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Abstract

The development of Machine Learning (ML), Deep Learning (DL), and Natural Language Processing (NLP) has made some breakthroughs, including the launch of ChatGPT by OpenAI. With its capability of understanding and generating natural language conversation, it has marked a significant milestone and received great attention from the public. It opened new applications in various domains, such as Google Bard and Microsoft Bing's latest upgrade using the Large Language Model (LLM) from GPT-4.

The deployment of ChatGPT is affecting how we work in multiple sectors, including the marketing industry. ChatGPT is considered a valuable tool for crafting content creation and personalized creativity for approaching any target audience. Yet, ChatGPT's marketing capability is more significant than content creation. Its learning system from vast amounts of big data presents another opportunity in this industry: to use it for marketing research. It is one of the essential steps in developing a strategy for effective marketing. This thesis will further discuss the opportunities and challenges of using ChatGPT-3.5 (OpenAI) in marketing research based on practical use cases, how it could revolutionize traditional methodologies in market and marketing research and possibly offer valuable insights into consumer behavior, preferences, and trends.

Table of Contents

1. Introduction	1
Groundbreaking AI Advances	3
Introduction to Artificial Intelligence Advances.....	3
Artificial Intelligence	4
Machine Learning	6
Deep Learning (DL).....	8
AI Influences in Industry	10
Main Players of AI.....	12
GPT Growth.....	17
GPT Capabilities and Limitations	18
The ChatGPT Applications Cases in Industries.....	19
The Implications and Challenges in Industries	20
2. The Marketing Industry and Artificial Intelligence	21
Marketing.....	21
The Importance of Research Market in Digital Marketing.....	25
The Process of Constructing a Marketing Campaign.....	28
Artificial Intelligence (AI) and Marketing.....	29
AI Strategic Framework in Marketing	31
AI Usage in Digital Marketing Practices	35
3. Artificial Intelligence in Marketing Industry	37
The Application of Generative AI in Marketing.....	37
Opportunities of Generative AI For Marketing Research.....	38
4. GPT For Marketing Research	42
Introduction.....	42
Literature Review.....	43
Objective.....	44
Methodology	45
The Automotive Industry: Manufacturing and Relation.....	46
Research Design.....	48
ChatGPT-3.5	48
GPT Prompt Engineering	48
Tokenizer.....	49

OpenAI API.....	50
Querying ChatGPT for Marketing Survey	51
Data Analysis Process	52
Examining ChatGPT by Replicating Insights from GWI Report	53
Study 1: Car Preferences Among Countries	54
Study 2: Top Priorities for The Car Buyers [New Cars & Used Car].....	56
Study 3: Research Source [Used & Trusted Sources].....	59
Study 4: Electric Vehicle (EV) Advantages.....	61
Study 5: How to Sway New Buyers.....	62
Behavioral Economics Theory and ChatGPT	63
Study 6: Prospect Theory	63
Willingness to Pay Represented by ChatGPT	66
Study 7: Willingness to Pay	67
5. Analysis of Findings.....	73
Limitations	75
Future Works	75
Integrating ChatGPT in Marketing Research	76
6. Conclusion.....	79
Appendix A – Example of prompts and configurations	81
Appendix B – Code	91
Experiment configuration	91
Source Code.....	94
How to use the code.....	99
7. Bibliography.....	100

1. Introduction

The advancement and growth of Artificial Intelligence (AI) in the past few years has received great attention from the public. Robotic process automation and computer vision remain the main used capabilities, however, natural language text understanding has advanced widely from 2018 resulting in its capability embedded in products and business processes (McKinsey&Company, 2024). The average number of AI capabilities that organizations use, that is natural-language generation and computer vision has doubled in the application from 2018 to 2022 (McKinsey&Company, 2024).

The most famous example of AI is deep learning, a method that teaches computers to process data in a way that is inspired by the human brain. Deep learning trains algorithms on big datasets to recognize complex patterns in pictures, language translation, and voice recognition. In result, it is possible to have results on translation, text summary, and sentiment analysis.

The use of natural language processing models of AI chatbots allow computers to understand human language, supporting businesses and organizations process content due to their low cost and improved user experience (Taecharungroj, 2023). Chatbots grow with a user-friendly experience to automate tasks and processes, streamlining communications has improved efficiency in many aspects. Principally in the Industry 4.0. which the revolution could make industries supported in tasks and ability to make decisions on their own.

The progression of this technology got public attention extensively when particularly OpenAI, an American AI research laboratory, launched ChatGPT as one of its natural language processing tools to the public in November 2022 and continuously improving. It enables automated text generation and has a major improvement of how we interact, communicate, and engage with machines. From the first-generation of ChatGPT where it employs a large-scale training of models that generates text models specializing in dialogue, to four-months later, in March 2023 they released GPT-4 with multimodal capabilities allowing prompt composed of both images and text input to generate text output. Furthermore, OpenAI has also introduced DALL-E, which can translate a text description to an original image and art. An advancement that enables it to generate more realistic and accurate images with greater resolution.

According to ChatGPT user data statistics, the platform managed to cross one million users within five days of its launch and grew significantly to a hundred billion users in two months (Brockman, 2023). Almost 88% of the traffic on ChatGPT is direct traffic. This has led to a big

market of innovation, where other big tech companies are also competing in the market, such as Google, Meta, Amazon, and Microsoft with similar initiatives.

Given all of these, the fast-paced development of this technology development has brought both alarm and excitement to the public. It is possible that in the future, the process of automation, artificial intelligence, and other technologies will decrease millions of jobs in the process while creating new opportunities in the job market. In several industries, some works are already supported and could possibly be replaced by AI and ChatGPT. Without clear regulation for AI deployment, it may result in harm to competition, consumer privacy, and consumer choice, lead to uncontrolled automation and inequality, push down wages and damage political discourse (Acemoglu, 2021). However, the technology can also support business to save time and be more efficient.

This study will discuss specifically the effect of the large language model ChatGPT in the marketing industry. I found plenty of research in marketing leading to conclusions that the generative AI; ChatGPT and DALL-E contribute positively to the process effectiveness in marketing mainly for content creation and automation. There are other studies indicating that ChatGPT imitates human behavior, entailing the irrational cognitive processes in humans. Therefore, with the facts and insights received, it suggests a further prospect that Generative AI (ChatGPT) could have potential applications in marketing research – which will be the core purpose of this thesis.

This thesis will explain the process of carrying out marketing research with ChatGPT with OpenAI API, by formulating ChatGPT as an imitator tool for human responses. I will identify the practice obstacles and insights during the exploration process, indicating any particular details needed to generate fair responses. There are several sets of exploration which the result will be analyzed with existing research, and economic and behavioral economic theory.

Groundbreaking AI Advances

Introduction to Artificial Intelligence Advances

This chapter of the introduction explains artificial intelligence, machine learning, and deep learning. The impact of their presence has been recognized in many industries as the growth is significantly rising, from manufacturing, healthcare, and retail to marketing, which I will discuss in the thesis.

As seen in illustration below, these three topics are interconnected in computer science and data science. Machine learning and deep learning are subsets of AI. They are AI techniques that focus on learning and making predictions based on data.

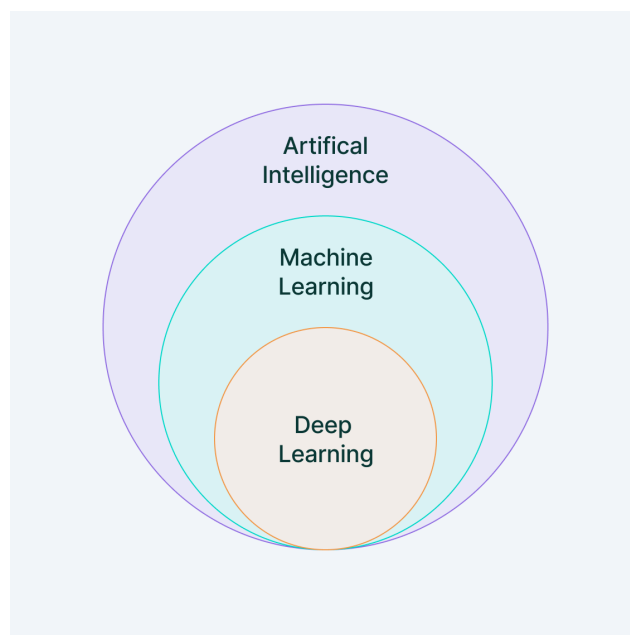


Figure 1: Layers of Intelligent Systems

The choice between deep learning and other machine learning methods may depend on the problem based on the scope and complexity, the amount of data available, and interpretability. Machine learning methods might be more familiar to use with structured data. However, deep learning methods can also be considered, especially when large, complex datasets are involved.

While they are all linked, each of them has distinct features and applications, which will be explained in the sections below.

Artificial Intelligence

Artificial intelligence is the ability of a computer or machine that is based on human intelligence, using techniques to allow machines to imitate rational human beings (McCarthy, 2006). This being said, it can act actively, resembling human intelligence, such as speech recognition, solving problems, reasoning, knowledge, perception, and manipulation.

According to Kuipers (Kuipers, 2022) the journey of crucial AI discoveries began in the 17th century when Thomas Hobbes and Gottfried Wilhelm Leibniz studied algebra and geometry modeling intelligence. They envisaged a symbol system that would be the basis of artificial intelligence—followed by the philosophers Charles Babbage, who studied the analytical engine, and Ada Lovelace, who wrote the first computer program to calculate the Bernoulli numbers in the 18th century. The studies continually evolved until 1936, when Alan Turing published Turing's proof, which is now referred to as the Turing Machine, and led to the creation and development of the artificial neuron.

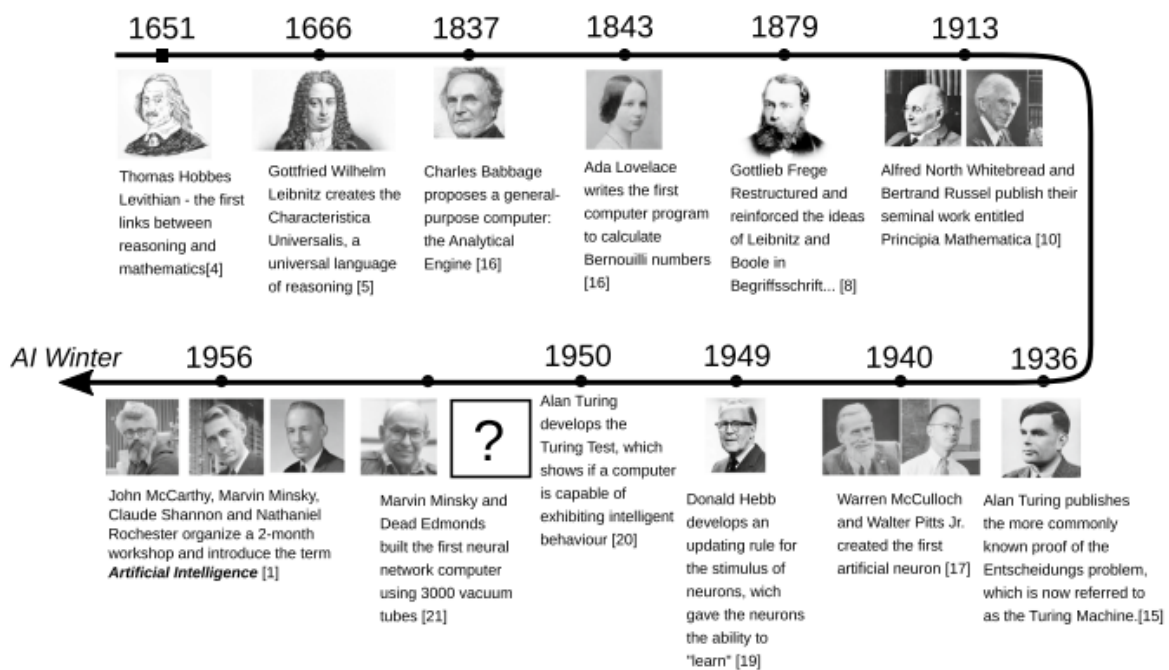


Figure 2: The Journey of AI Before Its Term of "Artificial Intelligence". Source: (Kuipers, 2022).

Alan Turing is a British mathematician and logician who invented one of the core concepts of theoretical computer science (the Turing machine). In 1950, he developed the Turing test, which describes a machine capable of computing any computable function and expressing intelligent behavior. According to Derndorfer (Derndorfer, 2004), Turing's test is Alan Turing's notable legacy in computer-related topics, and it is still the de facto standard in testing and analyzing if a machine is intelligent. The test comprises a person communicating with partners (a human or

supposedly intelligent machine) via text messages; if the person cannot clearly distinguish between a conversation with the machine and the human, then the machine possesses intelligence. One of his research projects, "Intelligent Machinery," was published after his death, which explored methods to enable computers to 'think' by adapting neural networks. Turing believed that future computers would be able to achieve everything that human brains were capable of. Today, this concept is widely known as "Artificial Intelligence" (Derndorfer, 2004).

Those journeys above led to the field of Artificial Intelligence (AI), which was introduced by the Dartmouth Summer Research Project in 1956. The conference was organized by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon. From then on, this era marked the birth of AI as a formal discipline.

After the introduction of AI, there was the enthusiasm and success phase of the golden age of AI. The programs developed after the Dartmouth Summer Research Project were followed by faster, cheaper, and more accessible computers that could store more information and solve algebra problems. Researchers were optimistic about its development, and the investment to support it was high, including developing new technologies for military use.

