach elucidates the impact of visual element design and placement on consumer engagement. The gaze behavior of customers is influenced by the location of the screen and visual indicators, as illustrated in Figure 6.

Figure 6 shows heat maps of data comparing the attention of the testers on the packaging styles, namely, the average duration of fixations (ms.) per person, for a total of 30 people and three styles, and the point of the area on the screen that the participants looked at. The results confirm that the central positioning of fixation hotspots (red areas) primarily attracts more attention, irrespective of the packaging style. However, fixation patterns adjust to the positioning of packaging styles on the left or right side of the screen, indicating that specific visual elements within the design can draw focus even when the style is not centrally placed. Additional findings reveal that areas containing key visual elements, such as logos or dynamic elements like drinks served in a cup with steam, consistently produce longer durations of fixations, reinforcing the importance of visual stimuli in capturing consumer attention. This demonstrates the combined effect of screen placement and engaging visual elements feature on consumer gaze behavior, providing valuable insights for optimizing packaging design and positioning strategies.

» **Figure 6:** *A visual diagram of heat maps (duration of fixations) obtained for model packaging images*

Table 5 shows the summary of the data of those who chose the packaging imagery styles that most influenced their consumer choice. shows that style 2, the images of instant lemongrass drinks served in a cup with steam, was the most chosen style. From interviews about the reasons for participants who chose style 2, which were images of instant lemongrass drinks served in a cup with steam, chose it because of the warm feeling felt when looking at it with their eyes, which is related to the preference to consume tea while it is hot rather than cold, and the feeling of being close lemongrass drinks served in a cup with steam, was the most chosen style. From interviews about the reasons for choosing each style, it was found that the participants who chose style 1, which were images of instant lemongrass drinks served in a cup, chose it for its simplicity.

A total of two participants chose this style of imagery. Meanwhile, the participants who chose style 2, which were images of instant lemongrass drinks served in a cup with steam chose it because of the warm feeling felt when looking at it with their eyes, which is related to the preference to consume tea while it is hot rather than cold, and the feeling of being close to a product as if it is in front of you, which is related to distance unlike other styles of images. There was a total of 15 participants who chose this imagery. Finally, the participants who chose style 3 chose it because of the refreshing feeling that could be felt by looking at it with their eyes, which is related to the preference for consuming tea while it is cold rather than hot, and the sensation of the movement of water that attracts the eye. There was a total of 13 participants who chose this imagery.

Table 5

Consumer's choice of packaging imagery style

Consumers' choice					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	[1] Images of instant lemongrass drinks served in a cup	2	6.7	6.7	6.7
	[2] Images of instant lemongrass drinks served in a cup with steam	15	50.0	50.0	56.7
	[3] Images of instant lemongrass drinks being poured into a cup	13	43.3	43.3	100.0
	Total	30	100.0	100.0	

Discussion

This research looks at how the style of images on the packaging of an instant lemongrass drink affects people's attention using eye-tracking technology and an analysis of the number of fixations to see how much attention people pay to it before they decide to buy it. This research fits with the work of Gofman et al. (2009), who discovered that using eye-tracking technology to study how people see packaging could help the researchers find the most interesting parts. It was found that images of instant lemongrass drinks served in a cup with steam and images of instant lemongrass drinks being poured into a cup resulted in a dynamic emotion.

This type of imagery can attract more attention from consumers than packaging imagery that results in a calm emotion, using more detailed packaging imagery can add interest to the product, according to a study by Gvili et al. (2015). While the number of fixations of consumers in a large number of products may be due to high interest in the product, the number of fixations may be caused by a certain uncertainty about a product that may be less interesting or by consumers revisiting a previous product of interest; alternatively, there may be a smaller number of fixations for a longer viewing period compared to other products. Re-examination is a process where consumers quickly review the information or details of a product to gain a better understanding before moving on to another one. The results show that the numbers of views of the three packaging imagery styles are significantly different, which is also in line with the concept of Gofman et al. (2009), who explain that images with increased movement are more attractive.

