

Creativity and technology in the age of AI

About this research project

Understanding creativity and its relationship to technology

This research was commissioned by Adobe, with the goal to interview creative professionals in order to thoroughly understand the role technology plays in their creative process. The research also closely covered the role of AI and machine learning (ML), the attitudes of creative professionals to these emerging technologies, and their perceived impact on creative work.

Methodology

The research consisted in qualitative research interviews with over 75 creative professionals working in design, illustration and imaging, motion graphics and UX/UI design. Interviews were free-flowing discussions that lasted between 45 minutes and two hours.

Geographic reach

The research covered the United States and Europe (covering Germany and the UK). Over 75 interviews were conducted.¹

About the research participants

Professional experience ranged from 2 to over 35 years, and many of them have produced work for companies such as Apple, Adidas, Amnesty International, Audi, Coca-Cola, Converse, Disney, Facebook, Google, Instagram, Kellogg's, Pepsi, Panasonic, Samsung, Swarovski, VW, WMF among many others.

Participants were creative professionals who were found and recruited based on Behance portfolios and recommendations from other professionals. A minority of respondents were referred by Adobe, but most were identified by their portfolios and appreciations.

¹ Additional research interviews, covering Japan, are currently being conducted. This report will be updated and expanded as soon as the data from this last research phase is available.

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Executive Summary

Key aspects of creativity

To understand how technology will impact creative disciplines like design, animation, and other creative work, it's important to understand what creativity is all about: It's not just the output that counts — creativity is a process and a life journey.

Creativity is not just *what* you create, but *why* you create it. And, equally important, it is about understanding what the client wants — and working with them on how to achieve it.

Original thinking, serendipity, and external, sometimes random influences are part of the creative process, which rarely happens in a vacuum. All of this makes creativity profoundly human.

Creatives see technology as essential

Technology is an enabler, the means to deliver on their vision. They see the value of technology in helping them to be more productive.

Creatives want technology that helps them get the job done, tools and workflows they can rely on to behave as expected, and that can make their work easier. The killer app is productivity and removing drudgery.

Potential of AI and machine learning

Creatives can see the potential of AI and machine learning to help with their workload. While they're not yet sure how AI will directly affect them, they perceive it as very intriguing, and see the potential for AI to streamline and optimize complex, tedious or repetitive processes.

Creatives also see the possibility of AI acting as a creative assistant: handling drudgery, teaching them new features, searching for images, or evaluating response to their work.

However, creatives want control over technology vs. the technology controlling them – *they* want to be in charge when and how they use the technology. This is essential to keep the focus on original thinking and creative problem-solving.

Creatives don't fear being replaced by robots

Most do not fear that their jobs will be replaced by AI, although they do recognize that the ways they work and how they spend their time will change.

The most frequent concern is that AI and machine learning could lead to homogenization of visual output, and might devalue their skills.

Another perceived threat is that technology developments could discourage experimentation and new approaches to solving creative challenges. Great work doesn't happen when everything is made easy.

Conclusion

AI is about detecting patterns, while creativity often implies breaking them in unexpected ways, and venturing into the unexpected.

AI and machine learning can help creatives keep up with the ever-increasing demand to produce more, faster, and manage the growing complexity of audiences, channels, and technologies.

AI has the potential to alleviate many tasks that are perceived as tedious or repetitive. With the help of AI and machine learning, ML-based creative assistants have the potential to significantly speed up these tasks (such as finding the right stock image, creating multiple iterations, or testing different approaches, and many others.) This liberation from mundane tasks allows creative professionals to increase the focus on their personal creativity, bold new ideas, and better client collaboration.

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*"Whether you succeed or not
is irrelevant. Making your unknown known
is the important thing."*

Georgia O'Keeffe

"Ideas come from everything."

Alfred Hitchcock

*"The worst enemy to creativity
is self-doubt."*

Sylvia Plath

*"We have to continually be jumping off cliffs
and developing our wings
on the way down."*

Kurt Vonnegut

*"Others have seen what is and asked why.
I have seen what could be and asked why not."*

Pablo Picasso

*"You can never solve a problem
on the level on which it was created."*

Albert Einstein

*"An idea that is not dangerous
is unworthy of being called an idea at all."*

Oscar Wilde

About creativity

The little we know about creativity

Creativity is elusive. We recognize when it is present — and we sense its absence when it is not — but what really defines it, how it functions, where it comes from, and how it manifests itself remains largely a mystery.

Even the most creative people cannot really fathom its scope (nor do they have a strong inclination to do so.) It would be presumptuous for this research to pretend it can provide clear answers to these questions — yet, in speaking with over 75 creative professionals in the United States and Europe, we managed to outline many overarching, common themes linked to creativity and the way it transforms inspiration to communicate vision and concepts in a tangible way.

"You can't wait for inspiration, you have to go after it with a club."

Jack London

Different aspects of creativity

Creativity manifests itself in many different ways, and its parameters should not be limited to intentional creative activity:

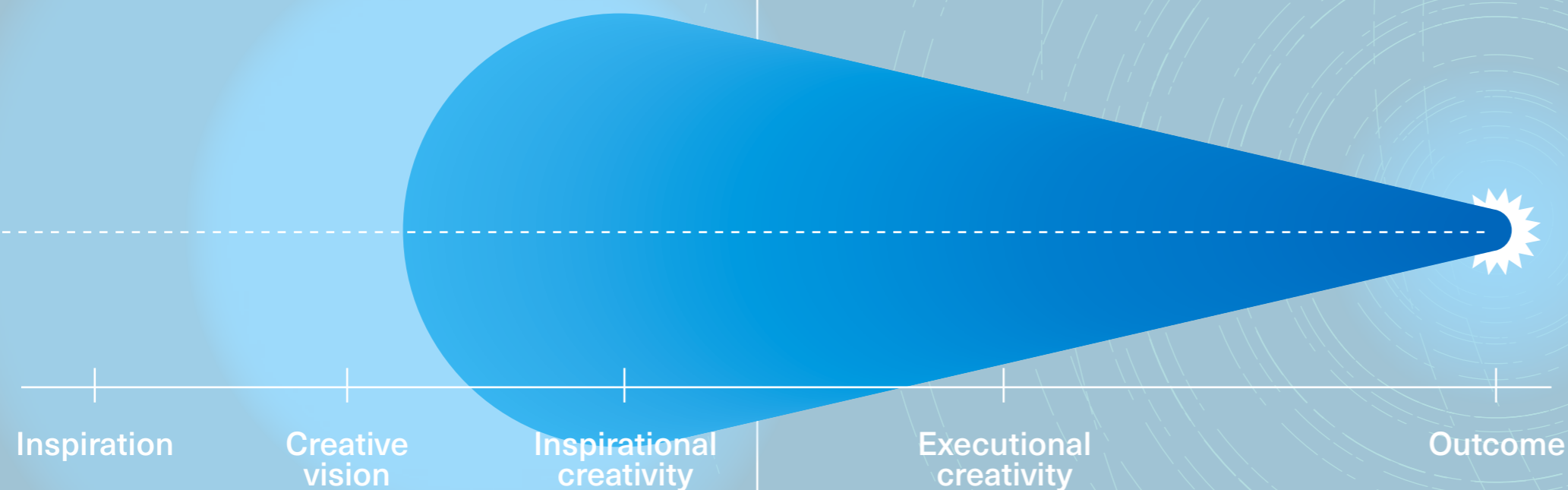
Situational creativity is the way in which any human being, confronted with a problem that has no pre-established solution, solves the problem at hand. Confronted with an unfamiliar challenge, situational creativity allows human beings to develop new solutions in a specific situation.

Inspirational creativity, on the other hand, is driven by a desire to realize a vision, elucidate an idea in an engaging, unexpected way.

Executorial creativity, finally, is the creativity that flows into the execution of almost any endeavor — and very specifically a creative project; it is the pragmatic/logistical approach to a myriad of individual steps and software operations that are required to produce the desired output.

The creative professionals, who were the respondents for this research, are acutely aware of these different aspects of creativity; they know that generally not only the initial creative burst at the beginning of a project requires their creativity, but that, in order to deliver what they envision in the beginning, their creative input will be necessary in almost every phase of a project. As one designer put it: *"As long as there is a decision to make, there is creativity."*

Creative professionals know that the creative burst that initiates a project is only the first phase; that all phases of the production process will require their creativity, be it inspirational, executorial or situational. In any case, for creative professionals, creativity is their core asset, their most precious gift. How they perceive it, and what is common to all the different forms of creativity we have researched will be examined in more detail in the following pages.



Creativity is about engaging with the world

The way creativity works and unfolds in the fields that were researched here is quite different from the well worn stereotype of the lone artist in his ivory tower, driven by the force of his inspiration to produce some mysterious work that he then presents to the world.

Creative professionals are sought out based on the quality of the work they have produced, but every new project is a new challenge, and requires, to some extent, to venture out into the unknown¹ — and this essentially means engaging with the world: with the client, in order to understand his needs, but also with the world at large, in order to find inspiration and the necessary creative thrust. On the receiving end as well, engagement with the world — in other words, the success of the engagement in which the outcome of a creative project is used to engage an audience or a customer, is essential.

Framed differently, for any creative project, the WHY is as important as the WHAT. In other words, the success of the engagement with its intended audience is the ultimate valuation of the outcome of the creative process.

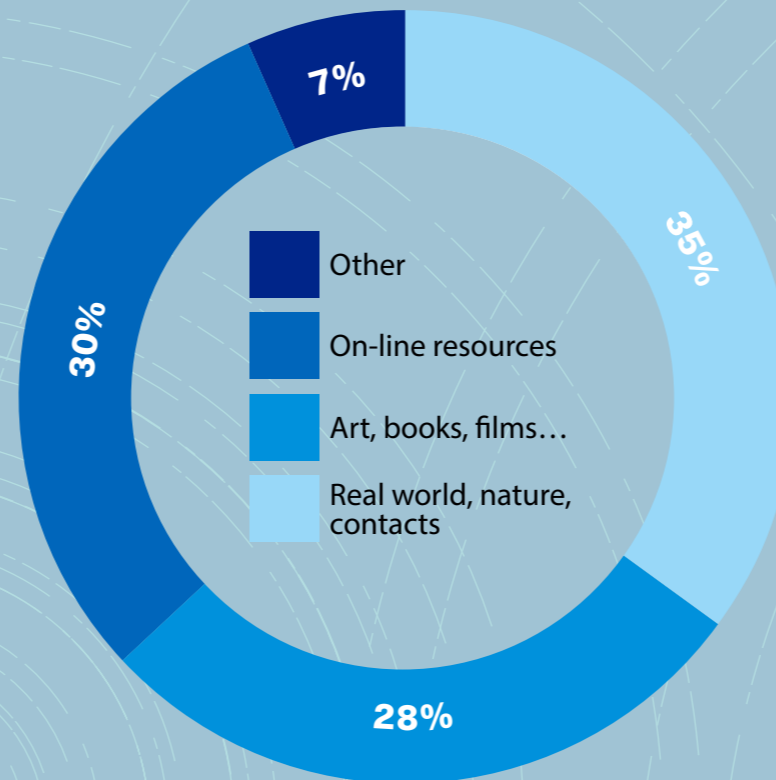
This, in turn, means that the quality and originality of the visual outcome is only one aspect to evaluate when looking at a creative project.² This aspect also underscores the complex role of technology, and AI and machine learning (ML) in particular, in the creative project. Technology is enabling the creative to release the potential of his/her vision. Yet, it is technology that defines the boundaries of engagement, by providing an ever-increasing number of distribution channels and platforms, which the creative professional needs to accommodate.

In a nutshell, this tells us that we should focus less on the details of the actual outcome of a creative project, and much more on the multi-layered engagement processes necessary to reach and touch its audience.