Since the birth of AI, it has faced a progressive journey. It announced the first chatbot, "Eliza," developed in the mid-1960s at the MIT Artificial Intelligence Laboratory, a computer program designed to stimulate conversation with humans by utilizing simple pattern-matching rules (Sharma, 2017). It can answer questions from reformulating statements, creating the illusion of a human responder when users ask questions to Eliza. Hence, Eliza was the first chatbot, and it was also remarked upon as the essential history of AI as it was the first human-machine interaction developed.

There was marked enthusiasm surrounding advancement until it reached the stage where the early optimism of the expectation was turned down, as, in reality, the progress was not as quick as was hoped. It happened in the 1970s-1980s and was known as "the first AI Winter" (Kaynak, 2021), and this period led to a reduction in funding and interest in the AI field.

From then on, the growth led to the entrance of AI in industry in 1980, impacting how humans work. AI is believed to impact humans' personal lives and transform how firms make decisions. The categorization of artificial intelligence is divided into two subsets, known by the names machine learning and deep learning.

Machine Learning

The field of machine learning was introduced in the 1940s and 1950s, related to Alan Turing's research on the possibility of machine learning from experience. Then, the term "machine learning" was coined by Arthur Samuel in 1959, an American pioneer of artificial intelligence research. According to him, machine learning is a "field of study that allows computers to learn without being explicitly programmed." Hence, it involves system exploration in creating computer programs to improve and adapt based on experiences (Aggarwal, 2022).

An example of the adaptation of machine learning is the evolution from basic chatbots to more advanced chatbots (conversational agents), which can answer complex questions. Earlier, with ELIZA, basic chatbots had trouble understanding human language until machine learning improved chatbots' ability to process natural language and learn from experience. It resulted in more modern applications for the public, such as Siri (Apple phones' virtual assistant) and Alexa (a virtual assistant released by Amazon).

Machine learning is a sub-area of artificial intelligence that can automatically produce knowledge, train algorithms, identify relationships, and recognize patterns. These identified patterns and relationships can be utilized in a new, unknown data set to make predictions and optimize processes (Aggarwal, 2022). Machine learning works very differently from traditional software development, as machine learning learns from data independently to improve accuracy and can create its own approach code. The algorithms build a scientific model that relies mainly on a sample of data that provides training data. Knowledge is the main lead of machine learning; it enables us to make predictions and decisions without directly performing the assignment.

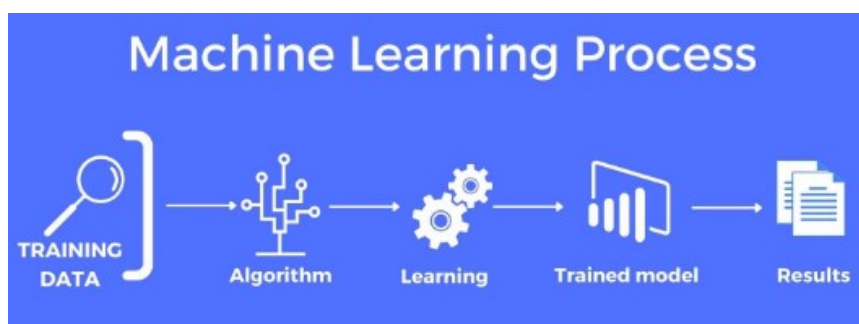


Figure 3: The Machine Learning Process. Source: (Viscanti, 2023)

In general, machine learning relies on data to make algorithm training possible and perform its function, with the standard methods of getting the data by completing surveys, interviews, observations, experiments, web scraping, and sensor data collection. For example, in marketing

purposes, the users can collect data from sources such as web scraping on social media interactions and website analytics. With all the data collected, preprocessing is needed to ensure the relevant information before developing the machine learning further with data labeling.

There are three categories of machine learning: supervised, unsupervised, and reinforcement. The data put into a machine learning algorithm can be input-output pairs or only inputs.

The first learning method is **supervised learning**, where the model predicts data based on the data features set and trained. The training dataset required should cover both input and output pairs, where the input shall cover examples and the output shall cover labeled answers. For instance, a company may forecast sales of a marketing campaign (referred to output, y variable) based on monthly sales historical data (referred to input, x variable) to make a business decision on the advertising budget in a certain period. A trained dataset, based on data collected in past periods, is needed for this model to enable the company to predict sales. In another case, supervised learning algorithms are mainly used in object recognition, machine translation, and fraud detection.

Unsupervised learning methods are used when the input and output are both unlabeled. Hence, the learning system can detect patterns without any prior specifications. Training datasets only consist of variable x to find similarities or differences between data points and group them. The problems that unsupervised learning tackles include grouping a dataset based on a similarity metric and projecting data to a reduced dimension space. This method is commonly used for image and speech recognition and in marketing to predict customers based on behavior and interest.

The last machine learning method is **reinforcement learning**, based on rewarding desired behaviors that allow the AI-driven system to learn through trial and error using feedback by interacting with the environment. There are no input and output pairs. However, we need to set the goal and provide a list of allowable actions and their constraints for the outcome. The model will process to achieve the goal unassisted by using trial and error to maximize a reward. In online marketing, this method is used to run personalized advertisements to a target audience and let the machine work to determine which marketing content suits the audience.

Deep Learning (DL)

The surge of deep learning took place in the 2000s to 2010s, while the development evolved throughout several decades with the contribution of some figures' knowledge over time. The growth has influenced natural language processing, speech recognition, and reinforcement learning. It revolutionized machines to process much complex information.

Deep learning is a branch of machine learning based on artificial neural networks and simulation learning to impersonate the way the human brain works in solving complex problems. It simulates the human brain with artificial neural network techniques with the ability to learn from trained extensive data in such a speed learning that reaches beyond human capability. Deep learning can experiment and grow without involving humans; it is able to recognize images and text, communicate, and translate languages.

Deep learning consists of an input layer, an output layer, and extra hidden layers involving neurons attached to one another.

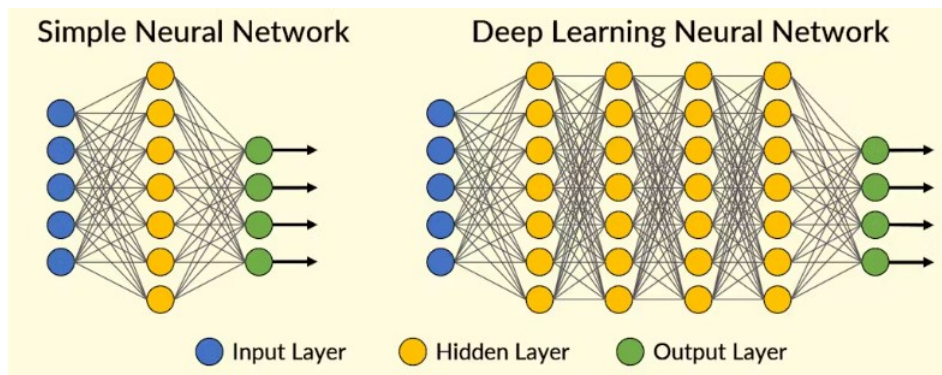


Figure 4: The difference of simple neural network vs deep learning neural network. Source: (Mostafa, 2020)

The term “deep” in deep learning refers to the number of hidden layers in the neural network architecture (Zohuri, 2020). While in a simple neural network, the number of hidden layers is one to three, deep learning has many more layers of software nodes that work together, which enables it to train a large amount of data. An additional node layer would also optimize the accuracy of the result.

In deep learning, the more is the variability in the dataset used for training, the better are the performances of the model when predicting. Compared to the other machine learning methods, we can assume that deep learning can do more and need less human intervention or supervision.

Some of the advantages of deep learning are described below:

1. The capability of automatic feature learning, which enables the system to extract new features without supervision automatically
2. Capability to discover patterns within a large amount of data and uncover complex patterns in images, text, video and audio. In addition, the data in different forms allows the system to proceed with information across multiple modalities. For instance, the ability to translate one spoken language into text or generate images from a textual description.
 1. The capability to process data both from unstructured data such as text, images, video, and audio and from structured data
 2. Improving accuracy, as deep learning models can deal better with data from multiple sources of information

Profound learning growth has become a game-changer in many industries worldwide due to its capabilities, such as chemicals, healthcare, agriculture, etc. The global deep-learning market is expected to grow and increase to USD 978.88 billion by 2032 from USD 52.13 billion in 2022 (Precedence, 2023). Besides, the expansion of generative AI solutions is also observed to highlight the growth of the deep learning market.

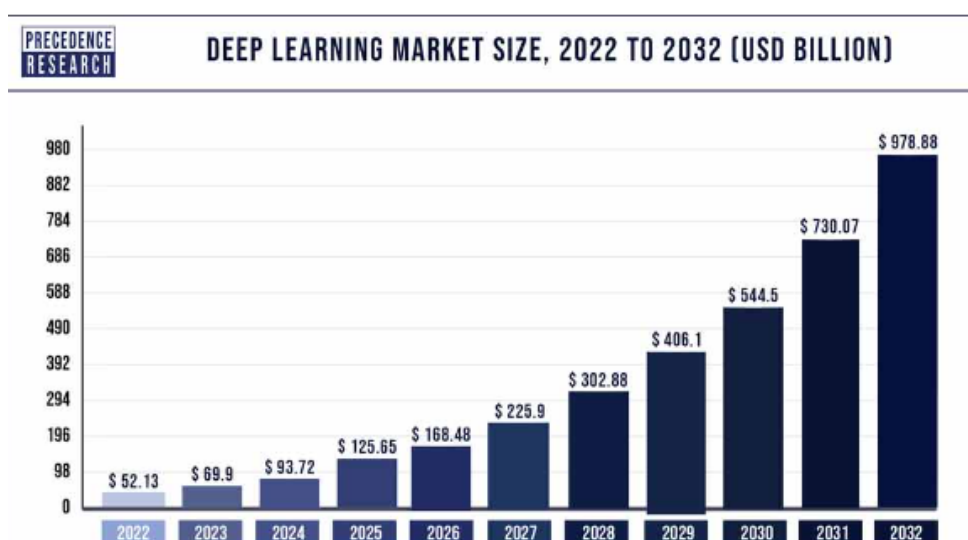


Figure 5: Expected Market Size of Deep Learning 2022 to 2032 in USD Billion. Source: (Precedence, 2023)

Despite the positive impact in many industries, deep learning has noted limitations and challenges in some areas. Due to the extensive data and high computational requirements, the method of using deep learning is often considered to be expensive and time-consuming. As well as the lack of interpretability, the number of layers could make it challenging to understand how

the predictions are made; it could be problematic when transparency is needed as it cannot explain how the system got an answer.

AI Influences in Industry

Artificial intelligence is essential in determining day-to-day experiences, especially in impacting various industry sectors. The presence of AI has dramatically influenced industries such as healthcare, finance, entertainment, and manufacturing.

Based on PwC artificial intelligence evolution trend research (PWC, 2024), the AI market is expected to reach an overall value of \$53.1 Bn globally by 2026, with an annual growth rate (CAGR) of 35.4% over the entire period. They divided the market, considering the technology, industry verticals, deployment, and end-user.

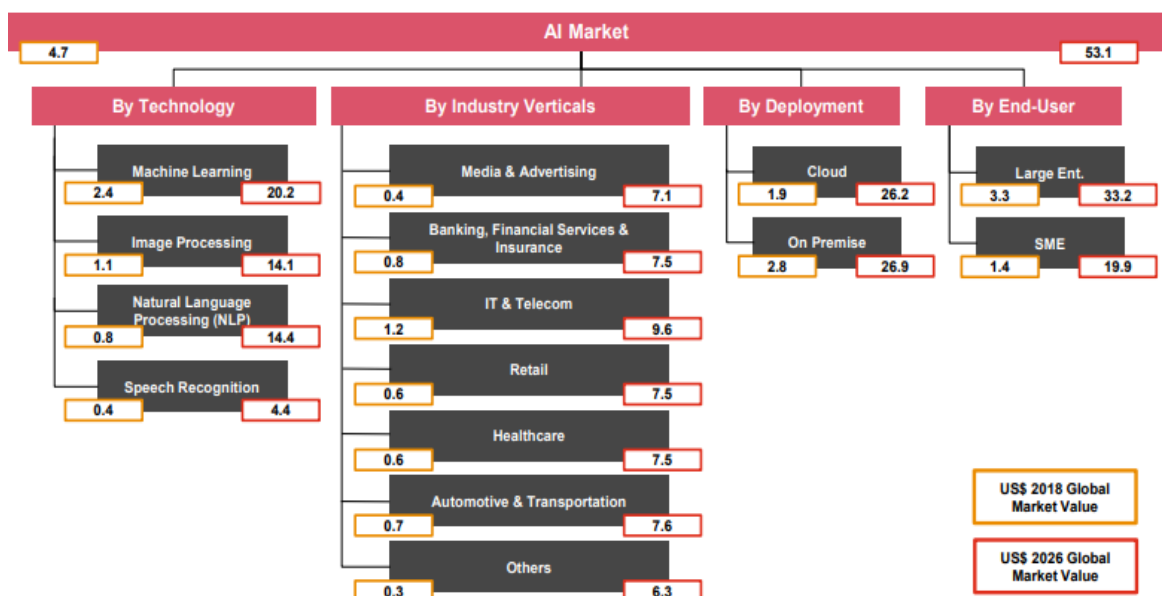


Figure 6: Enterprise AI Market Overview by Tech, Industry, Deployment, and End-User. Source: (PWC, 2024)

It is suggested that by the deployment, machine learning training models in the cloud and on promise which the deployments are within the enterprise’s IT infrastructure are expected to grow with a share of 49% and 51% in 2026. In other words, the growth differentiation is nearly equal. Large enterprises are expected to be the central portion of the market when looking at the end-users of AI.

