The Dawn of the 3D Spray:
Creating Street Art Using Polyurethane Foam

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Abstract

The diversity of techniques, methods and tools in creating Graffiti and Street Art allows artists to constantly evolve and discover new ways to express their ideas and implement their work. At the same time, a large number of researchers study and observe artists and their work, in an attempt to experiment with the emergence and spread of the phenomenon of urban art in combination with other scientific environments, such as engineering, robotics, programming and more. In this article, after the introduction to the power and importance of spray paint as a tool and symbol for the evolution of urban art, a first glimpse on the street artist - designer follows. This new type of creator can intervene radically in shaping the urban landscape by properly utilizing the designers' toolbox to help innovative ideas come to fruition. One of these ideas is to use polyurethane foam as a "three-dimensional spray". Using it, the artist can create embossed or three-dimensional works on a large scale, taking existing practices one step further. A case study illustrated by a variety of images is presented before the conclusion of this paper, describing the creation of a lion's head directly on the wall using polyurethane foam spray and then painting it with graffiti spray paint.

Keywords: 3D art, mural, spray paint, design

Introduction - Power of the spray can

The spray is now a widespread tool used in a variety of applications and comes in many different forms. It is an invention that has been around for almost a century and is an integral part of the equipment of different professionals, from carpenters to painters. It is also used in the automotive industry, in construction, in modeling, in furniture making and elsewhere. A much more "famous" kind of spray than the rest is the graffiti spray paint. A tool almost exclusively used by graffiti writers in the beginning, now also widely used by street artists, the spray can has acquired a symbolic status and characterizes the street culture itself.

The widespread production of industrial spray and its use by writers as the only means for the creation of their tags and pieces was a crucial factor in the promotion and evolution of Graffiti art. Robert Weide claims that the spray is one of the items that were created without anyone having imagined what it will generate: " *What it created was the modern Graffiti subculture* ". The importance of the aerosol paint, the spray can, in the modern Graffiti movement and the symbiotic relationship between the object and the subculture are important concepts that have not been ignored by scholars of the latter. However, the depth of the description and analysis of this relationship to date, Weide argues (2006), was at best concise.

Regarding the spray, Schacter points out that while its' use is a form of material violence, it is in fact a "manifest violence", a type of violence that draws attention to arguments rather than violence and vandalism in the traditional sense of the word. Like the newly spatial structures and infrastructure that enabled the development of the modern urban public sphere, the mass availability of the spray as a tool can be understood that it functioned like the printing presses of the 18th century (or the emerging availability of tea, coffee and chocolate), the city walls themselves are used as clubs or cafes where people openly exchange thoughts and ideas,

creating a set of practices aimed at resisting 'public authority', against the growing passivity caused by the aforementioned transformation of the public sphere (Schacter , 2014: 69).

Speaking of the past, a similar case of movement evolution based on a tool is that of the Impressionism. From 1841 onwards, painters could buy paints on metal tubes that had the highest portability of any other container until then. The ability to use colors outdoors, enable painters to render artworks that represented scenes of the environment, nature and the world, in a way that had never happened before. Bell (2017: 129) refers to Renoir's claim: "*Without tubes of paint, there would have been no Impressionism.*"

The availability of a new technology, either in the form of a tool or in the form of a system, can bring about a critical change in an artistic field, or even in an entire art form. Just as the example of the use of metal tubes to transport paint inspired the artistic movement of Impressionism, so did the transfer of paint to metallic aerosol containers, spray cans, which inspired the Graffiti movement, closely followed by Street Art. This shows how powerful a change can occur by an artifact, either when simply evolves from the idea of one or more people, or carefully designed. However, design intent, both in the first and in the second case, either by chance or intentionally, is always present.

Nevertheless, the spray can is an integral part of the development of Graffiti and Street Art, not only in the field of application and the restrictions it imposes as a color rendering system, but also as a tool for measurement. When writers traveled to trains and stations, they did not have measuring instruments and protractors with them. They used the spray cans as guides for the correctness of their lines. The straight edges of the bottle were also a tool for determining lines, contours and borders between letters and colors. Over the years, the bottle and the valve have acquired mythical dimensions: the knowledge about the valves and the various spray effects they produce is encyclopedic and is zealously guarded by the artists. Finding and handling the right valve, to create a certain type of line or shape, is a skill in itself [Blackshaw , Farrely , 2008: 66].

Other features that make aerosol paint a popular tool are portability, ease of storage, low price (in standard size bot-

tles), but also its small size and weight. In stores and shops with graffiti items, one can now look for many different products that operate with the same basic principle of spraying. Now, all kinds of paints appear in spray bottles: acrylic paints or water paints, textured paint that mimics tar, granite, marble and more. Last but not least, a vital part of street culture and a very productive relationship, of course, is the one between the spray and the stencil.