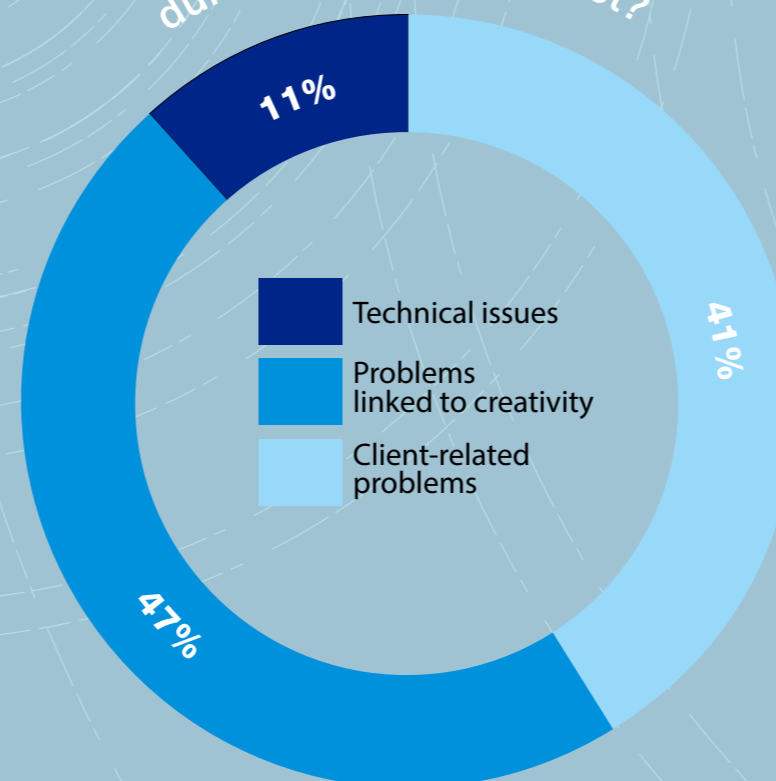
¹ It is true that some of the respondents in the research have a very personal visual signature for their work, which clients seek out and want them to apply without major changes to their product or brand — but interestingly, creatives see this way of proceeding as essentially uncreative: they fear being typecast, and they generally loathe doing the same thing over and over again. Creativity always needs to be a challenge for the creator, and creativity always is a new departure.

² Interestingly, current AI systems have not yet approached this question: when we hear that a computer has “painted a Rembrandt” we are meant to marvel at the technical expertise of the AI system imitating human-produced outcomes, but never to ask the essential question: What did Rembrandt want to express? Why do his paintings engage us in such a strong way centuries after they were created?

Where do you find inspiration?



What do you fear the most during a creative project?



Creativity is profoundly human

It should not come as a surprise that literally all the participants in this research view creativity as an essentially human capacity that has as much to do with openness to the world, joy, empathy, even vulnerability, as it has with specific skills or talents. There is strong agreement that, however much has been written about creativity, its essence is not fully (if at all) understood — hence the deep-rooted doubt that AI systems can become truly creative.

Technology, however, is held in high esteem, and the incredible variety and power of tools available is universally appreciated. However, these are perceived as a supporting framework for creativity itself, which happens in the real world and in the connections the creative makes with other people and the client. The notion that an AI-based system could be creative in the full sense of the word, according to the same parameters and standards they apply to their own work, was rejected by the vast majority of the creatives interviewed for this research. In other words, creatives want the support of all the technological possibilities at their disposal, but they do not want to lose control of creativity itself.

Inspiration can come from anywhere

Anything can be inspiring, and where exactly inspiration comes from changes drastically from one creative to the next: Some scour the web for images, get inspiration from work they see on Behance, Pinterest or Instagram. Others do the exact opposite: Their inspiration comes from lateral drifting, seemingly unrelated discussions with friends and colleagues, music, exploring nature, sometimes dreams.

While creativity is often seen as happening inside the head of the creative, what inspires them comes from outside. To be inspired, there is a need to open up to the world around us, and everything it can offer, from scraps of paper on a sidewalk to the work of admired artists or unexpected imagery found on the web.

Serendipity is essential

Serendipitous discovery is often at the heart of inspiration, and it is very important for a majority of respondents. What makes them function, and allows them to get out of inspiration block is very often something unexpected or unrelated. It is clear that they cherish this aspect of creativity: opening up to the world, being touched/inspired by things that have nothing to do with the job at hand.

Creativity is profoundly social

The research interviews also underlined how multi-faceted creativity actually is. If one steps back from a simple outcome-focused view (the creative simply trying to give tangible form to his inspiration), one realizes that we are witnessing a complex process that involves many phases, and is intrinsically linked to social interaction and connectedness to the world. In other words, creativity is intensely social, and stems out of all the interactions the creative has with the world around him.

The most obvious connection is the one that links the creative to the client. This relationship can be almost symbiotic: on one side the designer, who needs the client to realize his creativity¹, and has to grasp his needs and requirements. The client, on the other hand, relies on the inspiration and vision of the creative in order to attain a goal that has been defined in business terms, but as yet lacks the means to give it shape and form.

The quality of this creative-client interaction is essential to the success of a creative project. It requires trust and open-mindedness on both sides; just as the creative needs to gain a deep understanding of the client's needs — and in some cases dreams — the client himself has to accept that the creative often can provide a vision that exceeds his own.² If this process works well, it can be immensely beneficial for both sides, allowing the creative to fully exploit his capacities, and the client to receive a wider ranging outcome than he initially anticipated. If, on the other hand, this continuous exchange somehow backfires or never comes to fruition, it is counterproductive for both sides. It is therefore hardly surprising communication problems with the client are among the most frequently expressed fears concerning a creative project.

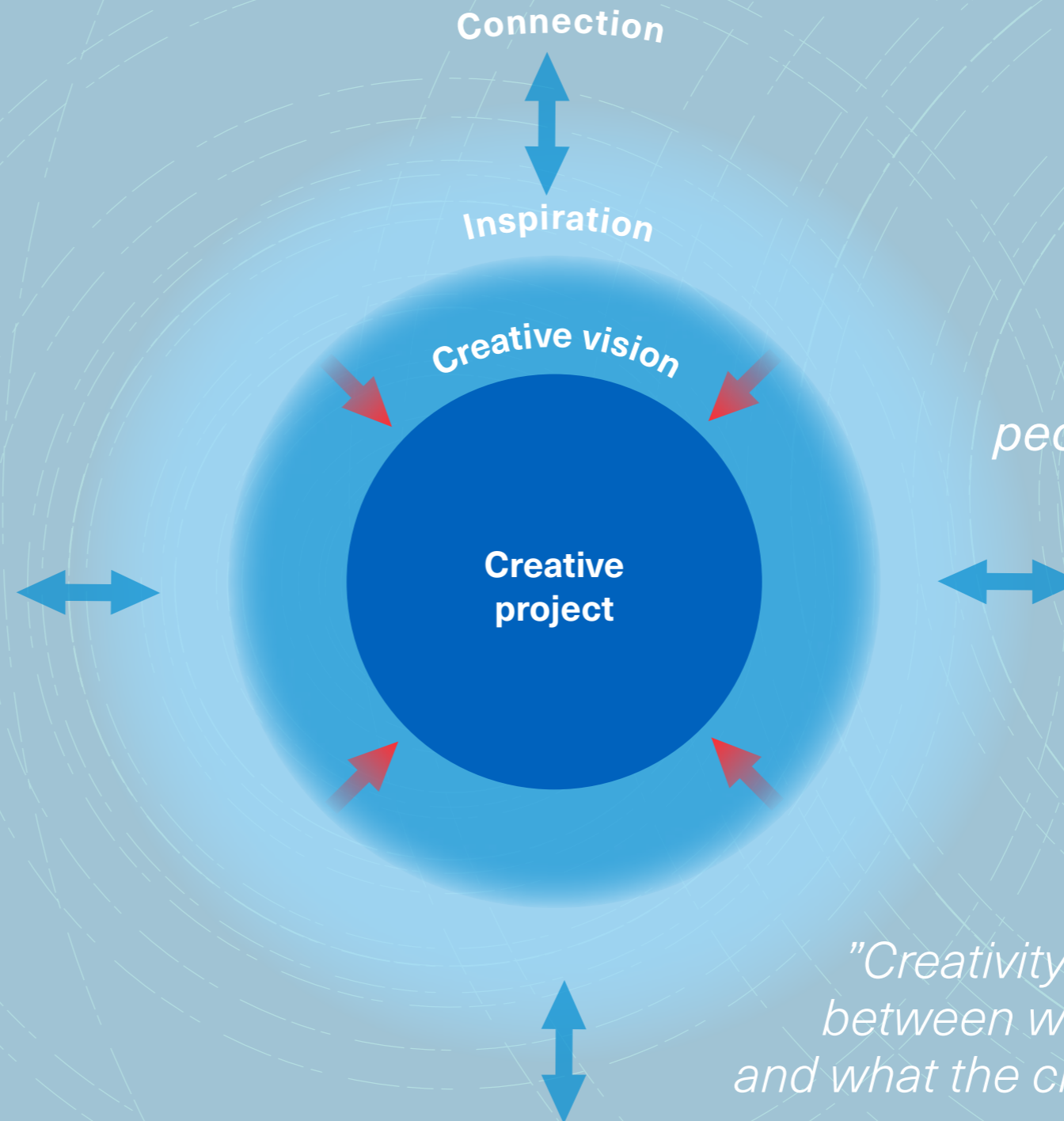
Creativity depends on the interconnectedness of the creative with the world, the client, friends and colleagues. There is also very often a sudden perceived connection with seemingly random, serendipitously discovered elements that feed into the creative process. This connectedness is the bedrock of creative work.

1 We are using the term client here in a very generic way, as the outside reason for the creative to apply his capacities. What is essential here is that creativity is not deployed into a void, but into a social space in which it functions.

2 Hence the frequent comment from creative professionals that they need to work with, and sometimes educate, a client to make him understand what a creative project can achieve beyond the initially stated business objectives. That's why many designers we interviewed have moved from simple graphic design jobs to branding and strategy.

"Creativity is all about the human connection. You can't listen to your client's needs without having thoughts of your own."

Kristine Arth
Founder & Principal Designer, Lobster Phone



"You can't separate people from creativity."

Marie Rack
Graphic designer

"Creativity is creating a bridge between what the client needs and what the creative can achieve."

Jan Siemen
CEO, Founder of Sons of ipanema

Creativity is a life journey

The vast majority of interviewees work in many different areas, use many different tools. Nobody can afford any more to do just one thing.

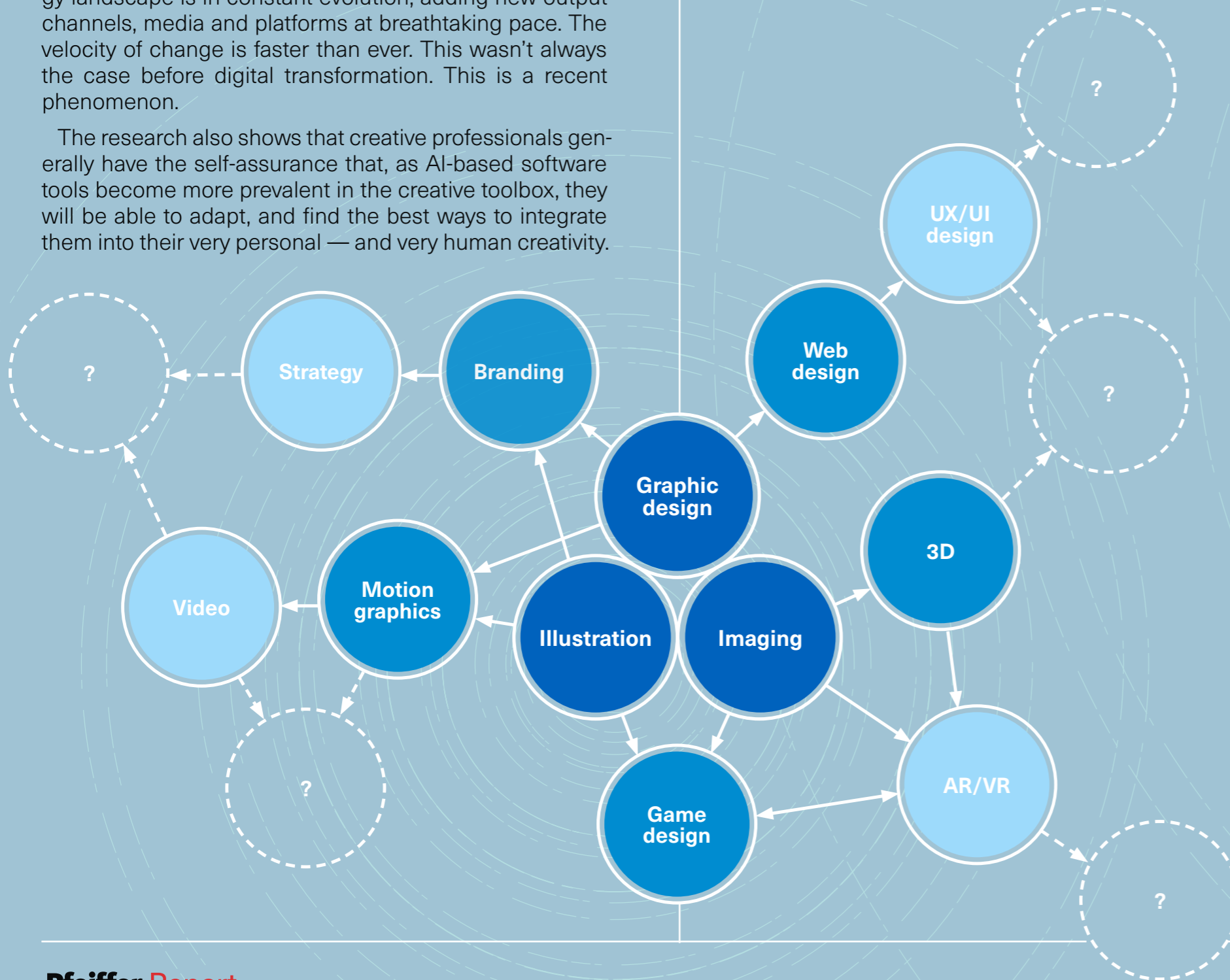
Creatives don't say "This is who I am — this is what I do", but rather "This is who I am — this is what I do now." Creative professionals are on a life journey that is less defined by a specific skill than by the capacity to apply their creativity to a variety of different situations, projects and challenges.