Global AI Market – by Industry Vertical
(US\$ Bn, %)

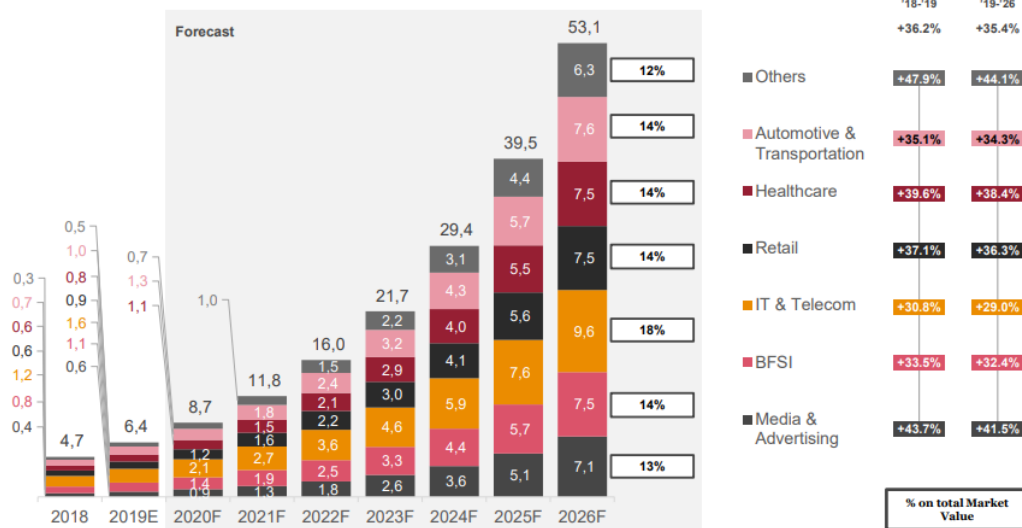


Figure 7: AI Market Overview by Industry Vertical Evaluation. Source: (PWC, 2024)

The adoption in industries is seen to be impacting across all industries. Up to the present, in 2023, the IT & telecommunications industry has been recognized as the most influenced sector compared to others. It is still expected to remain the highest contributor to AI market value. It is forecasted to be followed by the healthcare and media sectors if seen by the annual growth rate prospects (CAGR).

Global AI Market – by Technology
(US\$ Bn, %)

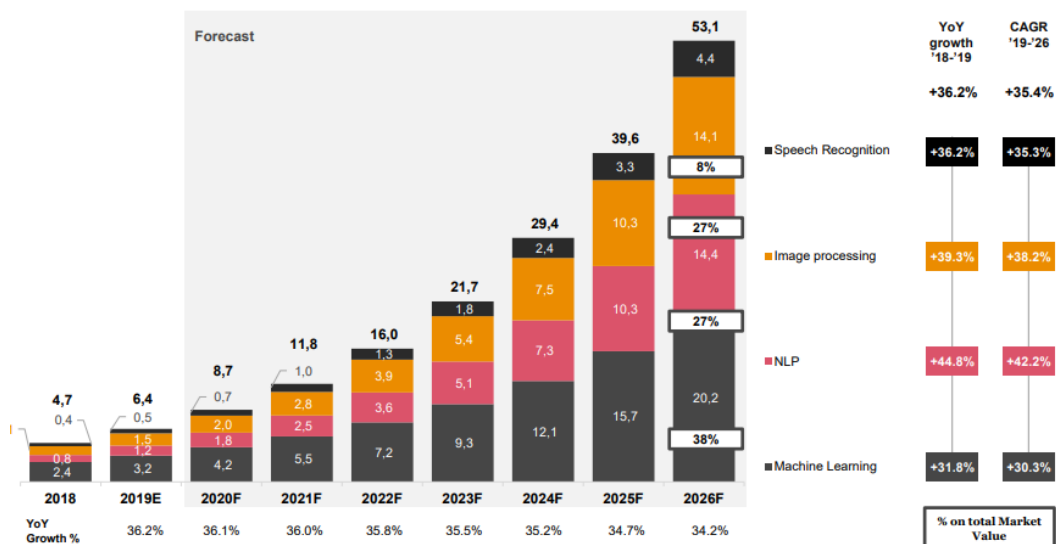


Figure 8: AI Market Overview by Technology. Source: (PWC, 2024)

Following all others, PwC (PWC, 2024) has defined the value market by technology in four elaborations: machine learning, natural language processing (NLP), image processing, and speech recognition. Considering those four prospects, the NLP's expected growth is the most promising, with an annual growth rate prospect (CAGR) of 42.2% from 2019 to 2026. The NLP

is a subfield of AI that focuses on communication between computers and humans in natural language, such as language understanding and sentiment analysis. However, in addition to the CAGR, if we look solely at the share in 2026, machine learning remains with the highest expectation (38%) compared to others.

Main Players of AI

This subsection will specifically discuss the players of AI in tech corporations and research institutions. Generally, the leading country in AI research and AI startups is The United States of America (USA). It remains in first place, with Silicon Valley as the critical place of some of the most extensive company growth, including OpenAI, Google, and Meta. Almost 60% of top AI researchers work for American universities and companies, and \$249 billion in private funding has been raised (Techopedia, 2023).

The tech giants imply corporations that focus on their businesses to provide products and services to the customers. Hence, it is often related to the company's innovative businesses and generating revenue. As a tech giant company, its initiatives are responsive to the market and industry, giving it high competition. The core influencers in tech giants are Google, Microsoft, Amazon, Apple, Meta, IBM, Alibaba, and Tencent.

On the other hand, some contributors to research institutions forge scientific knowledge and conduct fundamental research. Their research might not have immediate practical applications, yet the contributions they capture are long-term and affect the basic knowledge in the field of AI. Some key contributors to research institutions are OpenAI, MIT, Stanford University, UC Berkeley, University of Oxford, and Harvard University.

There are some other players of AI depending on the sector, such as in the automotive industry, hardware, robotics, healthcare, etc. However, this section will focus on some cases in tech giants and research institutions.

ChatGPT and Dall-e (OpenAI)

OpenAI was founded in late 2015, and it focuses on building the most value by developing new AI technologies, not commercial products. They aim to ensure that artificial general intelligence (AGI) benefits humanity by making safety and sharing benefits with the people. According to its structure, it has a hybrid system of profit and nonprofit, which lets the investors get a capped return if they succeed but without obligation to do so. Microsoft is one of the leading investors of OpenAI, reaching a multibillion-dollar investment in 2019 and 2021. However, OpenAI remains an independent company.

Throughout its existence, OpenAI has crafted a diverse range of AI and ML agents, extending from ChatGPT, which is known for the natural language processing conversation with data source updated until 2021 (ChatGPT-3.5), to DALL-E, which is an image generator model that can translate text ideas as the input into images.

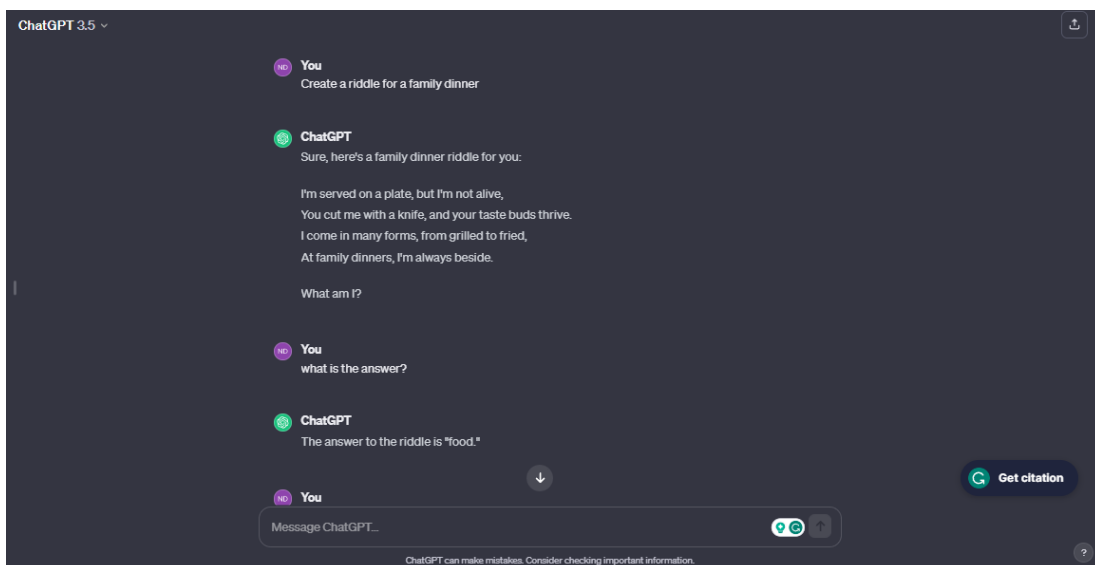


Figure 9: ChatGPT Interface. (ChatGPT-3.5, 2024)

This picture represents the interaction with ChatGPT-3.5. From its web interface it shows a text generation of a specific request or prompts, “Create a riddle for a family dinner.” They showed a tremendous dynamic response that can be considered creative yet still inside the context. This interaction illustrates the model’s ability to generate coherent and contextually relevant responses based on the input or prompt given. In every text generated, ChatGPT also provides options for users to give feedback (good or bad) or ask to regenerate responses.

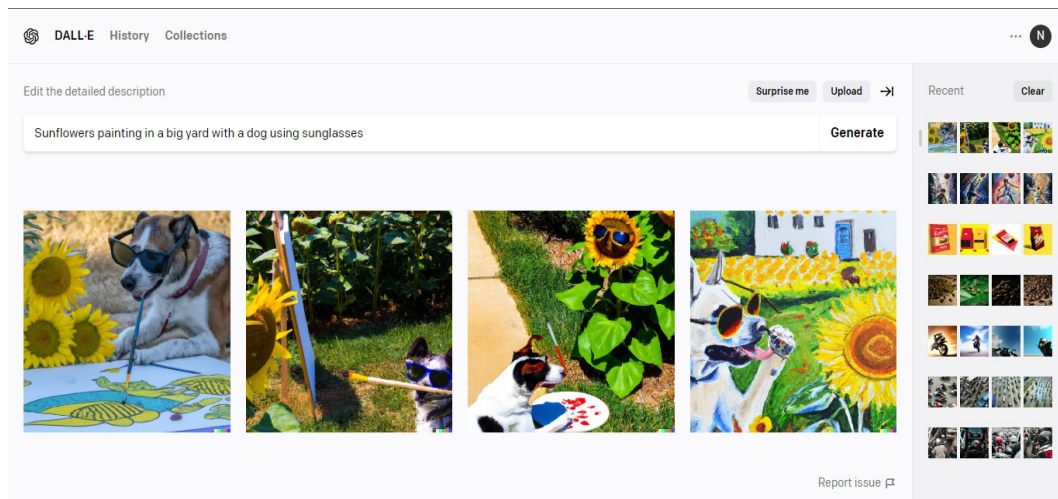


Figure 10: DALL-E Interface. Source: (OpenAI, Dall-e 2, 2024)

Additionally, DALL-E's capability of its generative imaginative visual based on a textual prompt by requesting several unrelated objects to create one image, "sunflowers painting in a big yard with a dog using sunglasses." As expected, the outcome aligns with its distinctive value – it creates an original and accurate image. The users are then given options to edit, save, or share the image generated.

Bard (Google)

Bard is a conversational AI chatbot launched by Google in March 2023, trained with a new LLM PaLM 2 (Pathways Language Model 2) and connected to internet access. Therefore, it can be concluded that information from recently published content advances ChatGPT in this case. However, according to its terms and conditions, they collect conversations, location feedback, and user usage information to support the product's improvement and development. This results in some trouble for some countries due to its privacy regulations.

The attention that it got from the public increased rapidly despite the privacy concerns. Noting from SimilarWeb (SimilarWeb, 2024), the growth of Bard lags far behind ChatGPT, but it is still growing, reaching 142.6 million visitors in May 2023, up from 49.7 million in April, according to preliminary data. Google Bard is open to the public (above 18 years old) if they have a Google account. It is an alternative to ChatGPT with the advantage of updated information sources, as Bard is built on top of search engines.

Bard also has a unique feature that enables integration between Bard and other Google products, such as Hangouts and Google Maps, which makes it possible to get as much information as possible.