A new type of street artist

This kind of technological leaps allow artists to experiment constantly, inventing new painting methods and techniques (just as they did in the beginning of the Graffiti movement with the modification of caps). But beyond the advanced techniques, the artists themselves are evolving on multiple levels. They are no longer just creators on the street but experienced professionals whose skills are called upon by public and private entities. Street artists are the painters of today and many of them acquire celebrity status or notoriety. They even go so far as to work with other professionals - designers, graphic designers, architects - and even themselves often come from similar backgrounds and use their knowledge in combination, shaping the urban and not only, landscape. They are commissioned to work for large companies and businesses, municipalities or communities that assign them small and large scale projects. They present their works in galleries and events called graffiti and street art festivals.

In the doctoral research carried out at the Department of Product and Systems Design Engineering in the University of the Aegean, the main research question revolves around the quantitative and qualitative criteria of the relation between Street Art and Design. Advocating for this relation, a new type of street artist is emerging. It is a kind of artist - designer, who, paralleled with the Homo Universalis of the Renaissance, is distinguished by his/her ingenuity and increased skills in the use of a wide variety of material and immaterial means, for whom the methods and techniques of controlling are borrowed from various and diverse environments. As by nature a capable problem solver, being a human, this character is selected to cope with the globalized environment in which he/she lives and works, while managing to compete with other artists and professionals, but also to promote his work ethic and beliefs through his/her labor and his/her life.

This artist-designer is the main exponent of the relationship between Street Art and Design and the doctoral study captures how this happens, through bibliographic and field research, through applications, experiments and case studies, but also through the personal engagement of the author as a reflective practitioner; a street artist and a graduate products and systems designer and engineer.

From this point of view, while street artworks function not only as spontaneous artistic expressions or symbolic acts of resistance to various kinds of regimes and frameworks (political, social, financial, etc.), but also as means of promoting or supporting them, the way artists and the various types of professionals around them act, is an issue worth exploring extensively. Especially when the backers and admirers of this global art movement make extensive use of new technological means to prepare, create, store and communicate works, ideas and knowledge related to Street Art, it is then that the role of Design begins to dominate most, if not all, stages and levels of this process.

The artists of today create large scale artworks with the support of machinery and construction equipment, handle technological tools and colors with complex chemical properties and functions, they are turning to the use of digital equipment for the organization and preparation of projects, but also for their photographic survey and internet circulation. And while in the past the art world consisted exclusively of artists, critics, curators, agents, collectors and audiences, today a wide range of professions benefit from or is influenced by Street Art, such as photographers, bloggers, tour guides, travel agents, advertisers, hoteliers, entrepreneurs of various kinds, writers, researchers, professors, activists, criminologists, public officials and many more. Also, Urban Art contributes to other major industries beyond the "Art industry" (if it could be called so), as the game industry, the tourism industry, the advertising industry, the fashion industry and so on.

In a nutshell, the concept and science of Design, whether indirectly or directly, either at an amateur - fundamental level, or in a professional - organized context, affects Street Art in a lot of ways. The artistic work itself is full of design functions - techniques and methods - dictated by the designer that each artist hides inside, whether in an embryon-

ic or in an awakened state. Street artists are invited through their work, not only to communicate their thinking and inner self, but at the same time to solve dozens of technical problems. This is because Street Art differs a lot from canvas painting. Large scale painting in the urban landscape is filled with constraints and risks that can only be addressed by experienced artists and their design skills. In order to be one step ahead of their predecessors, they need to be faster, better organized, better protected, better informed, work with ingenuity and innovation, and build their own equipment. For all this to happen, even if sometimes they don't do it intentionally, the artists are guided by the power of Design.

While parthenogenesis does not exist in art, the differentiated use of one or more techniques and objects can bring innovation in Design. The idea of the following case study is considered as such an example.

Polyurethane foam spray as a tool for creating art
In an effort to define the early street artist - designer and document his practice, researchers at the University of the Aegean along with the author of this article have already presented work on the subject. The design fields where the street artist - designer operates can be many. However, what has been studied so far concerns the field of service design and the field of system design y Arttem & Photon Painter System respectively). However, the connection of the street artist - designer to the field of product design, which stands as one of the most popular and fundamental Design disciplines, has not yet been studied. This paper introduces the concept of 3D spray for the first time. The main purpose is to create a product that serves the creation of large scale three -dimensional or relief works of graffiti and street art in the outdoors, (like how 3D pens and 3D printers work for small scale).