They are fully aware that they need to keep evolving their craft and continuously learning new things. The technology landscape is in constant evolution, adding new output channels, media and platforms at breathtaking pace. The velocity of change is faster than ever. This wasn't always the case before digital transformation. This is a recent phenomenon.

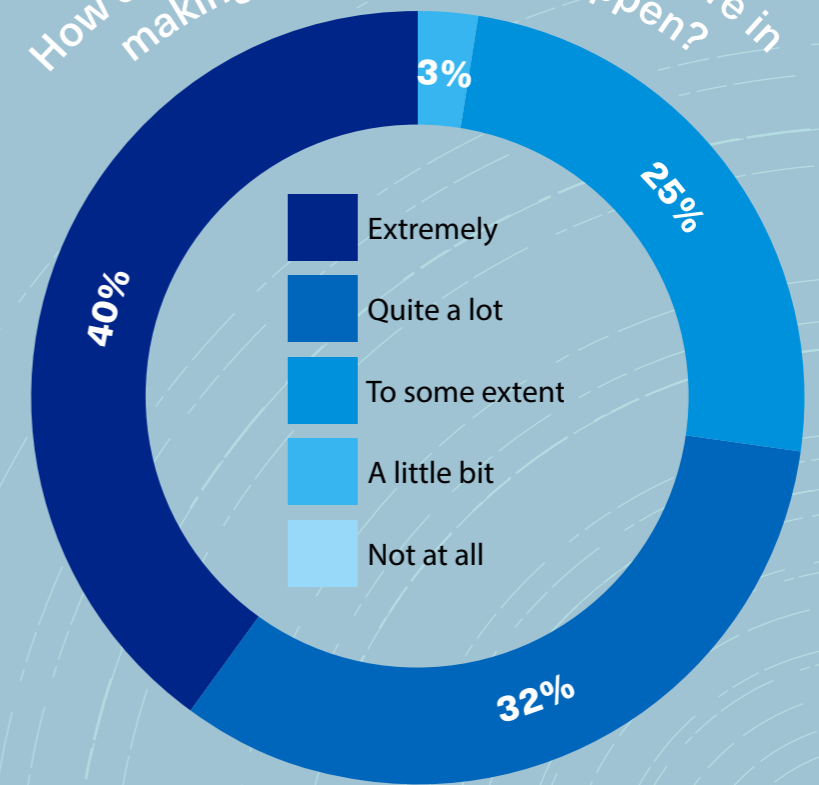
The research also shows that creative professionals generally have the self-assurance that, as AI-based software tools become more prevalent in the creative toolbox, they will be able to adapt, and find the best ways to integrate them into their very personal — and very human creativity.

"The entire point is to find out what we can do as creatives."

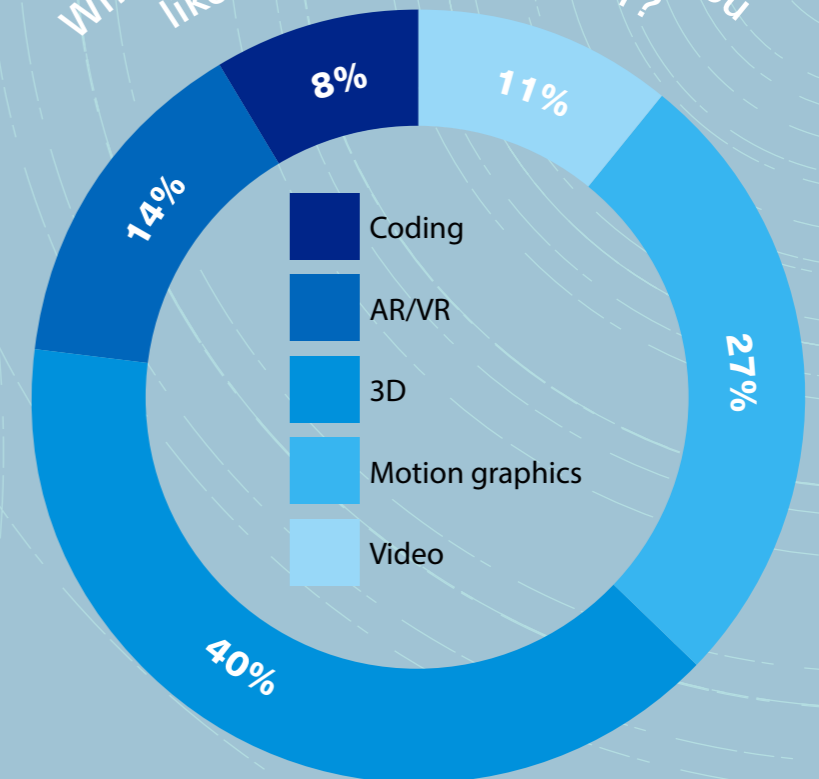
Kristine Arth
 Founder & Principal Designer,
 Lobster Phone



How efficient is the computer/software in making your creativity happen?



What kind of creative work would you like to do if it were easier?



The creative project

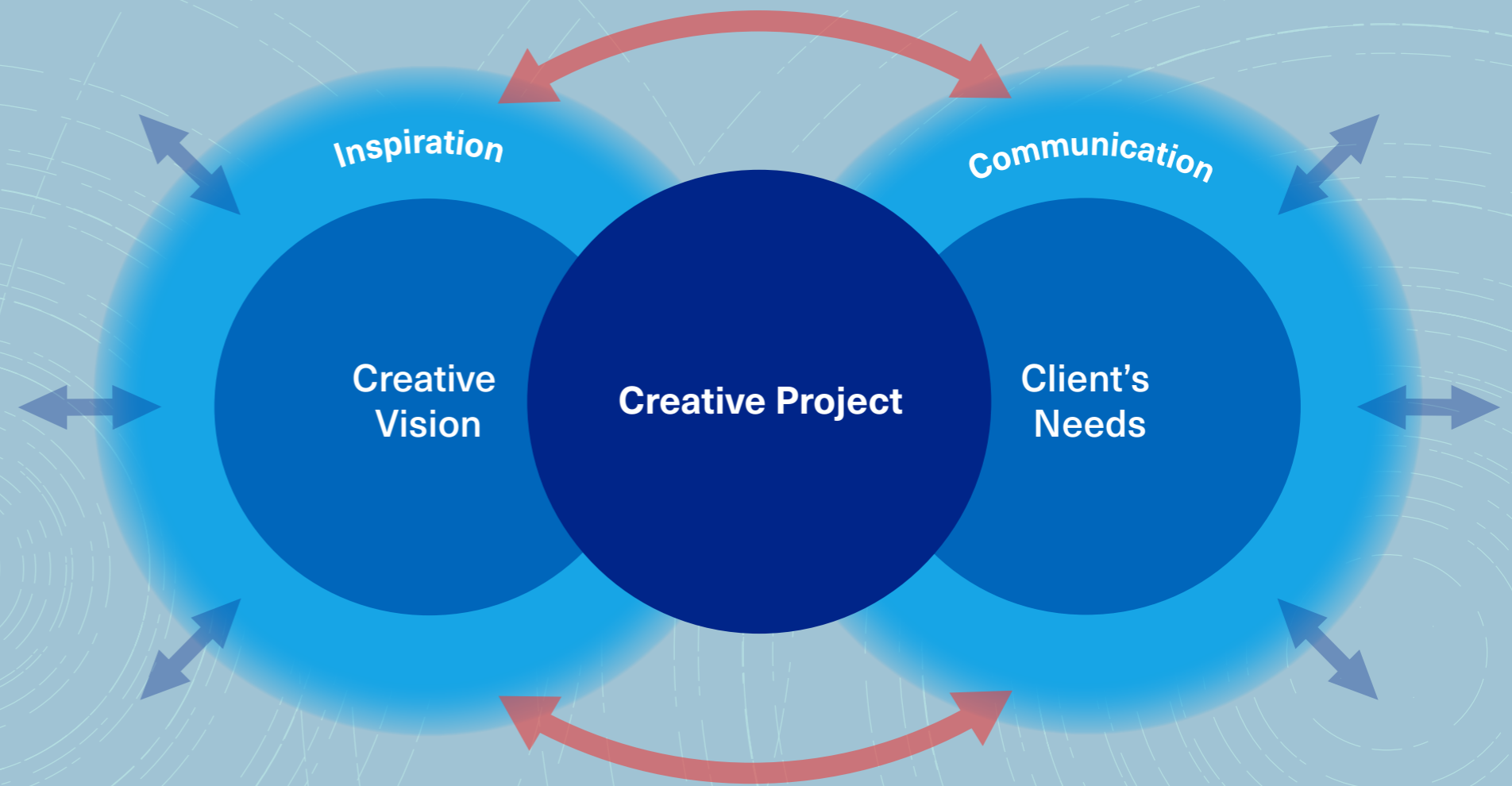
What, exactly, are the boundaries of creativity in the framework of a given creative project? Many factors come into play here: When the direct client is an agency, or the marketing department of a larger corporation, the contribution of the creative professional may have to integrate pre-existing decisions, branding elements or a corporate style-guide. In that case, the scope of creative intervention can be limited. That's also the reason why many respondents have a clear preference for working directly with smaller companies and start-ups, since this tends to afford them greater creative freedom in their work. Adapting pre-existing styles to a new format is rarely seen as creatively rewarding, and is repeatedly cited as tedious.

Most creative projects rely on permanent interaction between the creative professional and the client. When this interaction works well it is perceived as beneficial to both parties, and helps stimulate creativity. If, on the other hand, the interaction between creative professional and client is limited or inefficient, it slows down the creative process.

The creative project is based on vision, understanding and inspiration

Understanding the client's needs and dreams, and putting themselves in the shoes of the client's target audience is essential for creative professionals. This is what shapes their creative vision, and helps find inspiration. But the creative project is also shaped by technology: Technology defines what it is possible to create — and also what it is possible to deliver to the audience.

Both aspects are essential: creative professionals need to know how much of their creative vision can be realized in the given technology framework — but they are also tied to the increasingly complex demands of multi-format, multi-device content delivery. Understanding the dual role of technology in the creative process, both enabling and constraining, is essential, as it defines how creative professionals relate to the tools and technologies they use.



"Strategy drives creativity and thought-driven process, business need defines the rest."

Joe Lovelock

Creative Director, Studio Lovelock, London

Find your own limits / Be relevant / Experiment • Passion / Vision / Process • Make everything possible / Spontaneity / Dream • Unexpected / Connection / Openness • Exciting / Inspiring / Emotive • Unbiased / Making connections / Not being intimidated • Power / Happiness / Communication • Fun / Limitlessness / Ubiquity • Open-minded / Critical / Curious • Obsession / The bigger picture / Tools • Idea / Communication / Expression • Originality / Honesty • Art / Human Beings / Animals • Passion / Joy • Innovation / Visual / Life • Freedom / Combination • Images coming from my head • Interesting solution to a problem • Flow / Personal style / Being inspirational • Get started / Do it • Self-realization / Discovery / Fascination •