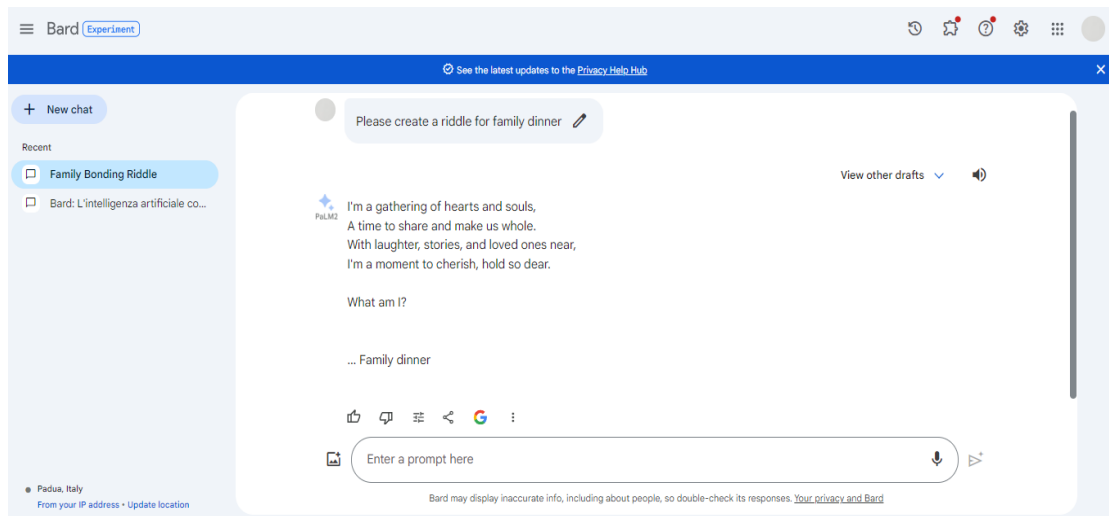


Figure 11: Google Bard Interface

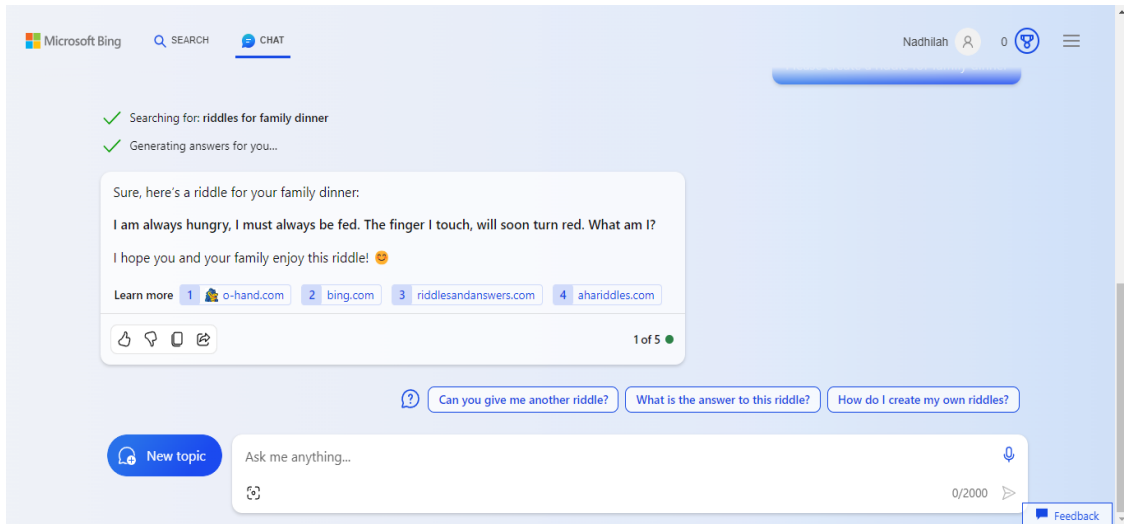
The interface of Google Bard is quite similar to ChatGPT and user-friendly. Using the same approach of giving it a prompt, Google Bard also shows its capability to produce text contextually fitting following the input. Some differences in the response interaction can be made to the text generated, such as modification options for the text to be shorter, longer, simpler, more casual, or more professional. There are also options for the text generated to be shared in other platforms, exported to a document, and double-checked with Google Translate.

Bing (Microsoft)

Microsoft's web search engine "Bing" has existed since 2009 and had the most significant upgrade in February 2023 with a Bing chatbot that utilizes the latest LLM GPT-4 by OpenAI. Users can access Bing through the browser "Edge". Hence now Bing is no longer a simple search engine. It provides information and answers questions in the natural language resembling human interaction. Similar to ChatGPT and DALL-E, text and image generation based on the order are also possible. However, one main difference is the data source where Bing is internet-based; hence, it continually has updated information. This advancement of Bing made them the first major search engine that upgraded with AI function. As reported by CNN (CNN, 2024), this enhancement in search engines expects a change in human behavior in using search engines

"We now expect from the internet — rather than clicking through a bunch of links to suss out the answer to a question, the new Bing will do that work for you".

(1 of 2 images)



(2 of 2 images)

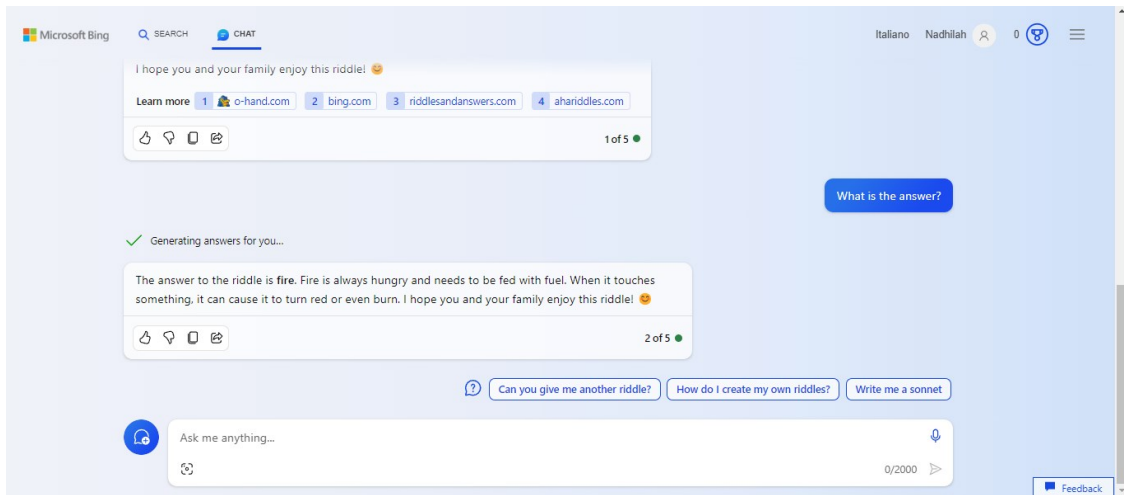


Figure 12: Microsoft Bing Interface. Source: (Bing, 2024)

The Microsoft Bing also demonstrates proficiency in generating text correlated to the prompt. Compared to ChatGPT and Google Bard, they have a different option at the beginning for the user to choose the conversation style: more creative, more balanced, or more precise – which will impact the text generation result.

GPT Growth

Generative Pre-trained Transformer (GPT) is a general term referring to AI large language models. The ensuing descriptions elaborate on distinct facets of GPT models:

Generative: GPT models are known for their ability to produce human-like text. They have been applied to various tasks, including language translation, question answering, summarization, and completing vast amounts of information.

Pre-trained: GPT models are pre-trained on large datasets from the internet and can generate contextually relevant text.

Transformative: They utilize neural network architecture, specifically the transformer architecture, to process vast amounts of data. It uses the previous data to understand the query's context and make predictions for the output based on it. This also enables the model to understand and generate complex patterns in language.

With OpenAI, this product model is named ChatGPT. A free-to-use AI system involving text, images, and voices to be used for engaging conversations, gaining insights, and automating tasks (OpenAI).

As of the present, OpenAI has released several versions of GPT. It has released the first GPT-1 (2018), GPT-2 (2019), GPT-3 (2020), GPT-3.5 (2022), and GPT-4 (2023). However, the boom of ChatGPT from the public was attained in late 2022 during the debut of version GPT-3.5. OpenAI stated ChatGPT acquired 1 million users just five days after launching in November 2022 (Brockman, 2023). The attention it got from the public made the growth of GPT users extraordinary with an unprecedented surge. Quoted by TechCrunch (TechCrunch, 2023) on the OpenAI announcement, ChatGPT now has 100 million weekly active users.

The latest launch of GPT-4 has been available only to paid subscribers until now. Nonetheless, compared to the prior version of GPT-3.5, it is claimed that with a more advanced model, the GPT-4 excels at queries with more advanced reasoning, understanding of complex instructions, and more creativity.

GPT Capabilities and Limitations

Since ChatGPT's debut in November 2022, it has captivated many attentions and users, leading to extensive discussions and conversations. Its capabilities ignited the interest of individuals, communities, and corporations with many beliefs on how the advancement will change the future through its application in industries.

Capabilities

As soon as it launches, one of the most highlighted capabilities of ChatGPT is text generation and summarization, which is highly coherent and human-like. It enables the public to create or summarize content, such as articles, stories, poetry, etc. as if humans had initially made it. The capabilities of natural language understanding also allow for the development of chatbots and other interactive applications.

Drawing on the research conducted for the competence of ChatGPT lies in its multilingual translation (Jiao, 2023). They did the research by evaluating the capability in four languages with Latin and other scripts (German, English, Romanian, and Chinese). The test included checking the clarity and comparing the language translations that involved 12 directions. It compares the translation result using ChatGPT versions 3.5 and 4 versus other commercial translation products (Google Translator, DeepL, and Tencent). The result was that GPT-3.5 was sufficient, but the score was still below the others. Meanwhile, there's an improvement in using GPT-4 that, to be concluded, has become an excellent multilingual translator.

It is commonly held that ChatGPT has applicability across various sectors. Numerous studies mentioned that ChatGPT is potentially revolutionizing education, for instance, in mathematical education. Research done shows that the overall sentiment of ChatGPT in education was positive, with many views that the learning experience can be enhanced by it (Wardat, 2023). It showcases some capabilities, such as solving simple and complex mathematical problems. Its advanced function is valuable for students, researchers, and professionals.

Meanwhile, in the research community, the presence of ChatGPT could help in the research process in evaluating overall quality and its significance. It can be a valuable tool to assist a researcher in providing detailed comments and critiques on strengths and weaknesses and to give suggestions and improvements. However, it is best believed that a human reviewer should be the ultimate authority in thoroughly evaluating the research before making a final decision (Xames, 2023).

Limitations

Despite the favorable outcome of ChatGPT, there are still some concerns about the limitations of its usage in the industry, mainly doubts about its safety and accuracy.

The first limitation is data privacy and ethics (Koubaa, 2023). This challenge is complex as it relates to personal information collected by ChatGPT. Its capability to train the model within enormous amounts of data means that it could include users' details, which is sensitive information. In another way, it may also spread false information that could negatively impact many people. Hence, the development of ChatGPT demands that it take more account of its data privacy and security for users.

Subsequently, the possibility of biased results on ChatGPT is also a challenge. It could be from a dataset bias that influences quality, cultural and linguistic bias, and bias discrimination due to the large datasets containing stereotypes and prejudiced language. As a result, the models might unintentionally grasp the biases and respond accordingly (Ray, 2023). Kouba et al. (Koubaa, 2023) state that various threats could question the validity of the ChatGPT result. Again, for instance, it is caused by biased training data. Hence, it is essential to ensure that ChatGPT provides accurate and reliable results.

The last limitation is the robustness and explainability; it is crucial to certify that the model result is always consistent in any context with interpretable explanations for its predictions (Koubaa, 2023). In other words, the success of ChatGPT applications has to address the reliability and accountability of its source.

The ChatGPT Applications Cases in Industries

This emerging GPT possesses immense business opportunities. Some corporations have demanded the ability to generate a structured conversational output. OpenAI released an article about some businesses that now apply the GPT system in their products, for instance, Duolingo and Khan Academy. As both offer online education learning through application, the advancement of conversational chatbots is precious (OpenAI, Customer Stories, Duolingo, 2023) (OpenAI, Customer Stories, 2023).

Duolingo offers their users a course in 40 languages, which mainly helps them learn vocabulary and grammar rules. With the help of GPT, they now have a better product strategy that can be used for conversational practice and contextual feedback on mistakes. The same advancement

is used at Khan Academy, with its online lessons offered for students of all ages. The refinement applies to a powered assistant for the users. The students can watch errors and corrections on a course's answer and could have individualized questions to prompt deeper learning. The results of both of those improvement applications could lead to higher user satisfaction.

The Implications and Challenges in Industries

The influence of AI in the market has revolutionized the functioning of businesses, enhancing productivity and performance in many industries. Many discussions of its impact on job activity and market have been raised, regardless if the outcome is adverse or favorable. It is indicated that the deployment of AI has significant implications for the job market and workers in various industries, and the three main implications of the study in various sectors are potential worker displacement, alteration in job standard, and the emergence of new job opportunities (Rashid, 2023).

The effect level varies across different sectors including the setbacks, for instance, manufacturing and retail industries experienced significant job losses due to automation, hence there are workers displacement. Nevertheless, it is predicted that for the same reason, various sectors will open new job opportunities specifically for roles with connection to AI, including AI trainers to ensure the systems used are operating properly for users. In consideration of this, job standards and requirements may adjust accordingly following the industry needs. The World Economic Forum in 2020 suggested that despite the estimation that 85 million jobs may be displaced by AI in 2025, it may also create 97 million new jobs (World-Economic-Forum, 2023).

2. The Marketing Industry and Artificial Intelligence

Marketing

Marketing refers to activities' corporations do to promote their products or services to connect and associate with their target customers. The technology advances changing human behavior significantly and the way marketers do marketing promotion is adapting. It has grown dramatically from where marketers only used offline media as the primary medium to the current situation where being present in online media is necessary.

One of the edges by using online marketing is to achieve profitable acquisition and retention of customers with enhanced monitoring. Putting together online and offline marketing is what is called the integrated marketing strategy. The strategy combines several marketing channels to consolidate communication. This gives marketers a holistic approach to consistent messaging and cross-channel coordination. The other attribution to this approach is the possibility of receiving data integration reports, as examined by some marketing and information systems literature studies.

The marketing industry relates to the fundamental 4Ps marketing mix. This framework was introduced in the 1960s which consists of four key elements; products, price, place, and promotion. The 4Ps Framework is commonly used to design marketing plans appropriate to their target market by “developing the ‘right’ **product** and making it available at the ‘right’ **place** with the ‘right’ **promotion** and at the ‘right’ **price**, to satisfy target consumers and still meet the objectives of the business.”. While the 4Ps are more related to influencing customers to make decisions, there was a framework adaptation to the 7Ps that is mainly relevant to the service industry with customized offers. They are the **people** of the company who are in charge of interacting with target customers, the customer journey **process for** positive experience, and the **physical evidence** where the services take place and physical evidence as a proof of the services provided.