3D Street Art already is already being created by many artists, some of whom work subtractively, like Vhills, who breaks the wall using jackhammers in order to create relief patterns, or additively, like Bordallo II, who constructs three dimensional animals, usually using rubbish, which he sticks or screws onto the surfaces where he wants to create his work. To date, however, the existence and use of a hand-held volume drawing tool has not yet been observed. While materials that have such properties exist, as, for exam-

ple, puff ink or polyurethane, which is used in the case study of this paper, there is no commercial product whose use is specifically aimed at creating 3D artworks on the street, as is the case with the "two - dimensional" graffiti spray paint. For polyurethane in particular, it is worth noting that it is used as a basic material for the creation of artworks which can be found in gallery exhibitions. What is certain is that it is a material with very interesting properties, the possibilities of which have not yet been explored thoroughly and that have also inspired the writing of this paper.

Basic information about polyurethane states that it was invented in the mid-1930s and can be produced in many variations, including as a hard or soft foam material for various uses. In the 1970s, it became possible to fill polyurethane foams in pressure vessels, thus laying the groundwork for the use of products by craftsmen and technicians. Polyurethane foams are available in one - or two - component versions in containers with propellant gas or in two - component versions in a container without propellant gas. While the one - component foams containing propellant gas can be applied with an angle adapter or a pistol, various propulsion systems are also used for propellant - free PU foams.

Polyurethane foams are designed as a bonding agent around windows and construction joints, partition walls, ceilings, floors, or for masonry holes for installing piping through walls and floors. In general, the foam has good adhesion to various materials, such as: concrete, bricks, stones, gypsum, wood, metal and many plastics such as polystyrene, fixed PU foam and uPVC.

From the above it is easy to conclude that the use of polyurethane foam is not suitable for the creation of works of art - or at least not in the way that the 3D pen works in the physical world or 3D brushes work in digital modeling environments (e.g. Zbrush, mudbox etc.). More about the technical characteristics and details of the use of foam follow in the next part of this paper, where the case study is also presented, in which an attempt to draw a realistic representation of a three - dimensional (relief) lion's head is made.

Case study - PU foam lion head
It should first be mentioned that the author of the article is an experienced street artist with activity in various cities in Greece and abroad, from 2008 onwards. He is also familiar with digital environments of three-dimensional design such as those mentioned in the previous section of the paper. So, starting with the logic of using polyurethane foam as a three-dimensional spray, it quickly became clear that it was going to be a demanding process. Trying to create a 3D artwork with PU foam is the equivalent of creating a mural with spray paint like the ones used in 1970 to paint furniture or other everyday objects. It has many similarities to the beginning of the graffiti movement, where sprays were a first-time tool, unsuitable for tags and pieces, without the ability to change caps and the use of which required special skill and patience to avoid dripping and to succeed in creating straight and consistent lines.

Figure 1. The tools of the criminal mischief: the cans II by Roger Gatsman

Figure 2. Lion head drawing

Figure 3. Brands of PU foam used

A wall about 9 square meters (three meters high and three meters long) was chosen to create the lion. The wall was initially painted with the background color to erase previous tags and sketches. The image (outlines) of the lion was found on google. The lion was chosen as the artist's personal preference, but also because he wanted to be able to portray the resemblance to the animal, thus examining how well the PU foam can function as a design/drawing tool. At first there the idea was to create a portrait of a famous personality, but since this was the first attempt in using PU foam, such a plan seemed even more grandiose and demanding. The outlines of the lion's head were painted with a marker on the surface.

The overall project took 3 days to be completed, with a total of approximately 20 hours of work. Two different commercially available foam brands, YTONG and Den Braven were used. These PU foams have common properties and almost the same drying time. A total of twelve 750 ml bottles were needed to complete the project.

On the first day of using the foam, two or three ours were devoted to become familiar with the tool. It should be noted that polyurethane foam spray does not work like the spray paint, with the valve on the top of the bottle, but upside down. It was then found that the foam could not easily stick to the wall when the surface was smooth. Because of this, there was a lot of waste of material falling to the floor which was impossible to use again. While the foam did not stick easily to the smooth surface, it was particularly sticky on clothes and protective gloves. Especially when the gloves came in contact with a large amount of foam, then they were immediately useless. The use of foam requires even greater protection from the use of spray paint, because if it comes in contact with the skin, in addition to the discomfort it creates, it is extremely difficult to clean, especially on areas of the skin with a lot of hair, such as in the scalp.

After 2 hours of experimenting with the foam on the first day, it was found that by spraying with less pressure, the foam came out in a smaller amount and there was a greater chance of sticking to the surface. This way and by waiting

Figure 4. The lion at the end of the first day and at the beginning of the second - 15 days later

Figure 5. The lion head at the end of the second day

10 to 15 minutes for the first lines to dry on the wall, the lion's mane began to form. Having created a first layer of foam lines, it was easier for the new foam to stick and so, little by little, larger pieces began to be added, until by the end of the first day most of the lion's mane, mouth and nose had already been made. By that time, six 750 ml bottles had already been used.