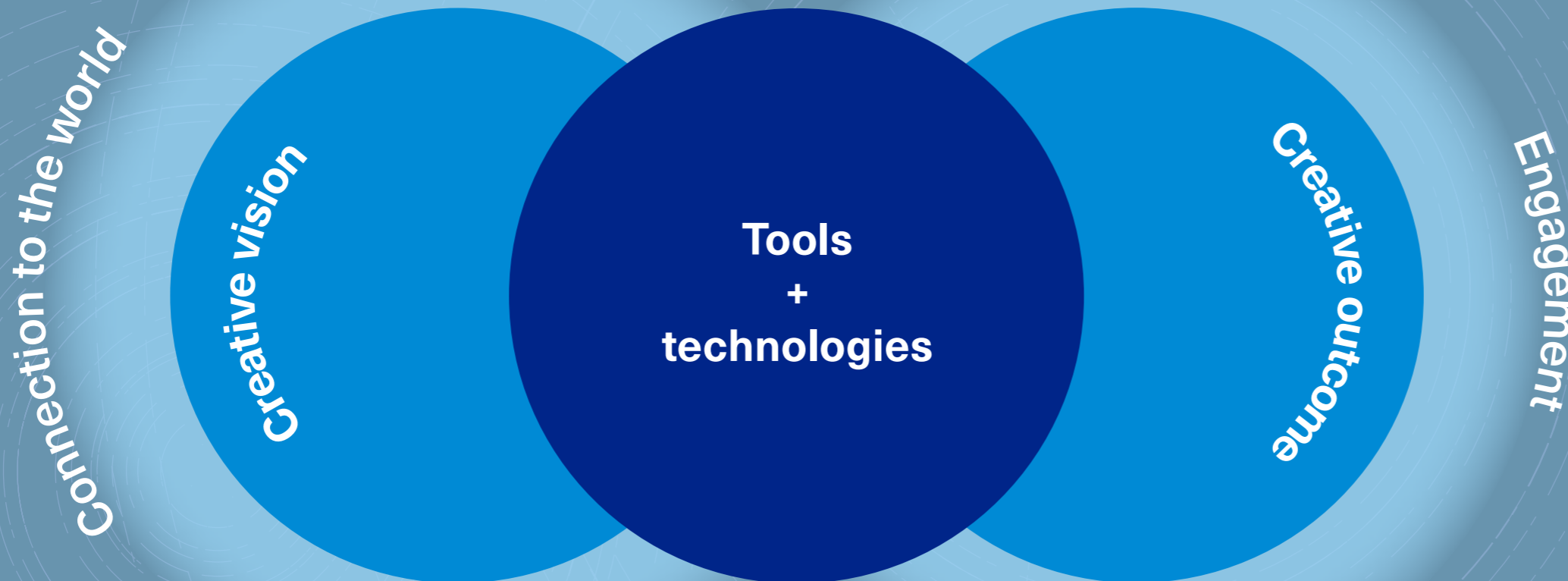
Three words

Curiosity / Trying something new • Imagination / Remixing / Freedom of mind • Imagination / Expression / Discovering something new • Going beyond your limits • Discovering something new / Searching • Collaboration / Curiosity / Awareness • Spontaneity / Inspiration / Not giving up (because it is impossible) • Freedom / Values / Pushing the limits • Freedom / Color / Form • Inspiration / Freedom / Conception • Communication / Exchange / Thought • Fearless / Unlimited / Freedom • Knowledge / Rhythm / Human • Imagination / Design Thinking / Communication • Freedom / Knowledge / Spontaneity • Feedback / Work / Weightless • Inspiration / Ideas / Joy • Experimenting / Creating connections / No fear of failure • New connections between ideas / Mental sparks • Inspiration / Execution / Passion • Teamwork / Images from my head / Problem solving • New / Inspiration / Thinking around corners • I'm a human being, not a machine • Originality / Depth / Future • Freedom of constraint / Daring / Forward thinking • Idea / Communication / Expression • Innovate / Being unique / Rare • Inspiration / Exploration / Execution • Inspiration / Unexpected / Exciting • Thoughtful / Unique / Expressive • Spark / Exciting / Life • Curiosity / Discipline / Vulnerability • Unique / Inspiring / Inventive • Curiosity / Joy / Enthusiasm • Inspiration / Preparation / Perspiration • Ideas / Freshness / Composition • Innovation / Disruption / breaking patterns / Surprise • Smart solutions / Unconventional / Unique • Spark / Light / Inspiration • Process / Knowledge / Innovation / Ambiguity • Outside of the box / Draftsmanship • Expression / Style / Attitude • True / Freedom / Fearless • Manipulation / Sweat / Rethinking the world • Uniqueness / Individuality / Self-expression • Spontaneity / Freedom / Good communication • Connection / Craft / Creation • Connection • Expansive / Generative / Evolutionary • Freedom / Expression / Fun • Energy / Sex / Imagination

We asked all of the participants in the research to spontaneously think of 3 words that capture the essence of creativity for them.

Here they are...

Creativity and technology



What technology means for creative professionals

Creatives see technology as essential to their process. Technology — the combination of software, hardware and on-line services — is the essential toolbox for creative professionals. These are the tools they rely on, day in, day out, to get their job done, and they tend to have a strong relationship with their tools. Hence strong loyalty to the tools of choice — but also sometimes criticism when they don't perform as expected.

Creative pros rarely turn to software features in search of inspiration: However important software tools are for them, they don't look to the tool to fuel their vision. Rather, creatives tend to look for inspiration outside of technology.¹ Software features become important, on the other hand, once they are adopted and become part of the core tool-set; new features or creative options are considered only if they are perceived as immediately useful, and strongly resonate — or if there is a strong necessity to do so.²

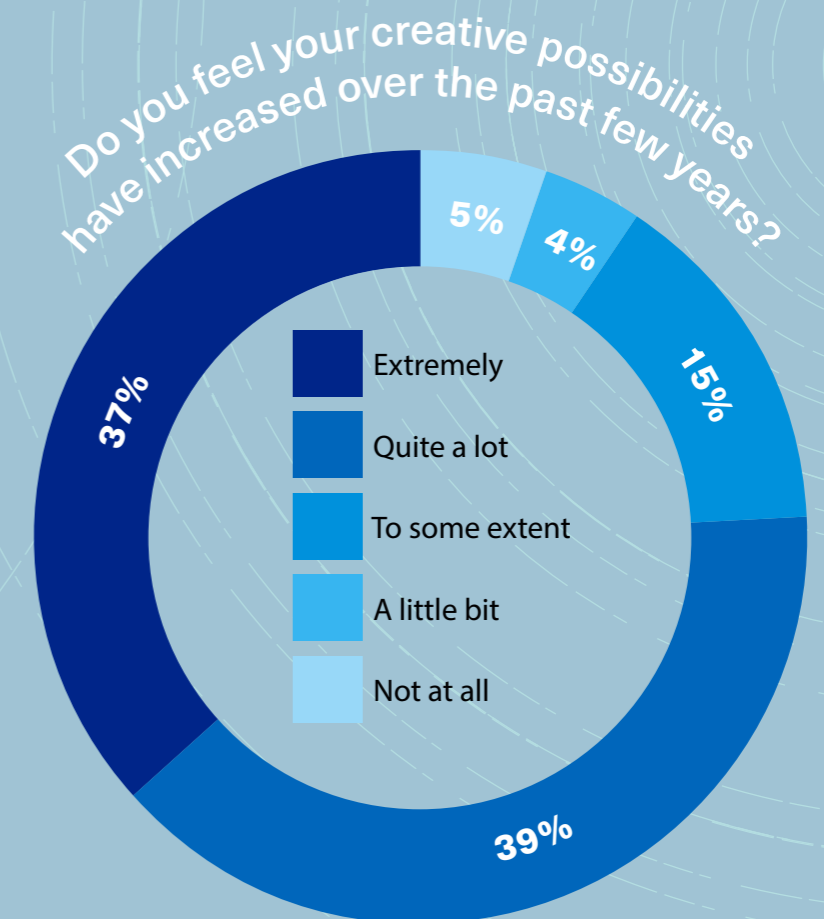
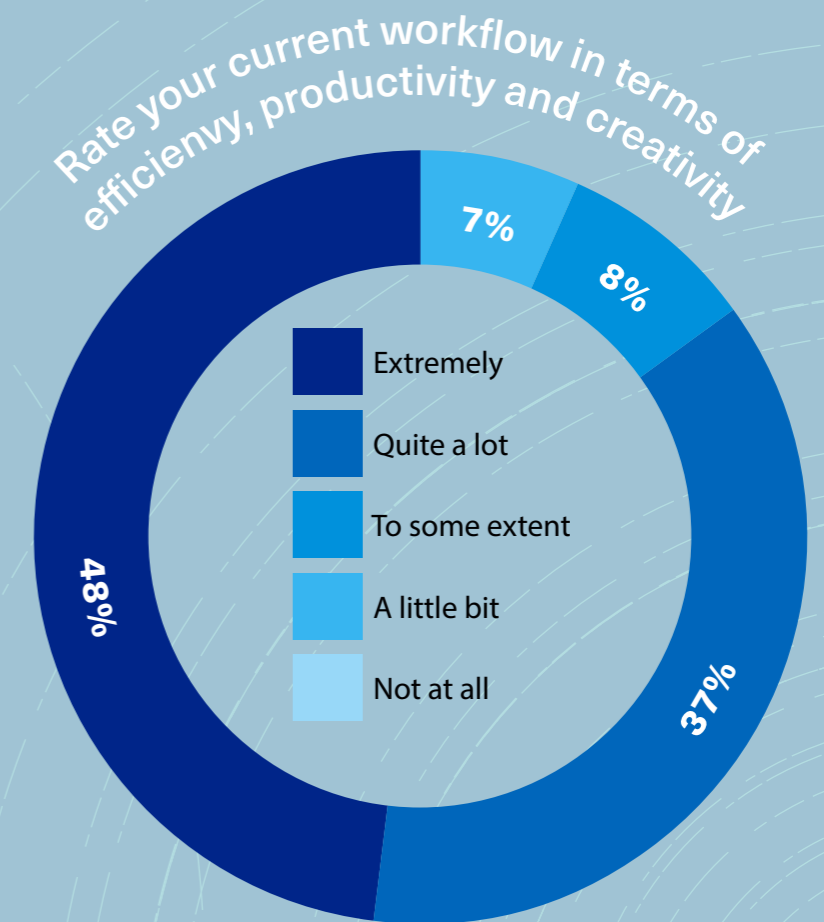
In other words, creative pros generally aren't feature-focused, but outcome-focused: They need to be able to realize their personal creative vision; new software features not only are rarely seen as inspiring, they carry the potential of disrupting the flow of creativity and disturbing reliable production processes.

¹ On-line resources, such as Behance, Instagram and Pinterest are not perceived as tools, but as a way to connect to the world and to find inspiration.

² There is another perceived threat linked to new creative software features that aim at innovative visual effects: The fear that easy effects will turn into fads that will be used widely, thus undermining the perceived originality of a project that uses them. This is particularly true in fields such as motion graphics or CGI.

"If software was built around a creative's mind it would never function."

Kristine Arth
Founder & Principal Designer, Lobster Phone



What do creative pros want from technology?

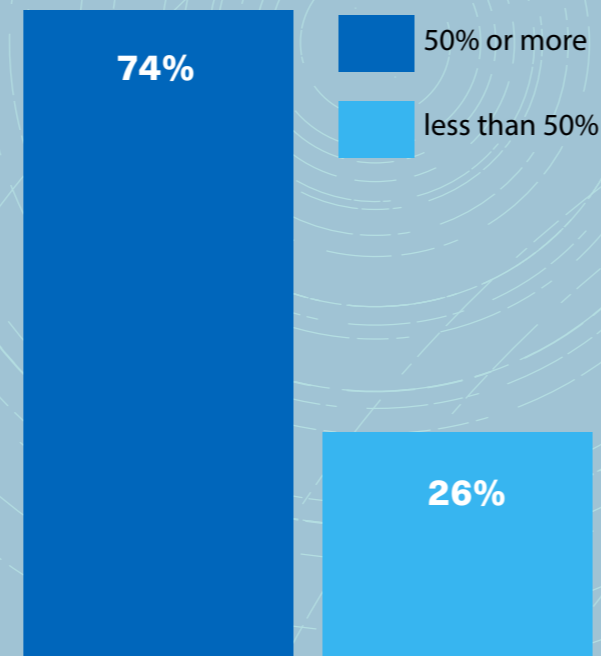
In a nutshell: To get the job done. The most important role of technology is to execute the vision, but not to get in the way of creativity. Creative professionals need to execute a project as quickly and smoothly as possible, and one of the frequently cited concerns is technology that doesn't behave as expected.

Productivity can be a "killer feature": Any software option or new technology that reliably reduces existing workload is likely to be very popular, especially when it targets operations that are widely perceived as tedious. This also applies to current bottlenecks, such as image search or learning new features, where AI is perceived as potentially very useful.