Another crucial aspect of marketing is the communication medium to utilize. Practically, there are three types of marketing mediums, which are paid, owned, and earned media. The **paid media** refers to a paid advertising placement for promoting the goods or services. The **owned media** are media assets that a brand or corporation owns. While **earned media** is the brand exposure in any media that is earned purely with efforts rather than payment, such as a product review in an online article from a publisher.

Digital Marketing Growth

According to the reports of global digital device ownership in January 2023 (WeAreSocial, 2023), it can be seen how most people now already own a smartphone (95.9%), compared to how feature phones are left behind. Meanwhile, there has also been an increase in the ownership of other digital devices, such as smartwatches, TV streaming devices, and smart home devices.

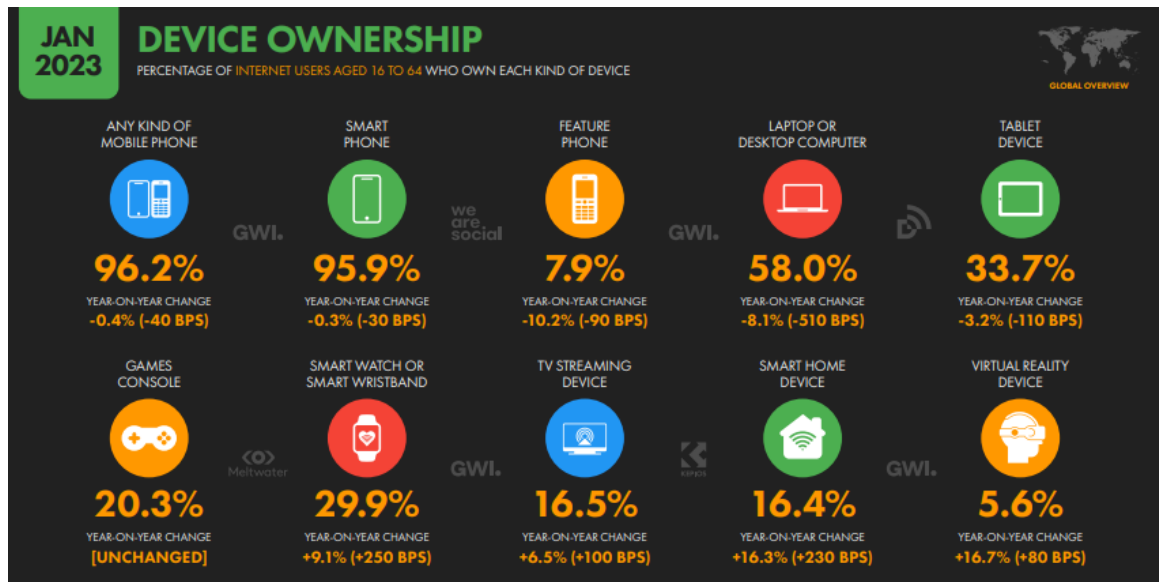


Figure 13: Global Device Ownership, Jan 2023. Source: (WeAreSocial, 2023)

The features of smartphones allow the user to connect to the internet. Hence, we can expect an increase in internet use, even though it is not the only factor. The research shows how internet users have rapidly grown since 1991. In 2023, it is reported that there are 5,158 million internet users globally.

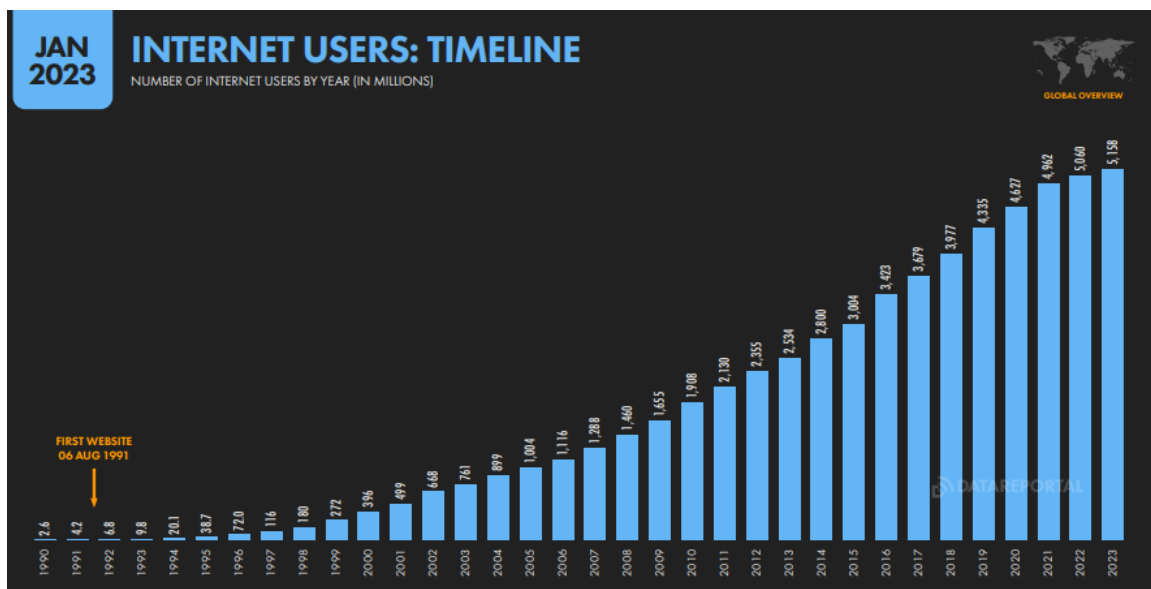


Figure 14: Number of Global Internet Users by Year (in million). Source: (WeAreSocial, 2023)

Breaking down internet adoption, the majority of continents have access to the internet, making the global average of 64.4%. It is highlighted that some areas still have low internet penetration, under the worldwide average, such as in Africa (western, middle, eastern) and Southern Asia.

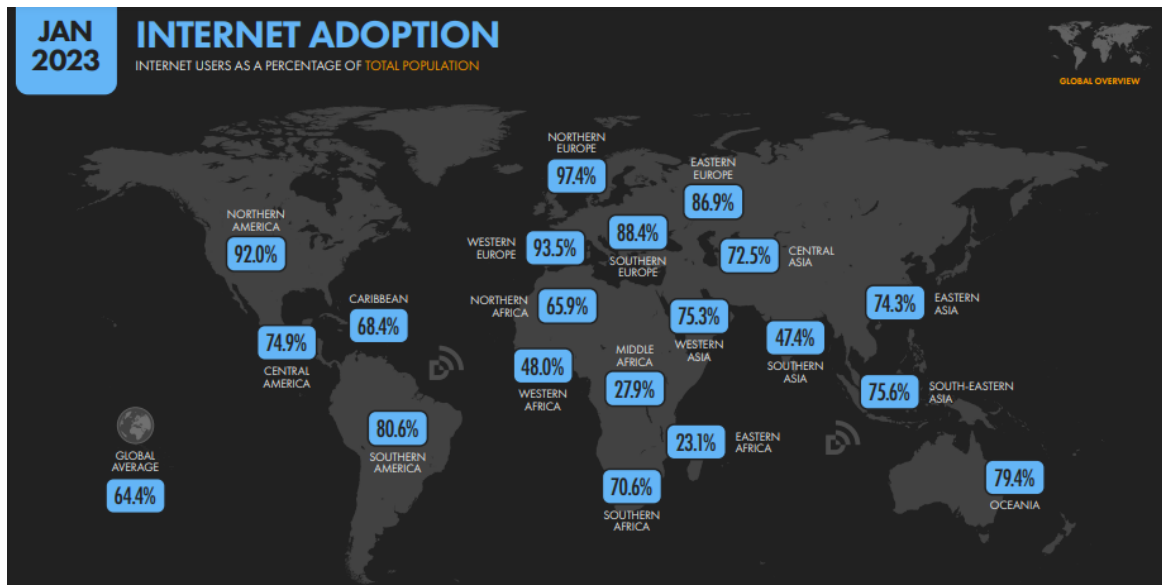


Figure 15: Global Internet Adoption, Jan 2023. Source: (WeAreSocial, 2023)

Despite the limited internet connectivity in some regions, internet usage has increased steadily in more countries, and the growth trend is expected to continue. Therefore, digital marketing allows advertisers to establish competitiveness within their industry by utilizing digital marketing.

In addition to the increasing consumer behavior in digital media, digital marketing has also advanced to be utilized. Below are some points of the advantages of using digital marketing:

1. **Broad and segmented reach.** Unlike offline marketing, which mainly targets local markets, any advertiser can specify their marketing campaign to a broader audience (worldwide) while keeping the audience segmented. Digital marketing allows advertisers to choose a segmentation filter by particular behavior, characteristics, and other factors.
2. **The optimization.** Online marketing analytics tools enable the advertiser to collect data fast at any time to optimize the strategy and possibly to make changes.
3. **Measurable result.** Digital marketing is more measurable as it allows advertisers to choose metrics for Key Performance Indicators (KPI) for their business. Quantifiable metrics are essential in marketing to be integrated into overall business strategy.

4. **Cost efficiency.** Digital marketing allows the advertisers to pay the marketing budget depending on the campaign objective. Whether it is paid per click, view, impression, or others. This rule may result in the marketing budget being more effective.
5. **Brand building.** Digital marketing can help establish credibility and trust, as it may allow two-way communication between the advertisers and the target audience. For instance, users may comment and react directly to the brand on social media.

The point of measurable results in digital marketing is effortless and a good way for marketers to review their overall marketing strategy.

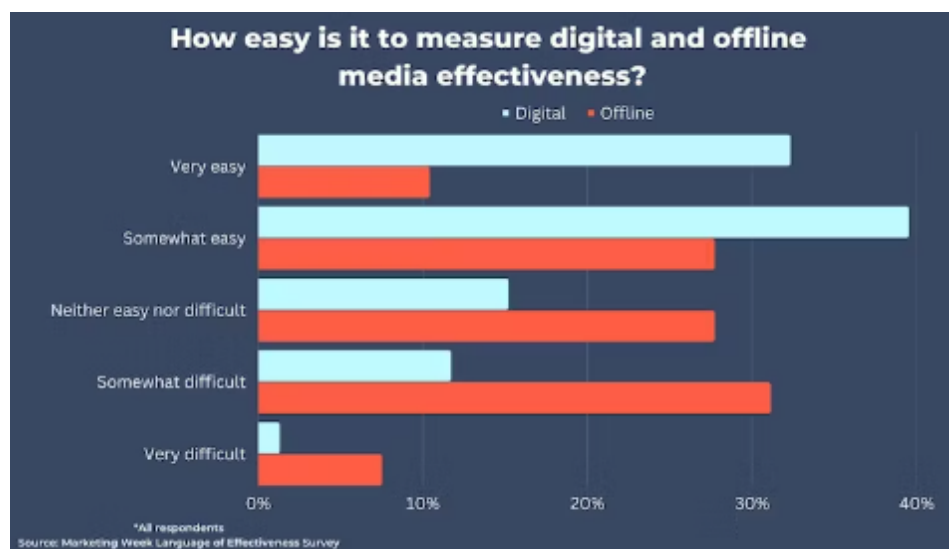


Figure 16: Digital vs Offline Media Measure Effectiveness. Source: (MarketingWeek, 2023)

A survey result by MarketingWeek publisher (MarketingWeek, 2023) stated that most marketers agreed that it is easier to measure the effectiveness of digital marketing campaign results in comparison to measuring the results of offline marketing campaigns.

Marketers benefit from the presence of digital marketing and big data acquired from users. According to GWI (Q2 2023) data, the average daily global time spent using the internet has reached up to 6 hours and 41 minutes by accessing the internet through mobile phones (95.8%) and laptops or desktops (62.9%). The digital world has trended e-commerce, benefiting business owners and consumers. For the past few years, adopting e-commerce has also impacted the possibility of small new business growth, resulting in the expansion of entrepreneurship and the economy. This transformation allows businesses to reach a broader audience, even globally.

We are entering an era where it is essential to integrate customer contact points throughout the distribution channels to achieve marketing targets (Kotler P. K., 2016). Hence, understanding

the needs, requests, desires, behaviors, and demands of the customers' big data is crucial to creating customer value in a business.

There are several ways for a brand to communicate its products or services to the target market through an online medium. The types include Search Engine Optimization (SEO), Social Media Marketing (SMM), Search Engine Marketing (SEM), email marketing, content marketing, paid-per-click (PPC), and influencer. Each can be utilized for different campaigns with distinct objectives, targeting different customer journey stages.

Despite the fact that digital media is increasing, several studies and experts argue the importance of including offline advertising. Adding offline media allocation for marketing could lead to better performance in some cases, depending on factors such as the campaign's background, objective, and target market. Hence, it is vital for marketers to consider an integrated marketing strategy in the plan and to understand which media mix is needed for the campaigns.

The Importance of Research Market in Digital Marketing

As outlined in the preceding subsections, marketing content creation requires market research to be well-executed and impactful to the audience and market result. The statement of Philip Kotler (Kotler P. , 2003) underpins this view, "the organization's marketing task is to determine the needs, wants and interests of target markets and to achieve the desired results more effectively and efficiently than competitors, in a way that preserves or enhances the consumer's or society's well-being.". Generally, the research market's importance lies in strengthening decision-making for business growth. The outcome of content marketing is not solely impacted by creativity, yet depends on the objective of a campaign; the result could be measured in awareness level, interest, traffic, and even sales growth.