Due to the emergency caused by the coronavirus pandemic, two weeks passed from the first to the second day of work. During this time, the first layer of foam had changed color due to its exposure to the sun, but had retained its volume unchanged, and was still hard and firmly attached to the wall. Note that the foam can be detached from the wall, no matter how hard it is. Of course, this does not diminish its value as a creative tool, since even spray paint can also be cleaned or altered on most surfaces using the appropriate technique.

On the second day, after about eight hours of work, the mane, mouth, and entire nose of the lion, as well as the eyebrows, were completed. The original intention was for the entire face of the lion to become three-dimensional and protrude in front of the wall, so that it would look like an oversized lion had passed through it. By that time, however, six more PU foam cans had already been spent. To create

such a big 3D head as it was first intented, it was obvious that a lot more cans would be needed. For reasons of material economy, but also because no one could guarantee the success of the result up to that stage, even in the scenario that an unlimited amount of foam was available, the decision was to stop adding volume to the artwork and the project to proceed to the third and final stage, that is, coloring. The coloring of the polyurethane foam would reflect the special features of the lion, a process reminiscent of texturing, the corresponding texture rendering in 3D digital models on various computer applications.

On the third day, 15 spray paint cans of the necessary colors were used in order to create the details of the lion's face. These details include capturing the eyes, nose, mouth and ears, but also coloring the fur and mane so that it matches to the real look of a lion. It took approximately four hours to complete the coloring. All stages of the procedure were of particular interest, but this step was a little more interesting, since the project gradually began to take shape. The colorless shape of the foam, although it looked like a lion's face, resembled more to a mockup or to a project that was not properly completed. The colors accentuated the texture and rendered the structural elements of the face, giving meaning and substance to the original design idea. It is fact that in this case, the texture of the

Figure 6. Different views of the finished artwork

polyurethane foam itself worked usefully, because its final form somehow mimics the texture of the hair and the lion's mane. If the subject was different, such as a human face, for example, the foam might not have had the right effect.

With the lion completed, the most part of the artwork was done and the result came close enough to the original idea - to create a 3D / relief lion's head with the use of expanding foam. The rest of the wall around the lion's face was painted decoratively and finally, with the placement of the signature, the project was finalized. An important observation is that in its contact with the spray paint, the polyurethane foam hardens a little more. Moreover, when the foam has been painted, even after several days have elapsed since its' exposure to the weather (sun, rain, etc.), there is no alteration of the color or volume of the object.

A comparative table with the characteristics and properties between spray paint and polyurethane foam follows. It should be noted that the two tools are judged on the basis of their functionality as design tools and whether they correspond to the creation of street art.
Comparative table between spray paint and PU foam as drawing / design tools

Conclusions and future research
With the use of PU foam and spray paint the lion head of the case study was managed to be completed. The result was satisfactory, since in the final work the characteristics of the animal were captured as realistically as possible and, to some extent, the sense of a three-dimensional representation was achieved. Another helpful characteristic of the polyurethane foam is that it can be modified in various ways (cut, poked, trimmed) and before it dries completely, it is still malleable. Another positive element is that even after its hardening, its weight remains small. On the other hand, the process was not entirely successful, as the lion's head looks more as a relief than a three-dimensional artwork. A large amount of the material was lost in the process due to little expertise in the tools' operation. Also because it is a tool not specialized for artistic use. In any case, these complications further stimulate the desire for even more experimentation, rather than limit it.

Although the use of polyurethane foam to create works of art cannot be considered as the production of an innovative product, it certainly lays the groundwork for further experimentation and study with the ultimate goal of creating a new tool. If such a tool is developed, it may be prudent to follow the spray paint evolution trajectory, but also that of the three-dimensional design tools of the natural world. Creating such a tool-product does not seem impossible for the world of design, provided that its design requirements and technical characteristics will be properly developed and categorized.

Priority should be given to ensuring the smooth flow of foam through the valve-tube, so as to achieve a uniform line during spraying. Such a controlled line will allow the artist to better handle the tool for improved performance in creating the volumes and shapes of his choice. Another feature that the tool should have is better grip on the surfaces but also the use of a reinforcing material, in order to allow greater support and increase the volume of the object that can be constructed. Finally, it would be very interesting to have different colors of polyurethane foam that will not be altered when exposed to the the sun, but also create caps that will control the amount of flow, to allow smaller or bigger line thickness.

Three-dimensional design in the natural world, in addition to being an interesting field of study, is also commercially profitable for professionals and businesses engaged in it. To create the spray paint, many different scientific fields have been involved and continue to explore the properties and future evolution of the object. As with the revolution that sparked the paint spray, a corresponding artistic and social revolution could follow the creation of the equivalent tool for three-dimensional design - painting. Let this article serve as a starting point for more efforts and resources of this kind, until colorful graffiti and street art " spring up " in three-dimensional space!

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