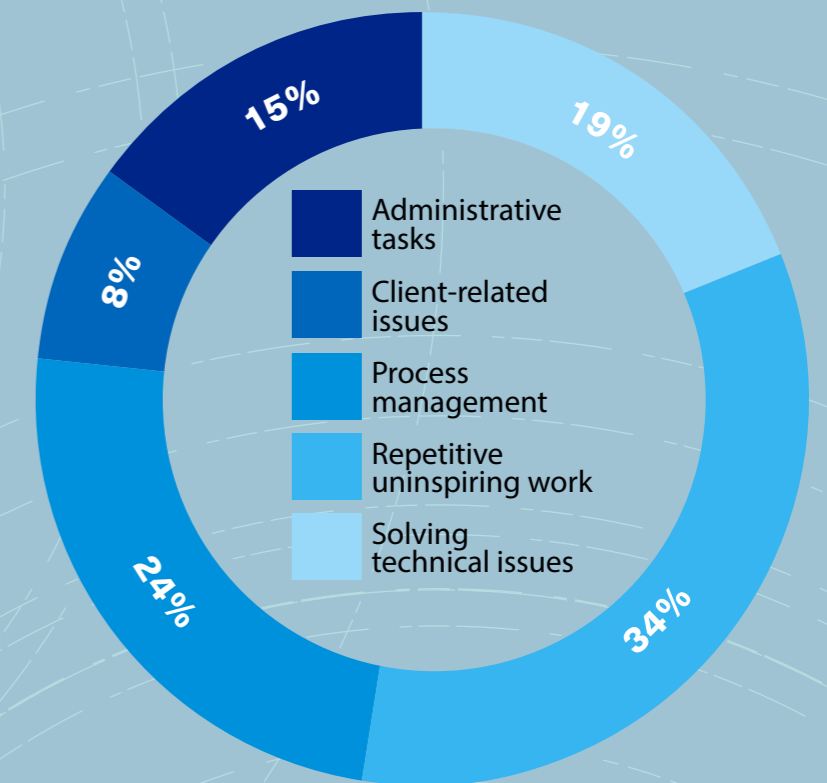
In short, there is a clear expectancy that technology should be there to serve the creative. Given the complexity of the modern media and device landscape, creative projects almost always include many phases of complex iteration, adaptation and process management that are consistently cited as the most tedious part of the creative project. Whether managing Photoshop files with dozens of layers, or coordinating the transfer of hundreds of assets from one system to another, the flow from creative intent to final, delivered outcome is a complex one, and can be more optimized. Many of the tasks involved in this transformation involve time-consuming manual operations, which are frequently perceived as tedious or mind-numbing. And that is also the specific area where creative pros see the greatest potential for AI and machine learning in their creative processes.

Yet this possible reduction of repetitive tasks is not viewed by all respondents as a positive: For some creatives, working through the repetitive steps required by the execution of a creative project is seen as useful and necessary. As one designer put it: "Not everything should be made too easy. The trial-and-error process linked to technology is actually important for the creative process. Errors are important, don't take them away."

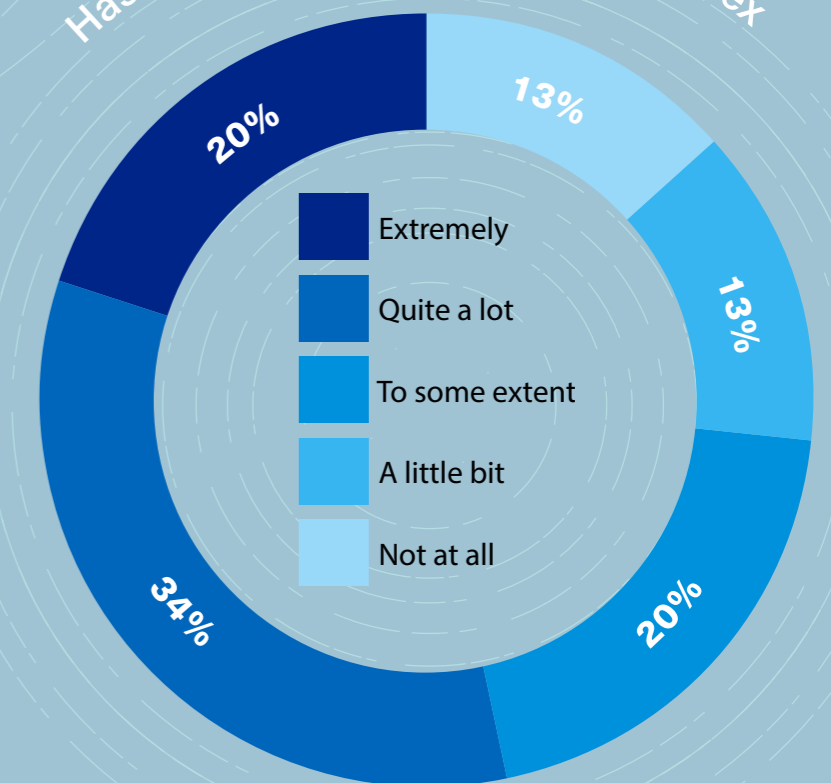
How much of your work is spent on repetitive, uncreative tasks?



What do you find tedious in your work today?



Has your work become more complex over the years?



"Technology is useful if it creates abilities that didn't exist before."

Evan Abrams
Motion Designer & Instructor

How do creatives view AI and machine learning?

Attitudes to AI and ML in general

To introduce the subject of artificial intelligence and machine learning (ML), we asked the participants in the research first how closely they followed the subject in general. Few of the respondents had a clear idea how AI and ML could be directly applied to their field of activity, but there is a clear perception that these are immensely important developments that will affect many areas of human activity.

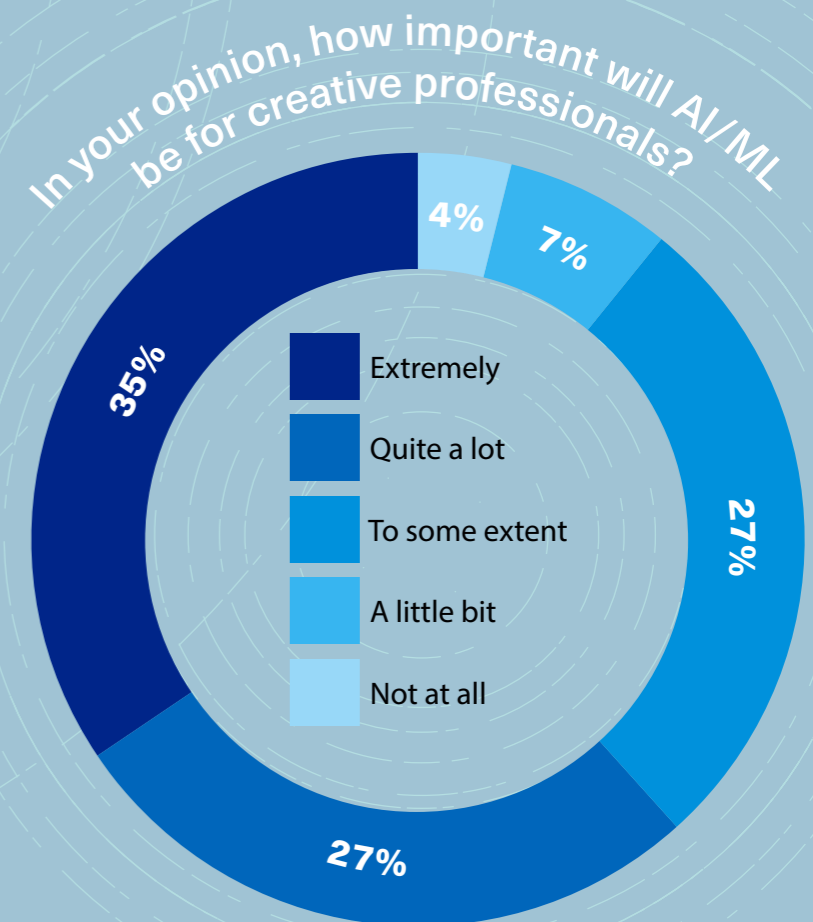
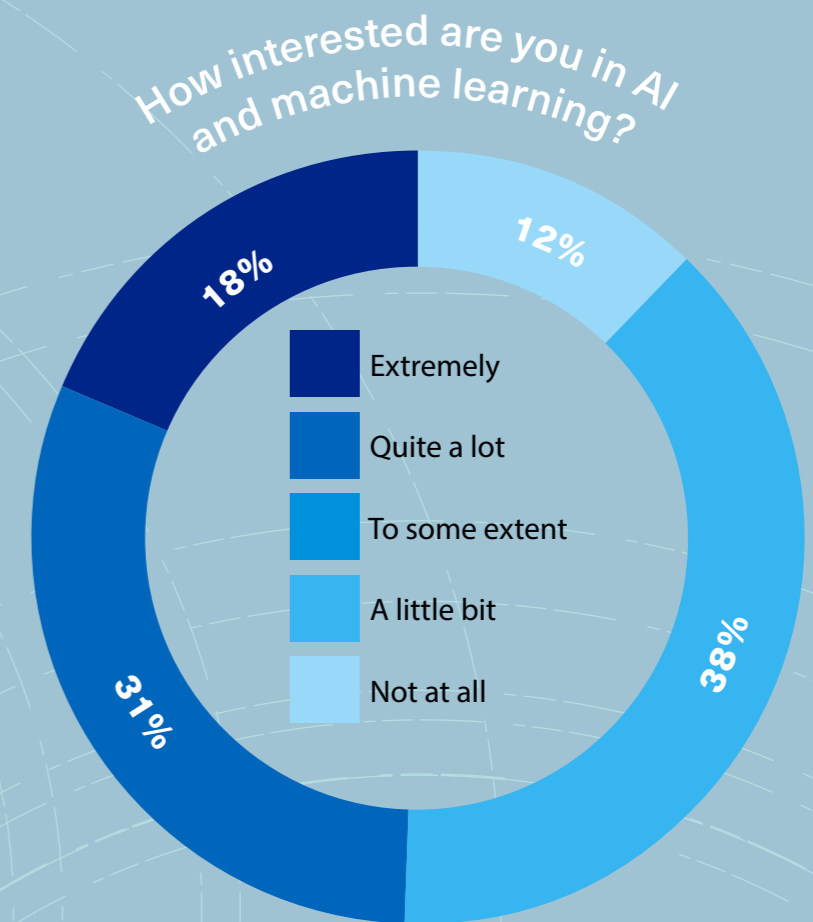
Only a relatively small number (18%) of creative professionals proclaimed a vivid interest in AI and ML — but interestingly, even fewer (12%) say they are not interested at all. On the whole, creative professionals participating in this research feel that AI and ML are technology transformations that are very important, but they are not yet sure how it will change the way they work.

On the other hand, there is little doubt in their minds that AI and ML will have a considerable impact: Over 60% of respondents said these developments will impact the way creative professionals work quite a lot or extremely — and only 4% think it will have no impact at all. It is hardly surprising, then, that the number of interviewees who would be strongly or very strongly interested in having a head-start in AI is even higher, at 63%.

It is also important to point out that many creatives stated they can imagine AI and ML affecting some parts of their current way of working. They also see it as a healthy challenge, and as a way to prove what human creativity can do. And some see this challenge as an invitation to “swim against the current”, to go in the opposite direction of AI and ML-based developments.

“AI will shift the designer to be a creative director. That will shift the focus from creating to decision-making — but no AI will supplant human decision-making.”

Evan Abrams,
Motion Designer & Instructor



How creative professionals view Adobe Sensei

About Adobe Sensei

Sensei is the umbrella-term that Adobe has chosen for the developments based on AI and machine-learning the company has been working on for several years. Part of this research, which was funded by Adobe, was to expose creative professionals to some of these developments, and to collect their impressions and thoughts.

Introduced in the last part of the research interviews, respondents were shown several videos of features based on Adobe Sensei, targeting specific parts of creative workflows such as style transfers from one image to another, new methods of searching for images on Adobe Stock based on machine learning, automated rotoscoping or physics-simulation-based graphic arrangements, among others.¹ We also provided context to Adobe Sensei developments, the techniques that were used, and Adobe's general approach to these developments.

How is Adobe Sensei perceived?

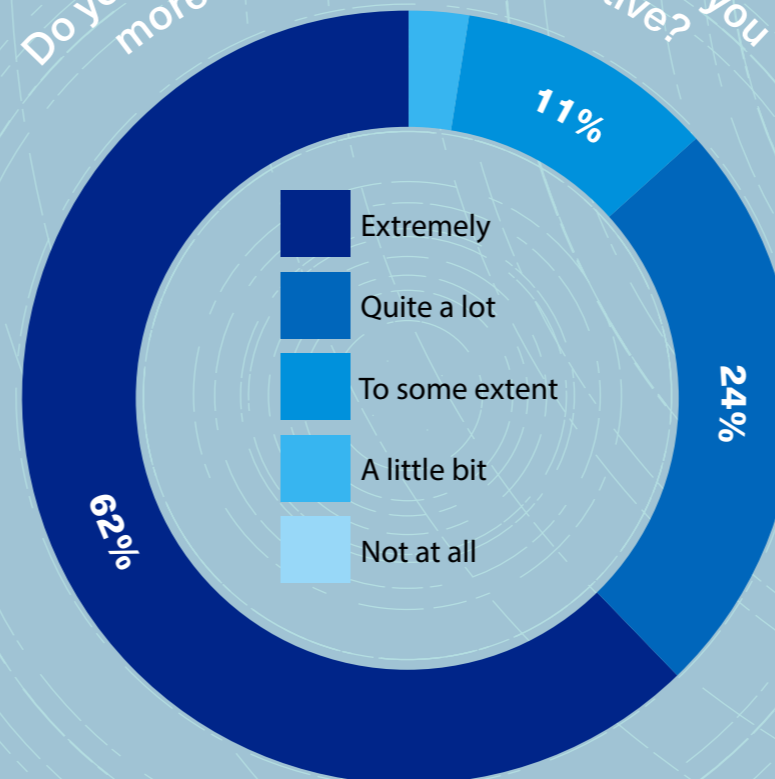
While relatively few creative professionals had heard about Adobe Sensei, and most of them had only a vague idea what it is exactly, once they were shown concrete examples of what Adobe Sensei can achieve, 66% of respondents said they were extremely interested in what these developments can bring. Only very few (7%) were only a little bit interested, or not interested at all.