According to an article by Kantar (Kantar, 2023), that is an analytics company of marketing data and insight, there are at least five main reasons that marketing research is essential for a brand marketing strategy. The points are:

1. Understanding Customers

When a marketer sells products or services, it is an essential step to understand the market they approach to create a consumer-based strategy, which means understanding their demographic, needs and wants, preferences, and behavior. The consumer-based strategy is the organizational strategy developed based on the consumer's insight

(Hamilton, 2016). A distinct market segment could lead to a different communication and strategy. For instance, there is a different pricing sensitivity between generations of age differences. The research can help a brand fully understand its potential customers. If the brands already understand the behavior of their target market, it would be possible to map out the communication strategy and touchpoints in each marketing stage for a certain customer segmentation.

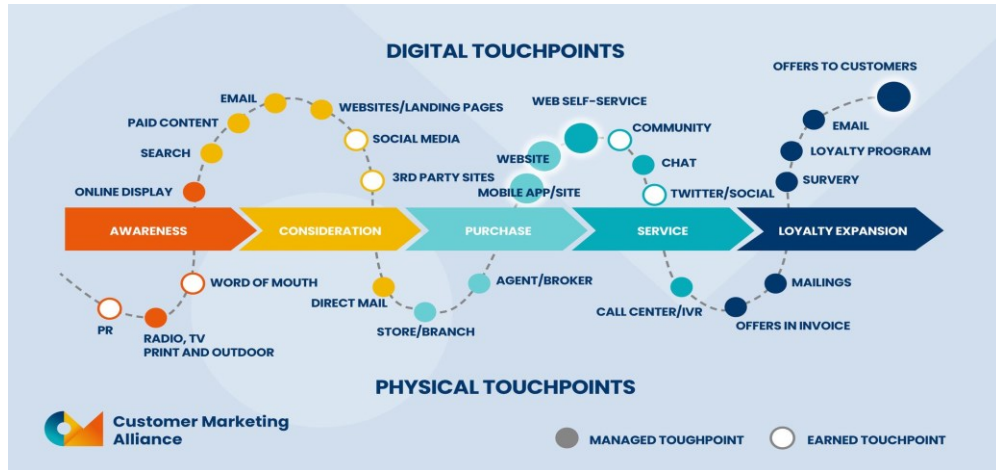


Figure 17: The Customer Journey in Marketing from Awareness to Loyalty. Source: (Alliance, 2023)

2. Risk Management

The marketing industry is always dynamic, and a business can be impacted at any time if there are any changes in trends. However, with a complete comprehension of the audience's behavior, the risk can be anticipated. For instance, regarding price sentiment, a brand could do a testing comparison between two or more prices before launching a product. To this end, the risk of marketing failure could be minimized.

3. Staying Competitive

In addition to understanding their target market, it is always best for a marketer to understand any trends and activities of the sector they work for. With a lot of competition in the market, a brand should answer consumers' needs with differentiation and uniqueness to avoid being a "typical product" like many others (Puzakova, 2018). Hence, it would benefit a brand to be unique and differentiate in customers' eyes. Moreover, understanding the competitiveness level in the market competition indicates the possibility of tapping into new, unexplored opportunities. It could result in market growth if done correctly.

4. Measuring Success

The brand must set up a Key Performance Indicator (KPI) to clarify the marketing objectives. Thus, the marketing person can optimize the campaign and precisely measure success at the end of the campaign. This is because, upon distributing marketing content to the public, the marketing person shall monitor and optimize the campaign. However, there could be factors other than marketing activities that impact the fluctuation of sales in products or services, such as increasing or decreasing expenses that a company has to pay in manufacturing. Hence, with market research, advertisers can thoroughly analyze the other factors.

The brand usually decides the measurement of marketing success. Some examples are:

- market awareness level of the offered goods and service
- comments and feedback from customers
- insights comparison to the competitors
- any other measurement that is considered to be the influential growth factor

Using a marketing funnel to check the marketing performance is also possible by evaluating the campaign performance result at each stage of the funnel.

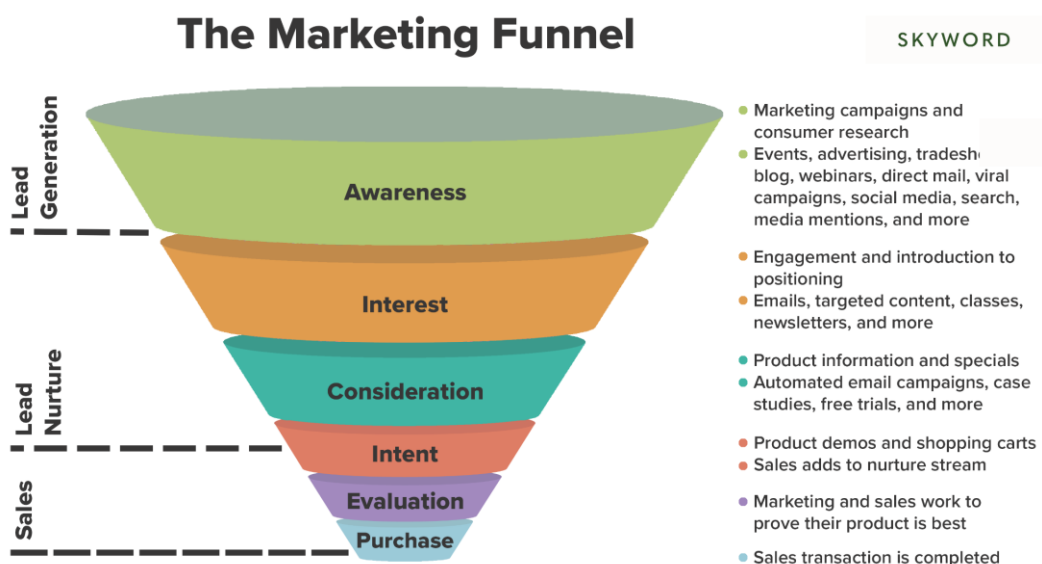


Figure 18: Marketing Performance in The Marketing Funnel. Source: (Skyword, 2024)

There are some stages in the customer marketing funnel: awareness, interest, consideration, intent, evaluation, and purchase. It is essential to take into consideration

that the first funnel (awareness) is generally the easiest stage to achieve, and the one-stage after is more challenging.

5. Informed Decision Making

Marketing now commonly applies the process of data-driven decision-making, which means that metrics and analytics support any decision-making related to the business. This is a positive aspect, as the given data could reduce the unwanted risk.

Hence, with all the points mentioned above, marketing research has a critical role in creating a robust brand marketing strategy, which marketers shall implement before creating creative marketing content.

The Process of Constructing a Marketing Campaign

The general flow of constructing marketing campaigns involved various essential steps. As described in the previous subsection, the processes could involve numerous individuals.

Marketing Process Cycle

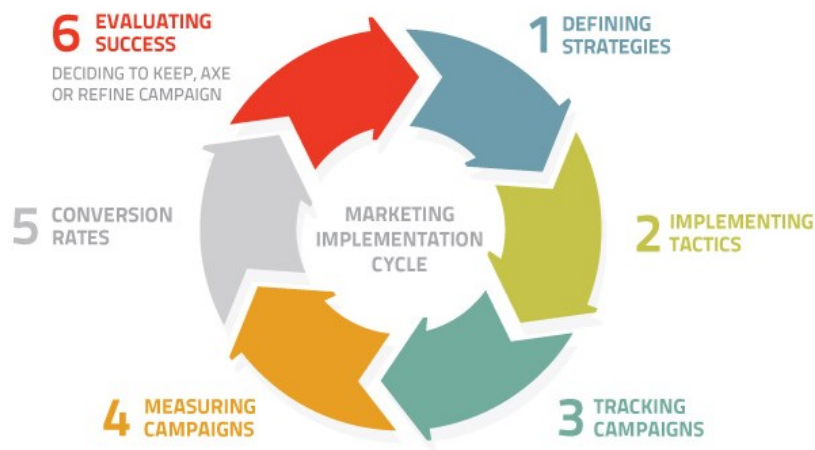


Figure 19: Marketing Implementation Cycle. Source: (DMD-Agency, 2023)

The marketing implementation cycle starts with defining the objectives and strategies of the campaign. In this first phase, the marketers can clarify the objectives they want to reach, the key performance indicators after the completion, and the budget for overall activity. With a clear direction of what to achieve, marketers should understand the target market and audience. Knowing the demographics, customer interests, behavior, and other relevant factors is essential to developing further strategy.

Moving forward, market research shall be conducted to understand better the audience, industry, competitors, and current market trends. Various initiatives could be made, such as developing a unique selling proposition (USP) for the product or service in the market. Then, the overall efforts above shall result in information and insights to develop the strategy marketing and communication plan, including the media placement strategy.

The implementation can be done by creating the creative based on media selection, publishing the campaign, and keeping track of the performance. Refining a campaign to make improvements or adjustments to enhance its effectiveness could be done, if needed, to reach or surpass the goals set at the beginning.

The last thing to do after the implementation is to measure and analyze the result, namely, how the media and creatives performed for the target market. Another market research could be implemented to know several aspects of the campaign results, such as if the communication impacted the brand image, interest, consideration, etc.

Artificial Intelligence (AI) and Marketing

While the progress in automation and AI technologies resulted in replacing numerous human jobs, the equilibrium between impact and opportunity is adjusting. In this case, AI has created new jobs in marketing and advertising, such as roles within the tech industry dependent on advertising-generated revenues, positions in advertising technology firms, and jobs related to data analytics.

However, the advertising industry has, indeed, highly initiated the adoption of AI to amplify operational efficiency, generate innovative campaign ideas, and enhance the precision of ad targeting and personalization. The development of generative AI is anticipated to create a more significant impact in the marketing and advertising industry (Huh, 2023).

Following projected data by Statista, the market for artificial intelligence (AI) in marketing was estimated at 15.84 billion U.S. dollars in 2021. It is also projected that the value will increase to more than 107.5 billion by 2028.

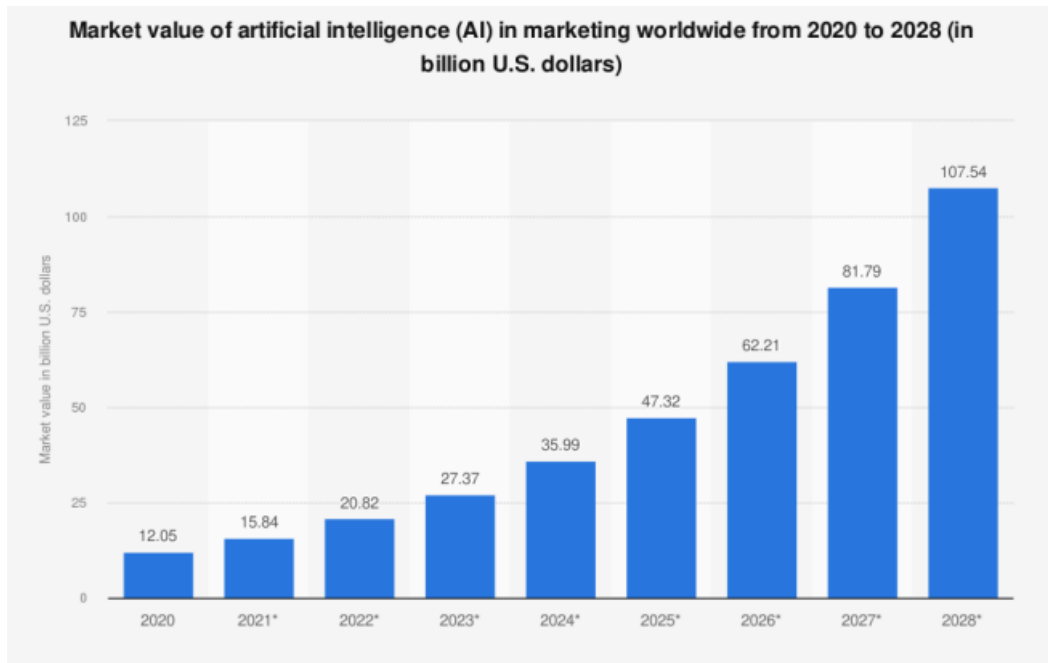


Figure 20: Expected AI Market Value Worldwide in Marketing Sector, 2020 to 2028.

Source: (Statista, Advertising & Marketing Report, 2023)

In a survey held by Statista across marketers who use AI in 35 countries in 2021 and 2022, the most used capability of AI lies in automatic interaction (chatbot), customer personalization, and process automation, which was reasonable as that was how AI improved digital marketing before the advent of GPT.

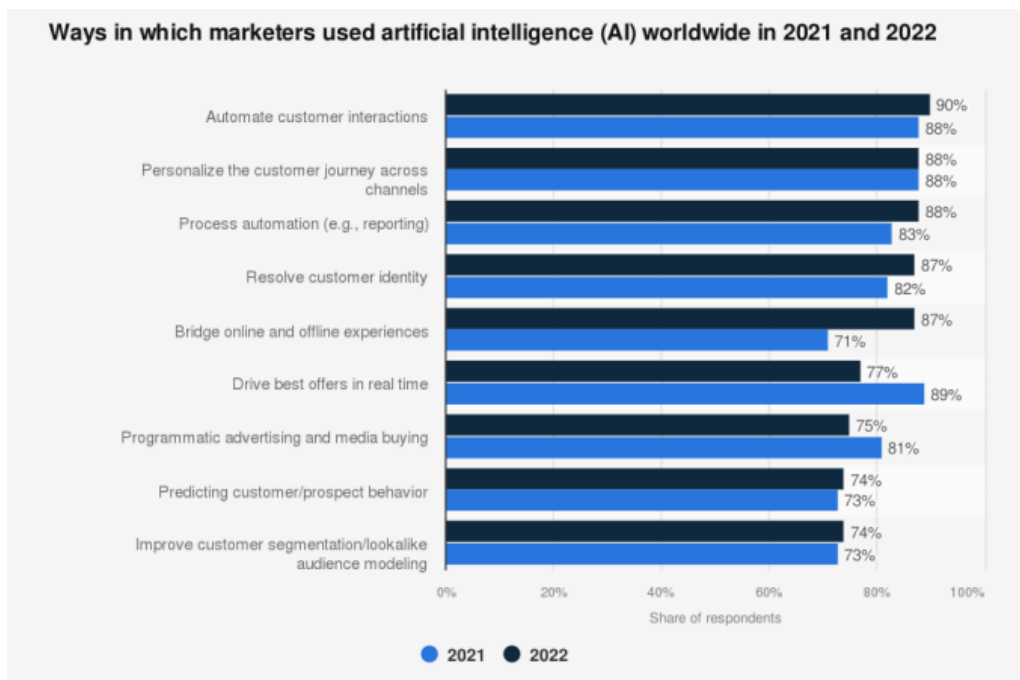


Figure 21: AI Usage for Marketers Worldwide across 35 countries, in 2021 and 2022. Source: (Statista, AI Report For Marketers Usage, 2023)

The AI advancement in marketing affected the workflow of this sector. A report among brand marketers in the United States in March 2023 stated that around 70 percent of respondents are excited about the ability to do faster market research on prospects and customers with the advancement of AI in marketing, followed by an interest in content creation with text generation.