In terms of the results of the fixation duration analysis, it was found that the images of instant lemongrass drinks served in a cup with steam had the longest duration of fixations. Next were the images of instant lemongrass drinks being poured into a cup, and images of instant lemongrass drinks served in a cup, respectively. This is in line with the concept of Köster & Mojet (2015), whose results show that the packaging imagery plays an important role in attracting consumers to look at it for a long time and retaining their attention. Vyas & Bhuvanesh (2015) state it is also important to make a good first impression on consumers. Kovačević & Brozović (2018), in line with the findings of Gil-Pérez, Rebollar & Lidón (2020), found that animated or highly detailed images could generate attraction and elicit positive responses from consumers. This is in line with the concept of Rolls, Rowe & Rolls (1982), who states that the appearance of the food that consumers see affects human consumption behavior. When the duration of a consumer's long-term gaze on one product is less than that on another, it may be because the product is very attractive at first, which makes interest in the brand last for a long time, but unlike with other products, there is no need to go back and look at it again. The packaging imagery of these other products can be looked at for a long time.

The analysis showed that there was an effect on customers' choosing when there was a considerable average duration of fixations on the packaging of a product, which was consistent with the concepts of Rebollar et al. (2015) and Clement et al. (2017), who state that the image on the packaging affects consumers' purchasing decisions, and Sielicka-Różyńska, Jerzyk & Gluza (2021), who state that packaging with different designs has a greater effect on consumers' purchasing decisions than the time it takes to look at the product. The concept of Fenko, Nicolaas & Galetzka (2018) shows that interest in health labels on packaging can predict consumers' health food choices, which is consistent with the findings of this study, which finds that the duration of looking at the packaging imagery has effects on the purchase decision, and consistent with the study by Huang, Peng & Wan (2021), which found that the design of the colors and flavors of the packaging can significantly influence a consumer's search for information, so taking longer to look at the packaging affects a consumer's purchase decision. According to the findings of this study, the duration of viewing packaging imagery has effects on purchasing decisions. However, we conducted a more thorough investigation of the proportion of packaging styles with the longest duration that participants viewed in relation to the packaging style that most influenced consumers' purchasing decisions using the one-proportion z-test. Our findings indicated that there was no consistency. During the test, participants observed the packaging designs on the screen and inquired about their differences.

It demonstrates that consumers are in the process of searching for products for an extended period of time, which may be a result of comparing similar products.

However, they are not always interested in making a purchase. This implies that the most effective strategy may not be to adopt a similar packaging design strategy or to create a counterfeit product. This is consistent with the findings of a study conducted by Melendrez-Ruiz et al. (2022) on the impact of gazing patterns on purchase decisions. The potential for confusion among comparable products exists if the product displays a similar pattern. It is a result of purchasing motivation and complicates decision-making. In this research, it was also found there were various additional factors, including consumer behavior and personal taste, which influenced the results. As stated in the conclusion, regarding the reason for choosing imagery, the personal preference to drink something while hot led to some participants paying attention to the image with steam because it gives a warm feeling.

Meanwhile, the preference for consuming products while cold led other participants to choose the image with pouring water because it gives a refreshing feeling. This is consistent with the research by Chynal et al. (2016), who found that the use of EEG could help in the analysis of the relationship between brain responses and purchase decisions. The analysis concluded that the use of eye-tracking technology was an effective tool to analyze consumer behavior.

Additionally, the results of this study are consistent with the study by Tonkin, Ouzts & Duchowski (2011) in the field of using eye-tracking technology to analyze consumer interest and evaluate the effectiveness of packaging, which shows that this context of research and evaluation in different environments can result in consistent research results. This is especially true in terms of the impact on consumers' purchasing decisions. The use of real and virtual environments in the research of Tonkin, Ouzts & Duchowski (2011) gave results consistent with research using laboratory environments.

Conclusion

The findings of this study emphasize the critical role of packaging imagery in influencing consumer interest and choice, particularly in the context of instant lemongrass drink packaging. Among the three styles examined, the imagery of a drink served in a cup with steam not only showed the highest average fixation duration but also emerged as the most preferred style, as revealed through consumer surveys. This style's ability to evoke warmth and emotional engagement underscores the importance of dynamic emotional packaging imagery and visually compelling elements in packaging design.

Additionally, the study highlights that images of instant lemongrass drinks being poured into a cup on packaging are also effective in capturing attention due to their dynamic emotion, offering an alternative for designers aiming to appeal to consumers.

Statistical analyses, including ANOVA and Tukey HSD tests, demonstrated significant differences in fixation metrics across the styles, reaffirming that the design of visual elements profoundly impacts consumer gaze behavior. The variability in fixation patterns further reflects diverse consumer preferences, shaped by individual experiences and emotional responses. By integrating eye-tracking technology with consumer surveys, this research provides actionable insights for packaging designers and marketers, enabling them to align their strategies with consumer behavior and optimize product visibility and appeal in competitive markets.