Adobe Sensei is widely perceived as having the capacity to reduce a lot of the drudgery involved in the production of creative content, and it is clear that creative professionals are eager to embrace these developments: Over 62% thought it was extremely likely that Adobe Sensei would make them more productive.

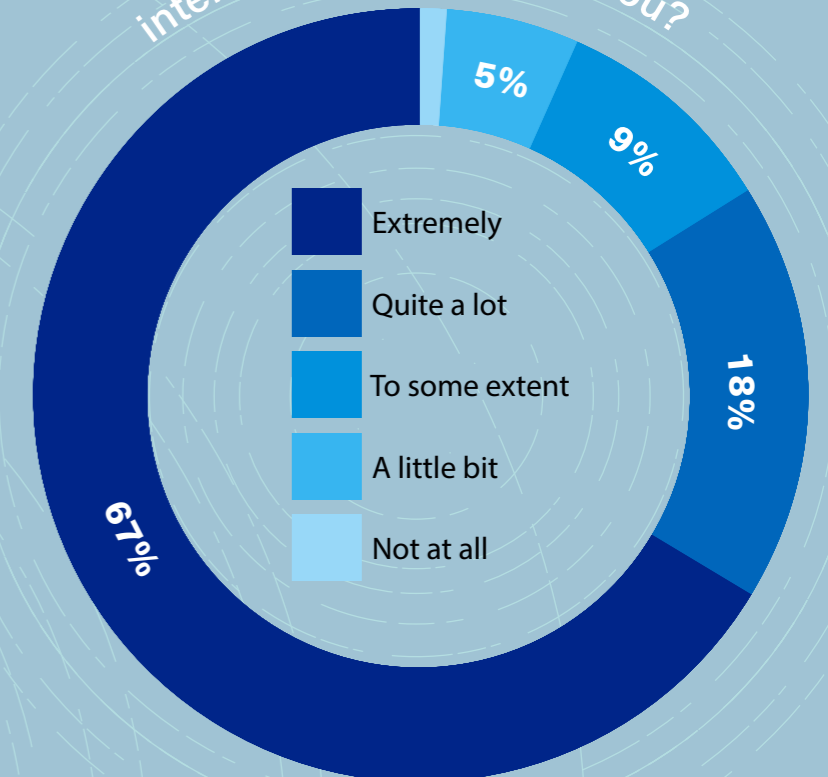
Responses to the question "Do you think Adobe Sensei can make you more creative?" were more diverse. Only 27% of respondents felt relatively certain or certain Adobe Sensei would make them more creative — but many creatives stated they felt Adobe Sensei could contribute to their creativity by executing mundane tasks for them, thus freeing up more time for creativity. A majority of creative professionals were very eager to experiment with these new developments.

¹ The following demos from the 2017 Adobe MAX Sneaks were used: 'Project Cloak', 'Concept Canvas', 'Project Lincoln', 'Project Puppetron', 'Project Scribbler', 'PhysicsPac', 'SceneStitch', 'Select Subject' and 'SkyReplace'. The videos used can be viewed at <https://bit.ly/2NAAyCY>

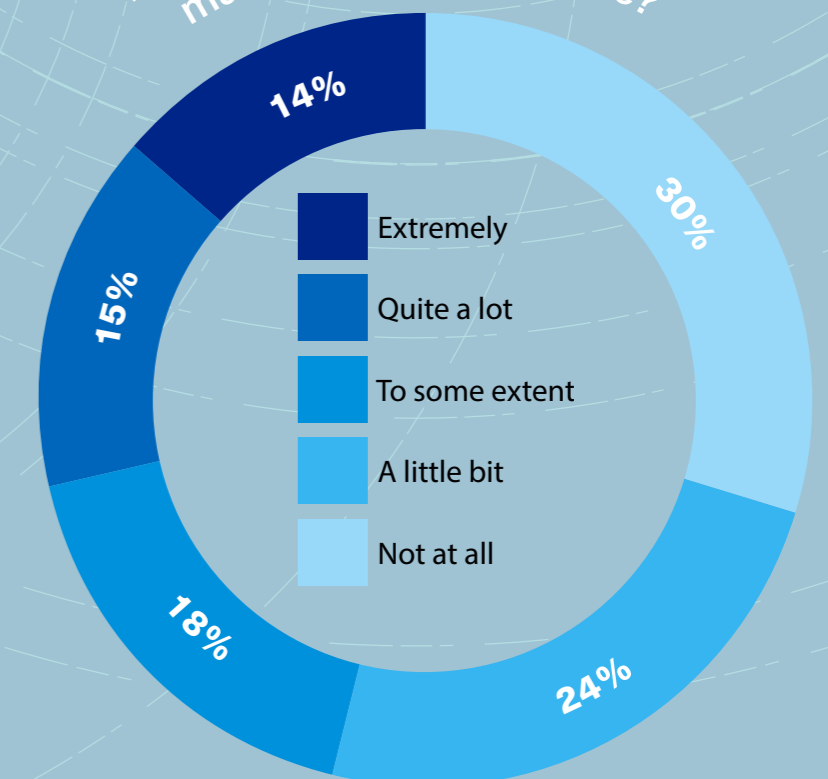
Do you think Adobe Sensei can make you more efficient and productive?



From what you have seen, how interesting is Sensei for you?



Do you think Adobe Sensei can make you more creative?



Perceived threats of AI and machine learning in the creative field

While creative professionals may not be worried about their job, the research shows considerable concern about possible side-effects of applying AI and machine learning to creative tasks: There is relatively widespread fear that AI will have a leveling effect on creative output, and could lead to a new level of homogenized, machine-driven mediocrity in visual production, that will allow almost anyone to produce good-looking results. The question is, will this make the differentiation between machine-produced output and the work a creative professional provides harder to perceive, especially for the untrained eye.¹

The concern is the leveling effect of AI on the way visual output looks, which in turn could lead to a devaluation of human creative skills. Professionals are afraid of losing control over the creative part of the process, and do not want to be dictated by the machine.

While the most prominent, it is not the only aspect of AI and machine learning developments that raise concern with creative professionals. Participants frequently cited the necessity for privacy safeguards and a clear policy regarding data collected from users. Some designers are also worried that AI-based tools will make it much easier for their personal style to be copied and duplicated.²

“AI will have an impact, but only on productivity. The creative vision will have to be there first “

Sherri Morris

Chief of Marketing, Creative & Brand Strategy, Blackhawk Marketing

“Personal creativity cannot be imitated by technology. It’s not because you know the tools that you are a designer.”

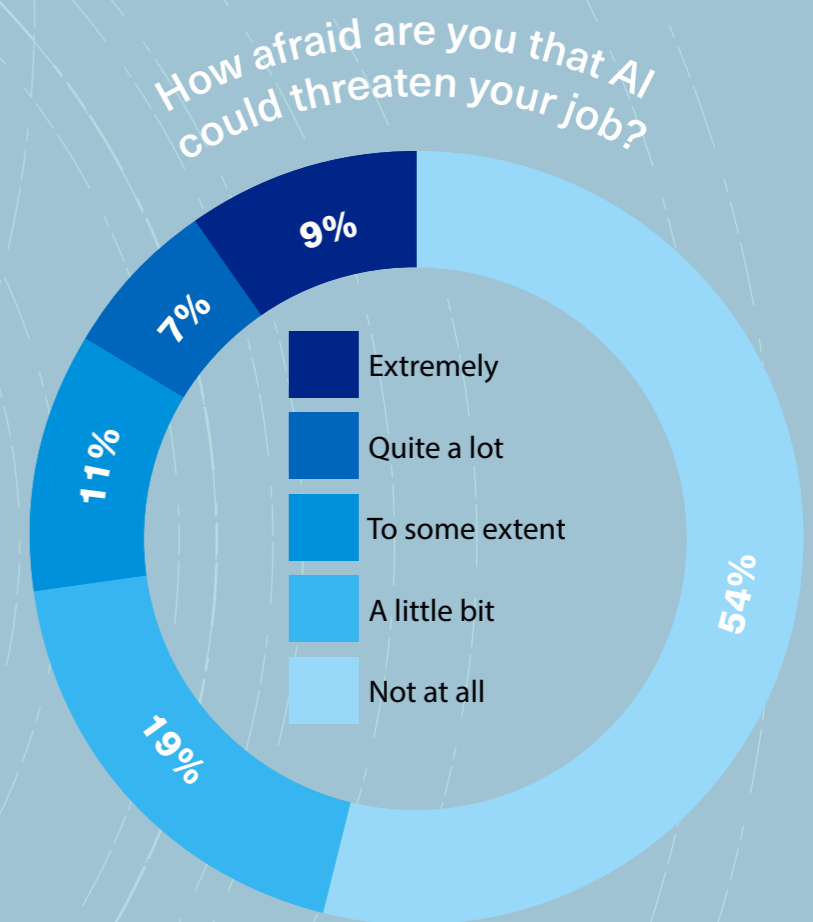
Christoph Gey

Art director, Cologne

“The threat of AI: Being reliant on doing/creating something for its own sake, instead of considering why we are doing it”

Joe Lovelock

Creative Director, Studio Lovelock, London



¹ A similar trend is often mentioned in this context, the move from hand-crafted websites to template-based developments that are less costly, but have had an important leveling effect on the way web-sites look today.

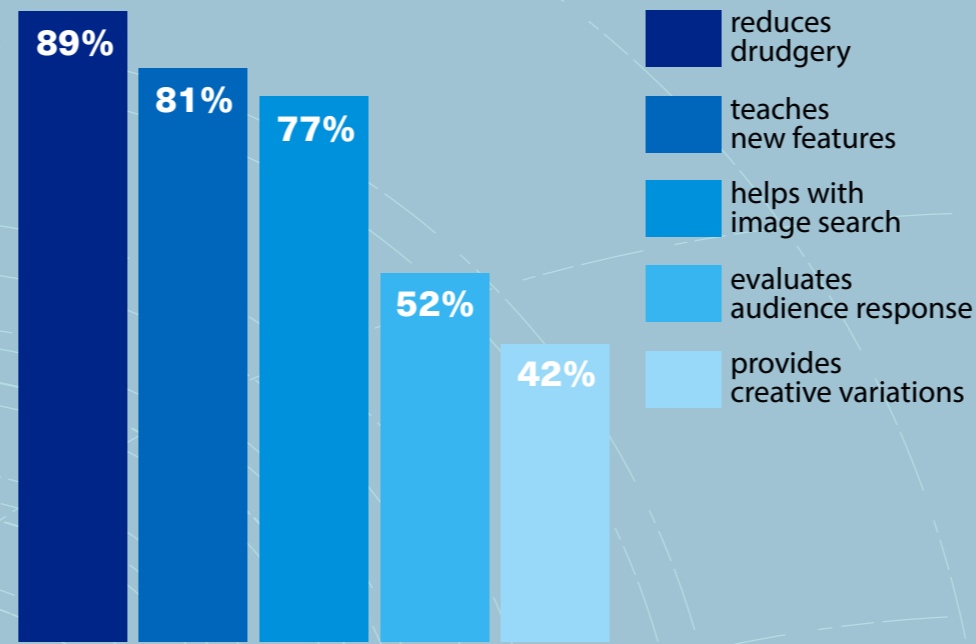
² One designer made the suggestion Adobe should develop an agent that uses machine learning to help creatives track on the internet where their style has been copied.

Attitudes to AI-based creative assistants

For this segment of the research, we provided respondents with context about the notion of an AI-based creative assistant. We asked them to imagine a machine-learning system that would offer targeted help with a variety of tasks, based on what the system had learned. The questions we asked respondents were first of all their general willingness to work with such a system, and then to rate the perceived usefulness of different types of creative assistants.

While a small number of respondents found the idea of working with a creative agent slightly odd or creepy, most of them are clearly willing to give it a try — under two conditions. First, the creative assistant would have to be much better than the current crop of voice assistants such as Apple’s Siri, or Alexa on Amazon devices. The second point is much more essential, and was voiced by a large number of respondents: In order for them to use such a system, it would have to be on their terms, and controlled by them. They do not want an always-on system that might interrupt their work, but rather one they can call upon when they feel the need.

Are you interested in an assistant that ...