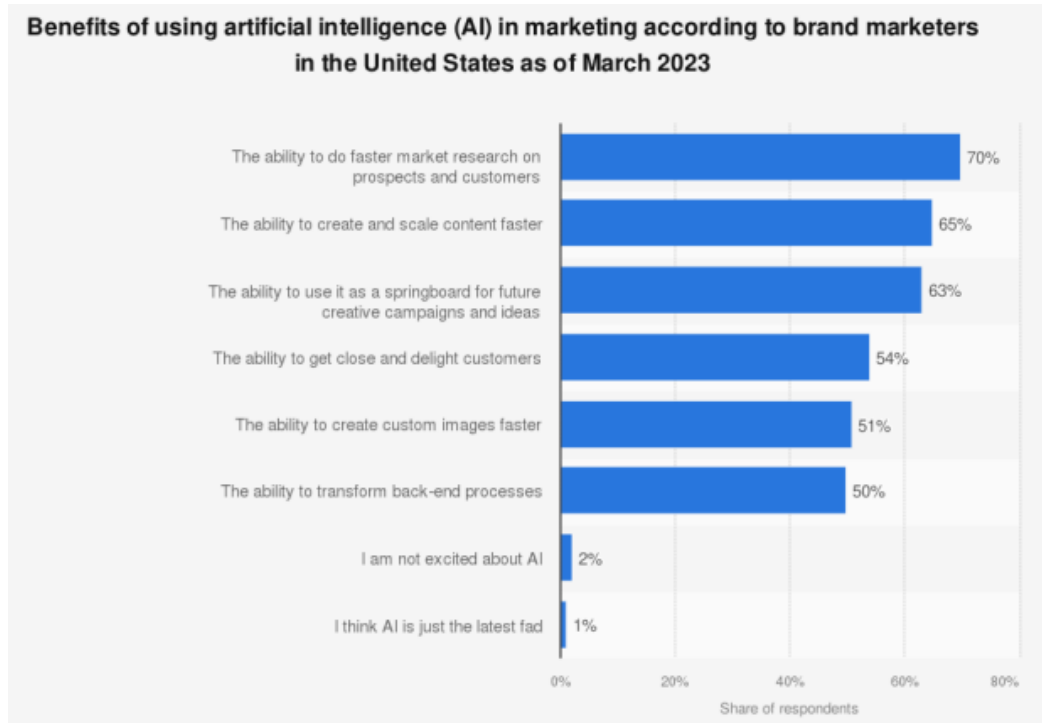


Figure 22: AI Benefits in Marketing Sector in US Market, until March 2023.
Source: (Statista, AI Benefits For Marketing, 2023)

It concludes a great interest from the practice and space to grow AI in the marketing field. Referring to the information from (Davenport, 2020) the most significant potential value of AI is concentrated in areas associated with marketing and sales (Chui, 2018).

AI Strategic Framework in Marketing

With the increased importance of AI in marketing practices, a study explored how natural human intelligence works in this industry, analyzing the connection between the stages of developing a marketing campaign and multiple AI benefits (Huang, 2021). The intelligences are divided into three categories; mechanical, thinking, and feeling which are explained below:

Mechanical AI	The intelligence applications that focus on automating repetitive tasks by following a set pattern include machine translation, remote sensing, and clustering algorithms. Due to its focal point on repetitive
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	tasks, it resulted in a uniform standardization.
Thinking AI	The intelligence that enables machines to create conclusions and decisions based on preceding data received. This process involves more complex analysis, including the unstructured ones, making it possible to develop personalization output capability—for instance a music recommendation on a digital platform.
Feeling AI	Intelligence that manages to focus on two-way interactions of humans and analyze their feelings and emotions. Acknowledging emotions in conversations could be helpful for marketing strategies dealing with customer experiences to build a positive relationship with them.

Table 1: The Artificial Intelligences Categories. Source: (Huang, 2021)

The implementation of AI intelligence relies on the intended purposes. However, in this study, the case that was done (Huang, 2021) interpret the applications of the three AI intelligences in the marketing process: a repetitive action starting from marketing research, strategy development, and implementing the action. Each stage is benefited by the AI intellectual, as illustrated in the following figure.

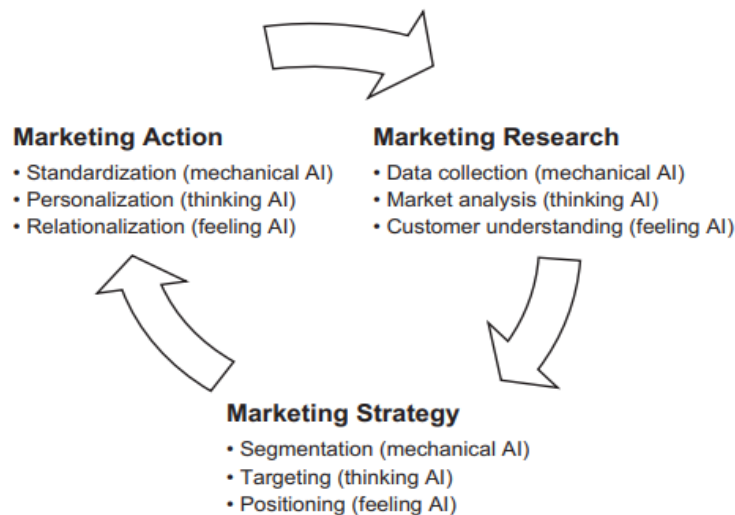


Figure 23: Marketing Stages and The AI Category. Source: (Huang, 2021)

The first stage is marketing research. It is the first essential process to understand the market and customer needs and wants. The process involves collecting data on related market information and analyzing the data.

Mechanical AI allows marketers to automate behavioral data collection of their market, such as customers' and competitors' data and survey and experimental data. Then, the thinking AI lets the machine work at a higher level, such as recognizing competitors or exploring new market opportunities. It can also generate insights into a product's competitive advantages to outperform competitors. Lastly, the feeling AI, with its ability to understand customers, could provide information on the customer's needs and wants with further details on the emotional data (sentiments, feelings, preferences, and attitudes).

The second stage is the marketing strategy, a strategic plan marketers or organizations develop to achieve their goals. It involves defining market segments, the right target market to approach, and brand positioning to the audiences.

The mechanical AI, with its clustering ability, could distinguish a broad customer's data into different smaller group segmentation, namely market characteristics, demographics, behaviors, or preferences. This would result in a better resonance of the marketing strategy on discrete customers. Subsequently, the segmentation is followed by thinking AI, which can be used for targeting. Targeting is the operation of choosing the right segment to focus the firm's marketing actions, and this can be done by the recommendation from thinking AI as it can process knowledge and intuition. For instance, the current practice targets recommendations on social media by using customers' historical interests, content, and connections (Liu, 2020). Finally, the feeling AI in marketing strategy can be advantageous for positioning, a brand strategy to maintain a desirable perception in customers' minds about their products and competitors. One of the ways is the positioning of a brand through its communication (for instance, a slogan). With AI advancement, it is possible to develop compelling slogans by understanding what resonates best for the target customers.

The third stage is marketing action, which refers to the marketing activities executed after all the initiatives are organized in a business plan. In this study, this progress specifically involves standardization, personalization, and relationalization. This study's discussion is structured by analyzing the three intelligences with a marketing framework of 4Ps (product, price, place, promotion) and 4Cs (consumer, cost, convenience, communication).

Product - Consumer: they illustrate the decision by using product/branding to represent the product and customer service to represent the consumer side. With mechanical AI, product/branding can be standardized automatically. For instance, the automatic generation of social media content to form equal tone, style, and messaging. Meanwhile, generating standardized online customer service chatbots can be helpful for the customers' side. The

thinking AI can be useful for personalization, such as giving personalization recommendations for product/branding and more advanced chatbots with natural language processing (NLP) to handle multicultural customers for the consumer's side. The last application on feeling AI can be done through rationalization, image brand tracking with text and sentiment analysis on social media for product benefit, and improving customer service agents to make conversations more natural and engaging by analyzing customers' feelings (e.g., customers' energy and empathy).

Price - Cost: Mechanical AI can be used to standardize transactions, such as automatic payments for online marketers. The thinking AI, instead, helps analyze cost preferences and personalize them for the customers. Some studies show how, recently, adjusting online pricing for optimizing sales could be done for customers by using pricing algorithms considering parameters such as customer choices and competitor actions. The last one is feeling AI, which can be used for rationalization negotiation price sentiment, including interaction and communication.

Place - Convenience: Regarding the place and convenience where customers can access products, mechanical AI can automate the service and retail by using IoT, while service robots can present convenience in the frontline; hence, customers are facilitated equally. The thinking AI could facilitate personalization in-store shopping, while feeling AI, in this case, helps marketing rationalization of the interactions for a higher satisfaction.

Promotion - Communication: with the brand promotional plan, mechanical AI can adjust automation in various operations, such as automatic planning, scheduling, and posting. Furthermore, the current trend of generating text and content with natural language processing is part of the thinking AI, as it uses the personalization ability in generating requests. The next step is feeling AI, which can analyze customers' responses to the marketing campaign, whether the sentiment feedback is negative or positive. It assists brands in taking into consideration the next steps of their marketing activity.

The explanation above concludes that AI intelligence in mechanical, thinking, and feeling could be associated with marketing. Notwithstanding the benefits derived from the technology, this study shows some limitations that could occur in practice. There is still a chance of data fallacy that may affect the process results, and collecting the data for model training may pose challenges related to invading customers' privacy issues. Some customers may also need more preparation or willingness to engage with feeling AI, as it is still growing and relatively new. However, it is apt to affirm that AI has made a lot of improvements in the marketing industry,

especially the AI mechanical and AI thinking that improves upon human thinking capability. With this, the AI feeling tasks could eventually be developed further.

AI Usage in Digital Marketing Practices

An article by Chintalapati (Chintalapati, 2022) illustrates a categorization of functional AI in marketing that is distinguished into five big groups with several sub-functional items. They are comprehended of integrated digital marketing, content marketing, experiential marketing, marketing operations, and market research.

Artificial Intelligence in Marketing Activity

Theme	How AI Has Transformed The Landscape
Integrated Digital Marketing	<ul style="list-style-type: none"> Intelligent search Recommendation system Programmatic advertising
Content Marketing	<ul style="list-style-type: none"> Content creation curation Automated insights Content personalization
Market Research	<ul style="list-style-type: none"> Customer segmentation Consumer behaviour Data mining
Experiential Marketing	<ul style="list-style-type: none"> Voice recognition Visual Transformation Image recognition
Marketing Operation	<ul style="list-style-type: none"> Marketing automation Forecasting Predictive analysis Campaign execution

Table 2: AI Application in Marketing Activity

Integrated digital marketing refers to synchronizing online marketing channels to optimize marketing activity for target audiences across multiple platforms. The application of AI, in this case, includes search platforms that deliver personalized content and recommendations to internet users based on their preferences and interests. Another example is the recommendation system that website platforms such as Amazon, Spotify, and Netflix provide users based on historical searches.

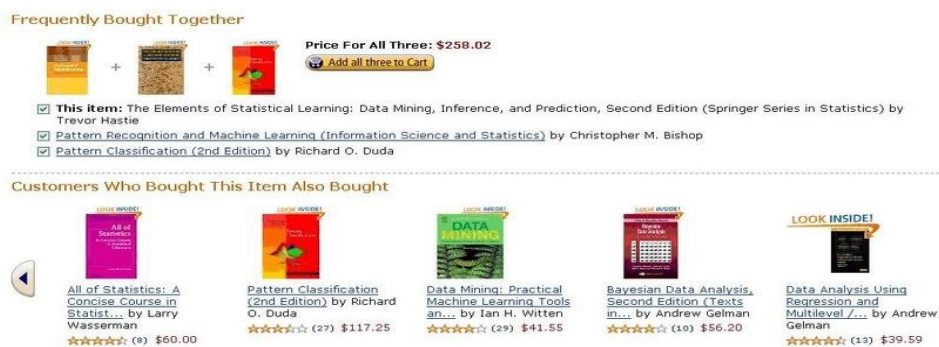


Figure 24: An Example of Recommendation System on Advertising

In the image above, we can see how online platforms give book recommendations to users correlated to the other user's behavior on purchasing similar products. A further case is programmatic advertising (e.g. YouTube ads and Google Ads), a digital advertising buying method where the process could be automated based on data-driven insights and user behavior.