These findings contribute to the broader understanding of how visual stimuli in packaging can be tailored to enhance consumer engagement, reinforcing the strategic importance of thoughtful and targeted design elements in fostering brand differentiation and loyalty.

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References

Andrychowicz-Trojanowska, A. (2018) Basic terminology of eye-tracking research. *Applied Linguistics Papers*. 25 (2), 123-132. Available from: doi: 10.32612/uw.25449354.2018.2.pp.123-132

Bangkokbiznews. (2024) *The herb market grows by 60 billion baht pushing herbs to soft power exports*. Available from: https://www.bangkokbiznews.com/health/well-being/1114148#google_vignette [Accessed 10th March 2024]

Central Laboratory and Greenhouse Complex. (2021) *Botanical Resources of Lemongrass Herb*. Available from: http://clgc.agri.kps.ku.ac.th/resources/herb/cymbopogon.html [Accessed 10th March 2024]

Chen, S., Liu, D., Pu, Y. & Zhong, Y. (2022) Advances in deep learning-based image recognition of product packaging. *Image and Vision Computing*. 128. Available from: doi: 10.1016/j.imavis.2022.104571

Chynal, P., Sobecki, J., Rymarz, M. & Kilijańska, B. (2016) Shopping behaviour analysis using eyetracking and EEG. In: *2016 9th International Conference on Human System Interactions, HSI, 6-8 July 2016, Portsmouth, United Kingdom*. Piscataway, IEEE. pp. 458-464. Available from: doi: 10.1109/HSI.2016.7529674

Clement, J., Smith, V., Zlatev, J., Gidlöf, K. & Van de Weijer, J. (2017) Assessing information on food packages. *European Journal of Marketing*. 51 (1), 219-237. Available from: doi: 10.1108/EJM-09-2013-0509

Department of International Trade Promotion. (2023) *Herbs and Herbal Products*. Available from: https://www.ditp.go.th/contents_attach/777079/777079.pdf [Accessed 10th March 2024]

Fenko, A., Nicolaas, I. & Galetzka, M. (2018) Does attention to health labels predict a healthy food choice? An eye-tracking study. *Food Quality and Preference*. 69, 57-65. Available from: doi: 10.1016/j.foodqual.2018.05.012

Gil-Pérez, I., Rebollar, R. & Lidón, I. (2020) Without words: the effects of packaging imagery on consumer perception and response. *Current Opinion in Food Science*. 33, 69-77. Available from: doi: 10.1016/j.cofs.2019.12.006

Gofman, A., Moskowitz, H. R., Fyrbjork, J., Moskowitz, D. & Mets, T. (2009) Extending rule developing experimentation to perception of food packages with eye tracking. *The Open Food Science Journal*. 3 (1), 66-78. Available from: doi: 10.2174/1874256400903010066

Gvili, Y., Tal, A., Amar, M., Hallak, Y., Wansink, B., Giblin, M. & Bommelaer, C. (2015) Fresh from the tree: Implied motion improves food evaluation. *Food Quality and Preference*. 46, 160-165. Available from: doi: 10.1016/j.foodqual.2015.07.015

Huang, J., Peng, Y. & Wan, X. (2021) The color-flavor incongruency effect in visual search for food labels: An eye-tracking study. *Food Quality and Preference*. 88. Available from: doi: 10.1016/j.foodqual.2020.104078

Ketudom, C. (2022) *Factors affecting brand loyalty of herbal tea products among consumers in Bangkok and its metropolitan area*. PhD thesis. Mahidol University. Available from: https://archive.cm.mahidol.ac.th/handle/123456789/4544 [Accessed 10th March 2024]

Köster, E. P. & Mojet, J. (2015) From mood to food and from food to mood: A psychological perspective on the measurement of food-related emotions in consumer research. *Food Research International*. 76, 180-191. Available from: doi: 10.1016/j.foodres.2015.04.006

Kovačević, D. & Brozović, M. (2018) Noticeability and recall of visual elements on packaging. In: *9th International Symposium on Graphic Engineering and Design, GRID 2018, 8 - 10 November 2018, Novi Sad, Serbia*. Novi Sad, Faculty of Technical Sciences. pp. 261-266. Available from: doi: 10.24867/GRID-2018-p32

Mawad, F., Trías, M., Giménez, A., Maiche, A. & Ares, G. (2015) Influence of cognitive style on information processing and selection of yogurt labels: Insights from an eye-tracking study. *Food Research International*. 74, 1-9. Available from: doi: 10.1016/j.foodres.2015.04.023

Mazhar, M., Daud, S., Arz Bhutto, S. & Mubeen, M. (2015) Impact of product packaging on consumers buying behavior: evidence from Karachi. *Journal of Marketing and Consumer Research*. 16, 35-42.