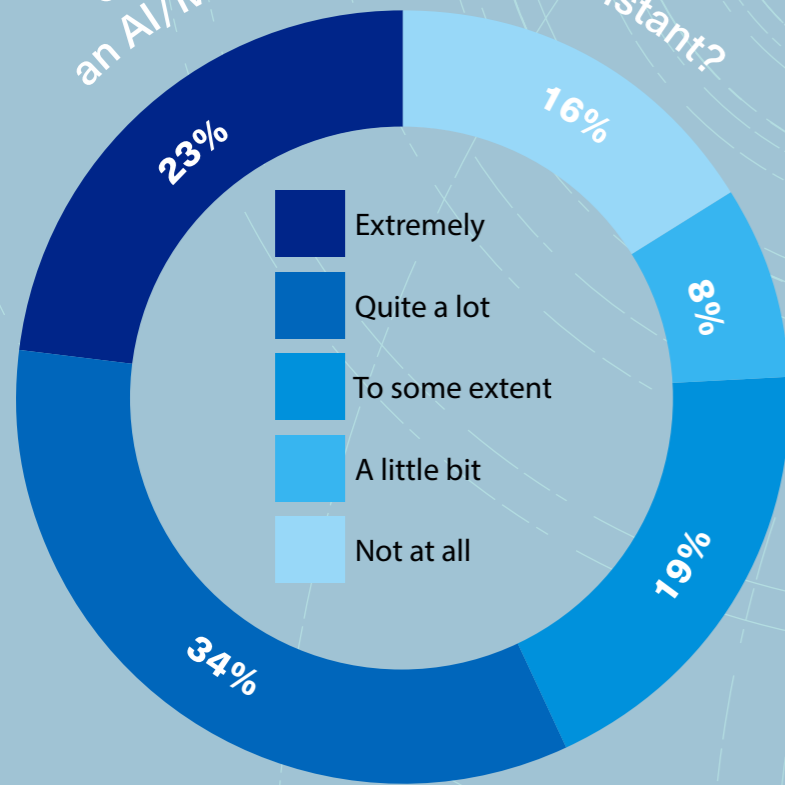
Of the different creative agents suggested during the research interviews, the clear favorite would be an assistant reducing drudgery and repetitive tasks: 89% of respondents said they were very or extremely interested in such a system. For creative professionals working frequently with stock images, or other materials such as fonts found on the web, AI and ML-based help with these tasks would be very welcome: 77% of respondents indicated strong interest for such an assistant. Assistants teaching new or unexplored features in their software also received strong approval ratings.

Things were less clear-cut with assistants providing creative variations based on a project at hand, triggering an almost equal amount of very positive and very negative appreciations. However, many of the interviewees said they would certainly try such an assistant, but they probably wouldn’t rely on it, since they want to stay in control of the creative part of their work.

One of the suggested creative assistants that drew the most interesting comments was a system that would help to anticipate different types of audience responses to a given project, based on machine learning. While some respondents (almost 18%) had spontaneous strong negative reactions to this type of assistant, over 35% stated extremely strong approval. What was particularly interesting, however, were the suggestions for the type of information the respondents would like to receive using such an assistant: Several designers mentioned they would like to test the uniqueness of a design; some creatives working on video and motion-graphics would be interested in testing when the level of attention might drop while someone watches a clip. And UX designers, finally, would welcome testing the coherence and intuitiveness of a user interface design.

In any case, the discussions about digital assistants were in many cases lively, and showed to what extent there are many perceived bottlenecks in creative projects that creatives would love to have AI/ML-based help with.

Could you imagine working with an AI/ML-based creative assistant?



“I would be interested in agent that teaches new features — but it would need to teach me not only what to do, but why it is important.”

Kristine Arth
Founder & Principal Designer, Lobster Phone

“I would love an assistant that helps me get to a given result faster.”

Juan Diaz-Faes
Graphic designer and illustrator

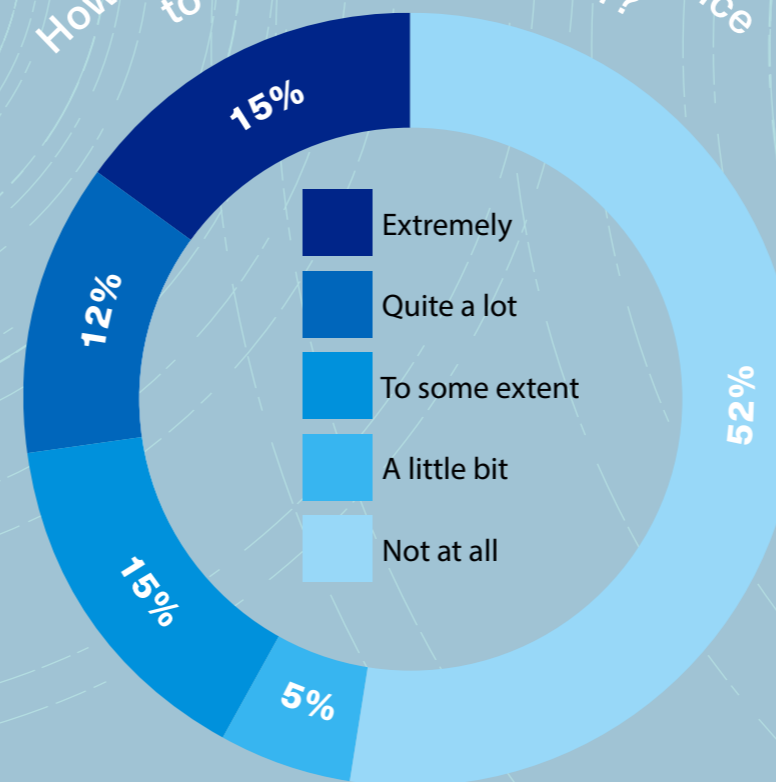
Attitudes to voice interfaces

The final question concerning the use of AI-based developments concerned interacting with the computer/software with their voice rather than using keyboard and mouse. A majority of respondents clearly stated they had no interest in using such a system, partly because their experience with voice interfaces such as Siri and Alexa were not perceived as efficient.

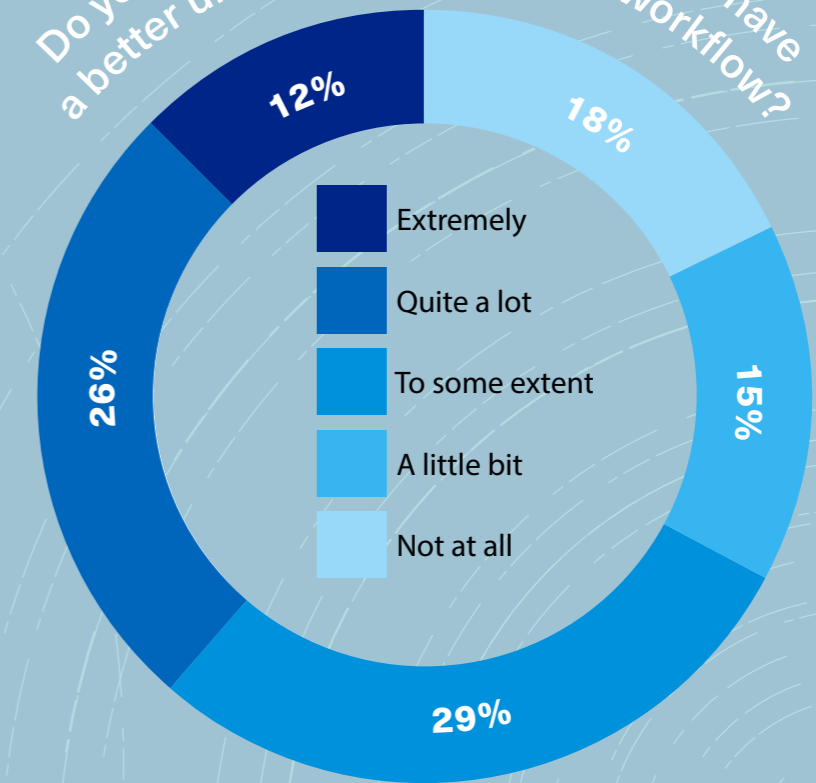
It is interesting to point out that there is a clear geographic difference between respondents from the United States and Europe in these responses: Over 43% of respondents in the United States said they were somewhat or very interested to use a voice interface with the computer. In Europe only 16% of interviewees made the same statements, while almost 60% said they had no interest at all.

Interviewees in the US were clearly more open to the idea, and also had a more differentiated approach to the way they might like to interact with the computer using their voice, providing tangible suggestions for the way it should work. The way it is imagined by some of the respondents is not for voice commands to replace what can be more efficiently achieved using mouse and keyboard, but rather, accelerate specific tasks, such as switching tools in an application, or issue file-management related commands such as "Save file as TIFF to project folder".

How do you feel about using your voice to control the computer?



Do you feel that your software should have a better understanding of your workflow?



Creativity and artificial intelligence: Analysis and perspectives

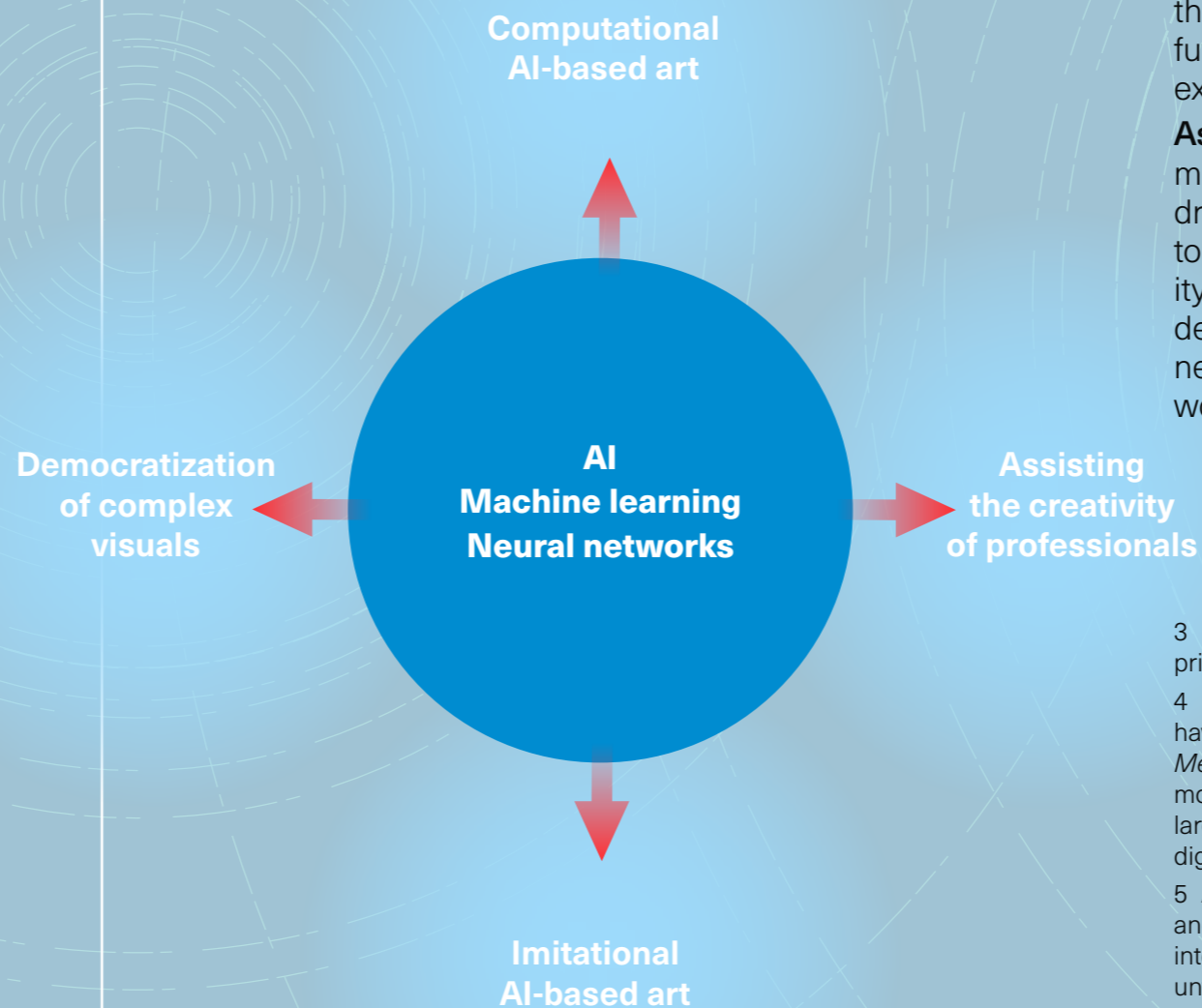
Where do we go from here?

Trying to understand creativity is difficult enough; attempting to predict how it will evolve in the future it is an exercise in futility. Yet given the nature of this research, and the amount of first-hand data collected, it seemed equally impossible not to attempt some form of outlook analysis based on what we have learned.

What AI and machine learning can achieve in the creative realm

AI, machine learning and neural networks have begun to enter the creative realm in a variety of ways, all of which are bound to have a significant impact not only on what kind of visual output is created, but also how it is perceived, and what role it plays in society.

Computational AI-based art: While the field of computational art has been around for decades, the use of AI and associated technologies is relatively new, and used by a growing number of artists, such as Pierre Huyghe¹ and Mario Klingeman². They generate visual output entirely based on neural networks, machine learning and other computational processes to create intriguing and often stunning work. There is no doubt that this field is likely to grow significantly over the next decade. On the other hand, it is not yet clear if it will interfere with traditional methods of producing art, or rather (as is likely) extend artistic practice into new dimensions.



Imitational AI-based art: Efforts to produce output that mimics (with varying degree of success) existing styles of conventionally produced art are also developing rapidly. Sometimes technically very impressive, (such as the AI-based “Rembrandt”³ that went on sale at Christies) this kind of visual reverse-engineering is in fact closer to sophisticated reproduction⁴ than to human creativity—yet highlights questions that can be disturbing about the essence of a work of art⁵.

Democratization of sophisticated visuals: AI and machine learning have the potential of making the creation of very sophisticated visuals available to casual users. By applying techniques such as style transfer and other machine-learning-trained methods to generate visuals that would have been very time-consuming to produce even for a skilled professional, AI and machine learning are lowering the barrier of entry to an extent that may lead to the devaluation of skills and expertise of creatives. It is likely that these developments will increase significantly in the future, and will have a distinct impact on the way creatives express and manifest their unique creative talents.

Assisting the creativity of professionals: Finally, AI and machine learning can be used to liberate creatives of drudgery, complex execution and organizational tasks, to allow them to focus more of their time on their creativity. While of the four examples listed here, this last set of developments is the least immediately spectacular, it will nevertheless have a strong impact on the kind of creative work that is produced.

1 <https://www.serpentinegalleries.org/exhibitions-events/pierre-huyghe-uumwelt>

2 <https://www.wired.com/story/neurographer-puts-the-art-in-artificial-intelligence/>

3 <https://www.wired.co.uk/article/new-rembrandt-painting-computer-3d-printed>

4 With respect to the notion of original and reproduction, it is worth having another look at Walter Benjamin’s “*The Work of Art in the Age of Mechanical Reproduction.*” What Benjamin observed in 1935 considering modern media such as the newspaper, radio and photography is still largely applicable to the notions we struggle with when we are discussing digital media and computer-generated art.

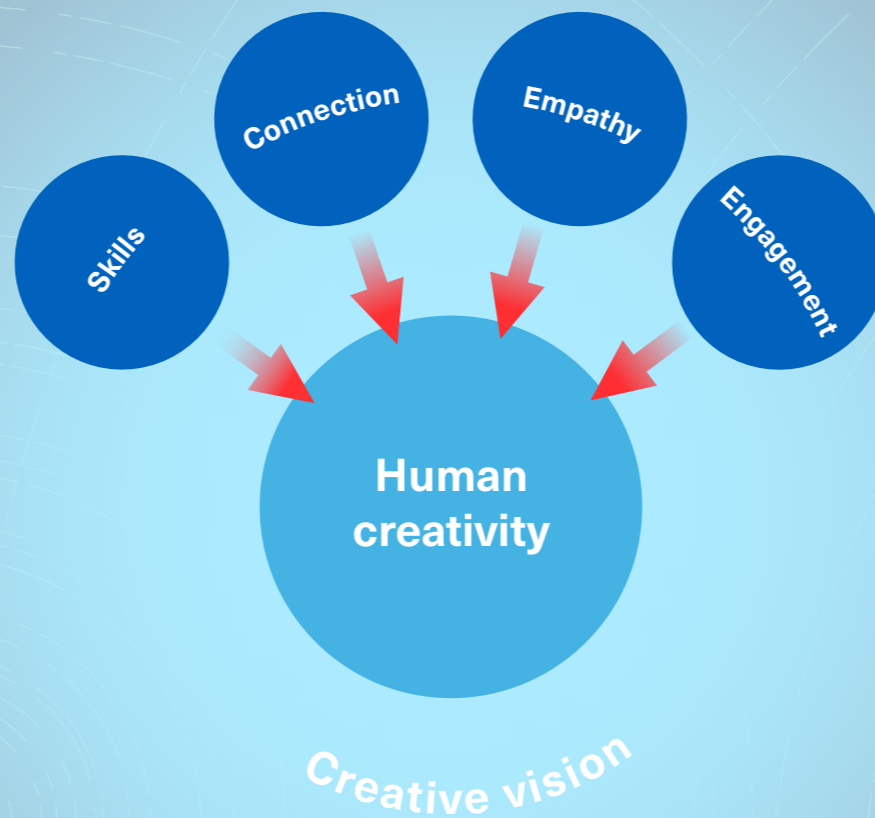
5 As technology pairs recent developments such as 3D printing with AI and machine learning, the question of the nature of the artwork comes into full focus: If the visual outcome gets so close to the original that an untrained eye might not see the difference, does it become real? Can you call a painting produced in 2018 a “Rembrandt”, just because it mimics stylistic characteristics? Or is it just an astute form of forgery, where the AI-based tools replace human forgers’ knack for capturing the look and feel of a particular artist? Finally, are we entering a completely new phase in mining the artistic achievements of the past, requiring us to redefine core concepts about art from the ground up?

Possible impact scenarios

To assess the impact of these different fields of AI-based developments on the creative realm in general, and on creative professionals in particular, we should first look at them individually, before attempting to analyze possible areas of ripple effects and cross-pollination..

Already in its current state, computational AI-based art is a fascinating field that is likely to inspire a wide range of emerging artists. Yet, as of today, there is a high entry barrier in order to produce works like the ones cited above, and such work requires a very specific mind-set and disposition, as well as considerable technical knowledge. In that sense it can not yet be considered a readily available tool for artistic expression — but it is only a question of time before “consumer-level” programs and technologies allowing to mine machine learning and neural networks make their way into the mainstream⁶, and start shaping what artists and creatives produce.⁷

The situation of imitational AI-based art is more complex. At the highest level it requires not only access to the original artworks, but also teams of specialists, cutting-edge technology and many months of collective effort. Given these constraints, it will take many years before these developments become accessible even for companies or institutions with considerable funding — let alone creative individuals. Yet ML-driven functionalities that allow specific style elements to be transferred from an existing image to another are starting to appear on-line⁸. Similar functionality is likely to show up in apps like Photoshop quite soon, as Adobe’s “Project Puppetron” demo at Adobe MAX 2017 suggested.⁹



“Of course I’d take into account what an AI system would suggest for my work — and then I would do the exact opposite.”

Nick Adams
Chicago Graphic designer

Depending on how this feature will be implemented, it could have wide-ranging ripple effects in the creative community. Making style transfer available as a push-button option could have a considerable impact on how creatives format multiple elements requiring a consistent style, thus speeding up their workflow — yet in the process running the risk of reducing the kind of creative accident that is often seen as a positive force in the creative process. On the down-side, depending on the power and implementation of such a feature, it could also facilitate plagiarism, a concern that has been voiced repeatedly during the research interviews.

But on the other hand, a style transfer feature could also allow improvised creative experimentation that would be impossible without the help of AI and machine learning. As one designer put it: “*Creativity does not necessarily mean using a tool for its intended purpose.*” Subverting tools and letting creativity run rampant in ways unintended by the developers is likely to lead to results we would have a hard time imagining now.

Positive and negative impact of the democratization of tools

The threat some see in the impact of AI and machine learning on human creativity is not new. The history of computer-based visual creation is shaped by the democratization of tools, making the production of sophisticated designs ever easier and more accessible. Starting with the first wave of page layout and vector design tools over three decades ago, this evolution has had an extremely liberating effect — but in its wake, countless professions have been challenged, and in some cases utterly devastated.

But democratization is not the only issue here. Increasingly, we can witness two kinds of creative tools: those aimed at the creative professional — and those targeting completely inexperienced users. This last group also includes apps that are not openly labeled as “creative”: Instagram and Snapchat have become creative platforms for millions of users who live happily with the limitations of the apps, and still manage to express their personal creativity. Similar considerations can apply to the increasingly powerful cameras in recent smartphones, that offer automated processing options for very sophisticated results, which previously would have required professional equipment and years of experience before.¹⁰

6 <https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html>

7 It is also quite possible that these computationally produced works will have an impact on traditionally created art, as observed in an article on Pierre Huyghe’s *Umwelt*: “...*Umwelt turns out to be a show of great beauty... the gallery-goer emerges from this most abstruse of high-tech shows with a re-invigorated appetite for the arch-traditional business of putting paint on canvas*” Simon Ings, Financial Times <https://on.ft.com/2Pdom7U>

8 <https://deepart.io/>

9 <https://www.youtube.com/watch?v=kAcTtEXFYIE>

10 See also: Adobe demo video on the future of mobile portrait photography, enhanced by AI and machine learning. <https://www.youtube.com/watch?v=DQ8va2ipK8I>

Yet we are only at the beginning of AI-driven creative functionalities. And as they expand, it is clear that they will amplify a trend that has been reported by numerous creative professionals during the research: Everybody feels like a designer now, and thinks what can be achieved with simplistic tools is to be considered at the same level as the fully structured creative project of a professional.

We are facing some far-reaching implications here: Traditionally, creative professionals are being considered and valued on the strength of the visual aspects of their work — yet it is becoming increasingly clear that what really counts for the appreciation of their work goes well beyond cool looking visuals.¹¹ But what that implies, in the long run, is that creatives need to find different signifiers for their capacities — and also on-line resources allowing them to show off their talents in other aspects than visual execution.

But there is another implication to this trend, which directly concerns software developers: The more AI and machine learning start to dominate the way visuals output is produced, the more important it will be for the developers of tools to understand — and to individually address — the needs of both the casual creative and the creative professional independently. The changes in the requirements of creative professionals to get their job done in the most efficient way need to be understood and addressed.

Assisting creativity in the light of AI-driven changes

Currently, for creatives, the most important developments based on AI and machine learning are linked to alleviating drudgery and repetitive operations that later stages of most creative projects necessitate.

The present research also underscores an expectancy that the multitude of individual steps in the production process should be more intelligently managed by machine intelligence in the future.

There is a problem, though: while in their overall structure, the processes involved are clearly defined, they way each individual creative handles them can be very different. In larger operations, workflow systems that handle these tasks more efficiently have been in place for many years; for the creative individual, however, these systems are often perceived as too constraining.

¹¹ Many creative professionals are fully aware of that fact, and make it clear that the real value of their work hinges less on the sophistication of the output, but on the creative intelligence and design thinking they bring to a project. As one designer put it succinctly: *"My clients come to me for ideas — not for execution."*

"To achieve a creative artificial intelligence, we would need to build a society of exploratory computers, all striving to surprise and impress each other. That social aspect of computers is completely missing, and this is what makes computer intelligence so mechanical."

Anthony Brandt & David Eagleman
"The Runaway Species"

In order to solve this problem, AI and machine learning can step in — not primarily in order to come up with a universal workflow solution, but rather in understanding how the creative mind deals with these issues.

This may turn out to be much more complex than it appears at first blush, as creatives need freedom and flexibility in order to build their own personal workflow — every creative organizes these tasks in his own individual way.¹²

In a nutshell, the big challenge for AI and machine learning developments for creative professionals is not to mimic how creativity works for them, but to understand the nuances and seemingly erratic jumps of the creative mind when it tries to organize the outcome of the creative process. Perhaps ML-based creative assistants could be a first step in this direction, but we can safely assume that it will be a complex task. In the words of the designer quoted earlier: *"If software was built around a creative's mind it would never function."*

What's next?

Of course none of the trends outlined above exist in a vacuum. Assuming that as AI progresses, human creativity remains at a stand-still would be a absurd. As machine intelligence becomes increasingly powerful in producing outcomes that in the past required human skills and expertise, how will uniquely human creativity evolve?

This research provides us with some valuable clues as we attempt to anticipate this evolution. Creativity is human, and it is social. And, not to forget, creativity is based on vision, connection and empathy. These are the factors, that allow the creative to produce outstanding work: The capacity to give form to intuition-driven connection, combined with inspiration and creative vision is what sets human creativity apart. Not to forget a deeply ingrained willingness to disrupt and challenge the status quo ...

And these are also the core aspects that will thrive as AI and machine learning progress in the creative space: Creatives are aware of what they can achieve. Those core human attributes of creativity have always been their strongest asset: Now we can expect these qualities of vision, connection and empathy to become the key component of what creatives need to demonstrate ever more strongly: That they, unlike the machine, can fully focus on the WHY of a project, while the machine can only produce the WHAT.

¹² A simple example: Most creatives follow some kind of naming convention for the elements and assets in their projects — yet they need the liberty of changing them when they feel like it.

Complete data from the research interviews