Melendrez-Ruiz, J., Dujourdy, L., Goisbault, I., Charrier, J. C., Pagnat, K., Nicklaus, S. & Chambaron, S. (2022) "You look at it, but will you choose it": Is there a link between the foods consumers look at and what they ultimately choose in a virtual supermarket?. *Food Quality and Preference*. 98. Available from: doi: 10.1016/j.foodqual.2021.104510

Ministry of Public Health. (2024) *Working age*. Available from: https://dohdatacenter.anamai.moph.go.th/index.php?r=groupdata/index-&group=1&id=3 [Accessed 10th March 2024]

Nikolaus, U. & Bendlin, S. (2015) Visual perception and recollection of pictures in packaging design. *Journal of Print and Media Technology Research*. 4 (1), 33-41. Available from: doi: 10.14622/JPMTR-1420

Pei, H., Huang, X. & Ding, M. (2022) Image visualization: Dynamic and static images generate users' visual cognitive experience using eye-tracking technology. *Displays*. 73. Available from: doi: 10.1016/j.displa.2022.102175

Pijitbanjong, P. (2015) Development of Lemon Grass Herbal Tea Product by Quality Function Deployment and Design of Experiments. *Princess of Naradhiwas University Journal (PNUJR)*. 7 (1).

Piqueras-Fiszman, B., Velasco, C., Salgado-Montejo, A. & Spence, C. (2013) Using combined eye tracking and word association in order to assess novel packaging solutions: A case study involving jam jars. *Food Quality and Preference*. 28 (1), 328-338. Available from: doi: 10.1016/j.foodqual.2012.10.006

Rebollar, R., Lidón, I., Martín, J. & Puebla, M. (2015) The identification of viewing patterns of chocolate snack packages using eye-tracking techniques. *Food Quality and Preference*. 39, 251-258. Available from: doi: 10.1016/j.foodqual.2014.08.002

Rolls, B. J., Rowe, E. A. & Rolls, E. T. (1982) How sensory properties of foods affect human feeding behavior. *Physiology & Behavior*. 29 (3), 409-417. Available from: doi: 10.1016/0031-9384(82)90259-1

Sansanaphongpricha, K. (2023) *Development of herbal medicines for the country's natural resources NAC2023 National Science and Technology Development Agency: NSTDAThailand*. Available from: https://www.nstda.or.th/nac/2023/wp-content/uploads/2023/04/se39-present-1010.pdf [Accessed 10th March 2024]

Sielicka-Różyńska, M., Jerzyk, E. & Gluza, N. (2021) Consumer perception of packaging: An eye-tracking study of gluten-free cookies. *International Journal of Consumer Studies*. 45 (1), 14-27. Available from: doi: 10.1111/ijcs.12600

Szocs, C. & Lefebvre, S. (2016) The blender effect: Physical state of food influences healthiness perceptions and consumption decisions. *Food Quality and Preference*. 54, 152-159. Available from: doi: 10.1016/j.foodqual.2016.07.009

Tathaisong, T. (2003) *Principles of art*. Bangkok, Wadsilp.

Tonkin, C., Ouzts, A. D. & Duchowski, A. T. (2011) Eye tracking within the packaging design workflow: interaction with physical and virtual shelves. In: *Proceedings of the 1st Conference on Novel Gaze-Controlled Applications, NGCA '11, 26-27 May 2011, Karlskrona, Sweden*. New York, Association for Computing Machinery. pp. 1-8. Available from: doi: 10.1145/1983302.1983305

Varela, P., Antúnez, L., Cadena, R. S., Giménez, A. & Ares, G. (2014) Attentional capture and importance of package attributes for consumers' perceived similarities and differences among products: A case study with breakfast cereal packages. *Food Research International*. 64, 701-710. Available from: doi: 10.1016/j.foodres.2014.08.015

Vyas, H. & Bhuvanesh, V. (2015) Packaging Design Elements and Users Perception: a context in fashion branding and communication. *Journal of Applied Packaging Research*. 7 (2), 95-107. Available from: doi: 10.14448/japr.04.0005

Wästlund, E., Shams, P. & Otterbring, T. (2018) Unsold is unseen… or is it? Examining the role of peripheral vision in the consumer choice process using eye-tracking methodology. *Appetite*. 120, 49-56. Available from: doi: 10.1016/j.appet.2017.08.024

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