In content marketing, AI employment can be helpful for the operation of content curation, automated insights, and content personalization. This means that a marketer can utilize AI algorithms to analyze their marketing content's performance or sentiment from the public – sorting content based on criteria that the users put, such as keyword, type, and industry. The aim is to generate insight and understand what content types perform more effectively. Based on the preferences report, the AI system could suggest user content recommendations. For instance, Google Analytics, an advertising platform to collect data from websites and apps to create reports that provide insights for business.

Market research, as one of the crucial stages before executing marketing campaigns, is also accelerated with AI. The algorithm for analyzing extensive data volumes could offer real-time and actionable insight into marketing strategy (Mallikarjunaradhya, 2015). The critical aspect to emphasize is that implementing data hosting, data mining, and data visualization of the customer report with the support of AI revolutionized the way marketing data is handled and interpreted.

Experiential marketing focuses on creating direct, immersive experiences for consumers to interact with their brand. This study explores voice recognition, visual transformation, and image recognition. The practical use includes conversational chatbots, intelligent personal assistants (e.g. Google Assistant, Siri on iPhone mobile), service robots, and self-driving vehicles. Experiential marketing ranks among the most cutting-edge technologies and heavily financed sectors in marketing.

The last group is AI applications in marketing operations, where AI revolutionizes the traditional approaches to operation. AI has changed the function of its automation process, forecasting and predictive analysis, and executing campaigns. For instance, Salesforce (a cloud-based Customer Relationship Management (CRM) platform) uses AI for automated campaign execution, lead scoring, and personalized customer journeys. With its ability to support marketing operations, machine learning techniques enable marketers to analyze information to find answers on complex strategic questions.

3. Artificial Intelligence in Marketing Industry

The Application of Generative AI in Marketing

As the consumer follows the technology trend, marketing consequently transforms the strategy and way corporations communicate to the consumers. The marketing practices are also rapidly influenced by the advancement of AI, specifically with the Generative AI.

The main effects of Generative Artificial Intelligence (GAI) asserted on its marketing content creation and market and customer insights generation. The illustration below shows how those propositions connect with the rest of the marketing objectives.

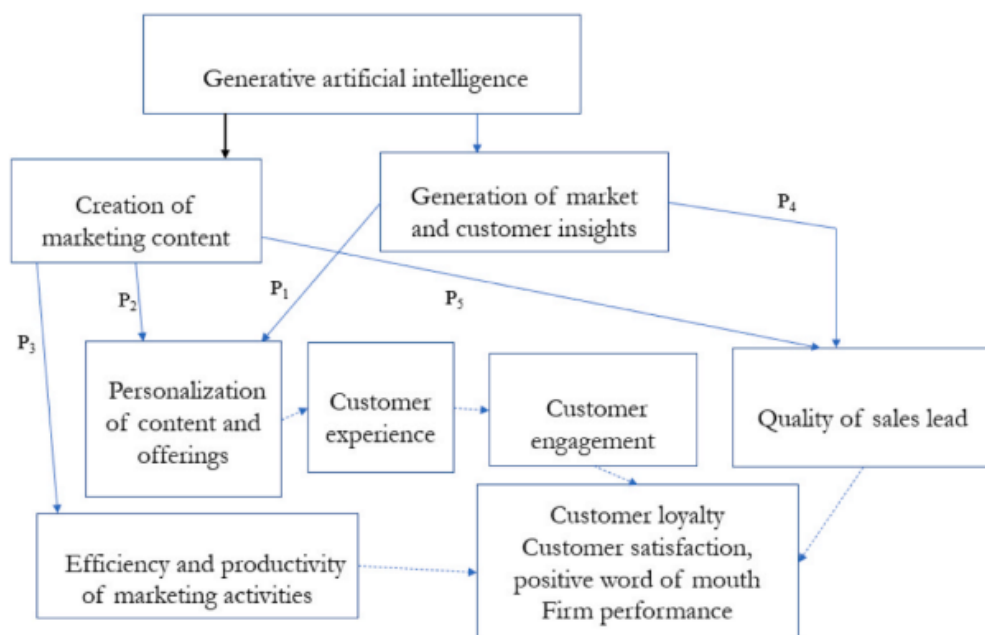


Figure 25: The Effect of Generative Artificial Intelligence on Marketing Processes and Outcomes. Source: (Kshetri N. D., 2023)

This is related to three main points: efficiency and productivity of marketing activities, personalization of content and offerings, and quality of sales leads. Each point applied in the practice of marketing could lead to a positive impact on customer loyalty, satisfaction, and performance of the brand in general.

The first feature is the efficiency and productivity of marketing activities. It is asserted that Generative AI tools can reduce the time and price consumed in developing marketing content compared to the earlier generations of technologies. One of the tasks that is related to this point is data analysis that is related to consumer feedback – by identifying and categorizing customer sentiment.

The second feature of GAI is its ability to personalize content by crafting responses with a personal touch. It could provide tailored communication, presenting either text or image results tailored to specific target markets. As illustrated in the GAI processes and outcomes above, personalization is believed to lead to a positive customer experience and engagement, which results in favorable satisfaction. A handful of cases include creating email marketing, social media posts, blogs, infographics, and chatbots.

Personalization is also valuable for market or customer insight generation to understand customer behavior or attitude. For instance, a customer purchased insight in the past that could help in personalized recommendations. As the tools gradually adapt and learn, the system could improve recommendations as additional data is incorporated, leading to more accurate suggestions.

The last feature of content creation results in the quality of sales through insight generation with a higher quality that could improve behavioral targeting. The system of GAI tools content is more effective and captivating compared to the earlier technology generation (Kshetri N. D., 2023). It is useful to craft personalized communication that resonates with the audience

Opportunities of Generative AI For Marketing Research

The growth of Generative AI and its application to the marketing industry shows positive signs of improved effectiveness and performance. It is comprehended that in the current marketing cycle, the most supported process with generative AI lies mainly for content creation.

Referring to several studies summarized by Kshetri N. D, (Kshetri N. D., 2023) on generative AI applications surveyed among marketing professionals in early-middle 2023, it was observed that most users who employed this technology utilized it for creating marketing content and personalization. Additionally, some users harnessed it to generate insights about their customers. Numerous articles indicated a higher performance in the function. It is estimated that the productivity of marketing functions with Generative Artificial Intelligence could reduce marketing expenditures by a range of 5% to 15% (McKinsey&Company, 2024).

Comprehensive Overview of GAI use among marketers

Survey conducted by	Conducted/ released in (respondents)	Key findings	Additional findings
Salesforce in partnership with YouGov (Salesforce. 202)	Conducted from May 18 – 25, 2023 (1029 marketers)	51 % using GAI. An additional 22% had plans to use the tools “Very soon”.	GAI saves marketers over five hours of work per week
Boston Consulting Group (Ratajczak et al., 2023)	Conducted in April 2023 (>200 CMOs from several sectors in 8 countries in North America, Europe, and Asia)	70% using GAI and 19 % were testing. Only 3% had no plans to use the technology	Top 3 uses: personalization (67%), insight generation (51%) and content creation (49%).
AI-powered marketing chat solution provider Botco.ai (StreetInsider.com, 2023)	Conducted in March 2023 (1000 marketing professionals)	73% used GAI tools to create marketing content	Most common benefits expected from GAI: increased performance (58%), increased creative variety (50%), cost efficiencies (50%), faster creative cycles (47%), ability to learn and improve (39%), augmentation of human creativity (34%)
The Conference Board, in collaboration with Ragan Communications (The Conference Board, 2023)	August 2023 (287 marketers and communicators)	87% of marketers had used/ experimented with AI tools	Top applications: summarizing content (44 %), doing the legwork/stimulating creative thinking (41%), personalizing of customer/user content (33%), research (30%), generating content faster (30%), enhancing customer service (17%).
Software company Sitecore (“AI & Composable Marketing Software Survey”) (Sitecore, 2023)	March 2023 (over 400 marketing professionals in the U.S.)	> 80 % experimented with AI. 78 % believed GAI can help get “closer” to “desired Customer	Mechanisms by which GAI can help closer to customers: more personalized content (75 %), a better understanding of customer needs (74 %),

		experience” (7% worried it might make it more “distant”).	ability to provide a stream of relevant content (67%) (Bennett, 2023a).
Management consulting company Chief Outsiders	2023 (80 CMOs with Fortune 500 experience) (Chief Outsiders, 2023)	Areas in which GAI tools are likely to provide most value (score out of 8): content creation and management (7.37), market research and competitive insights (6.1), digital marketing (5.6)	Improving the customer experience (5.08) Marketing technology strategy, adoption and use (4.41)

Table 3: Comprehensive Overview of GAI use among marketers. Source: (Kshetri N. D., 2023)

To provide further insights on this subject, this thesis explores additional considerations by outlining opportunities for utilizing Generative AI in marketing, specifically with ChatGPT. It underscores its potential role in marketing research—a crucial aspect of the marketing process that has received modest recognition compared to the other uses.

Some relevant studies demonstrate that, in addition to its rational computations and creative abilities, ChatGPT also exhibits similar behavior to humans, including human irrationality in the decision-making process. This nature shows ChatGPT’s potential in behavioral research, making it a valuable tool for marketing practitioners in doing marketing research.

A research paper performed trials on ChatGPT to understand its response with several social game experiments: the prisoner's dilemma, ultimatum game, and trust game (Azaria, 2023). The social games are multiplayer games with assessments over each game that require ChatGPT to select an action, and the outcome may depend on their actions. There was a presumption that the computer may respond with more rational behavior over human-like feedback. Conversely, the result showed the opposite: ChatGPT's response to the social game experiments turned out to be similar to how humans would respond initially.

Incorporating additional insights into this research, the author also examined a variety of cognitive biases studied in humans and demonstrated it with ChatGPT. One of them is an intuition bias test. With the perspective that people favor quick, intuitive assessments over thoughtful reasoning, they asked ChatGPT about the bat and ball problem.

USER: A bat and ball cost together \$1.10. The bat costs \$1.00 more than the ball. How much does the ball cost?

CHATGPT: The ball costs \$0.10. The bat costs \$1.00 more than the ball, so it costs $\$0.10 + \$1.00 = \$1.10$. Together, the bat and ball cost \$1.10.

USER: That's incorrect, try again.

CHATGPT: I apologize for the mistake. Here is the correct solution: The bat costs \$1.00 more than the ball, so if the ball costs "x" dollars, the bat costs x+1 dollars. The cost of the bat and ball together is \$1.10, so: $x + (x+1) = 1.10$ $2x + 1 = 1.10$ $2x = 0.10$ $x = 0.05$ The ball costs \$0.05.

Figure 26: Intuition Bias Test Prompt in ChatGPT. Source: (Azaria, 2023)

As demonstrated in the visual representation above when the paper was published, the initial response of ChatGPT of this cognitive reflection test was incorrect until it was asked again to answer the correct calculation. It is a captivating result as it shows how ChatGPT indicates similar cognitive biases observed in humans. One of the notions underpinning this analysis is that the training data used is modeled based on human-generated text, and the training method relies on human input (Azaria, 2023).

Another research about cognitive process of ChatGPT analyzed in the paper "Is ChatGPT Humanly Irrational?" (Ma, 2023). The authors did an experimental test on ChatGPT regarding its capability in decision-making, and the result indicated its patterns closely resemble human subjectivity. The result assumption is similar to the previous research discussed in this subchapter. Regardless of the algorithm system it uses, ChatGPT shows a tendency to replicate human cognitive biases and irrational decision-making tendencies (Ma, 2023).

The study observed several behavioral experiments on how ChatGPT performs decision-making under risk, uncertainty, and variable utility conditions. The tests were held with seven theories related to psychology, behavioral economics, and decision theory. The decisions are divided into two categories: discrete decisions and continuous decisions.

The discrete decisions were tested with five concepts: 'Gamblers' Fallacy,' 'Loss Aversion' and 'Framing Effects,' 'Effect of Relativity,' 'Effect of Zero Cost,' and 'Ultimatum Game.' Meanwhile, continuous decisions were tested with the concept of 'Effect of Ownership,' 'Anchoring Influence,' and 'Ultimatum Game.' All of the experiment's results were compared to the pattern that has been identified in humans. It is concluded that all observations done with ChatGPT possessed the same pattern as how humans usually act, with a likelihood of demonstrating human irrationality in making decisions.

In essence, both studies underscore the premise that generative AI, particularly ChatGPT in this context, emphasizes the potential for application in human behavioral research. The tests reveal patterns in human thinking and decision processes that extend beyond strict rationality, often influenced by psychological factors in concrete situations.

4. GPT For Marketing Research

This chapter presents the project's motivation, objective, methodology, implementation and results.

Introduction

Throughout the preceding groundwork on Generative AI growth and its intersection with marketing, it is intriguing to see the potential in this sector. The preceding chapters have delved into crucial aspects such as machine learning, deep learning, and the emergence of advanced Generative AI. The relationship between marketing and customer behavior is also an essential point of discussion. Nevertheless, the potential of AI could extend beyond current comprehension.

In the journey of understanding AI's impact on marketing strategy, the findings underlined that it brings myriad opportunities and challenges in marketing practices – raising the concern of what lies in the future and how organizations may refine their marketing strategies and processes with AI transformative.

To address these queries, a preliminary examination (Davenport, 2020) presents research prospects on some factors that, in this case, the thesis will highlight as related. One of the assuring areas for future research is AI and marketing strategy. Predictive accuracy holds consideration that it potentially alters businesses' frameworks by relying on data and forecasts from AI algorithms. For instance, this can be useful for predicting optimal prices for products or advertising resources and budget allocation. Hence, for this case, future research could explore the optimal ways to integrate insights derived from AI with human judgment, which this thesis would explore from the viewpoint of the potential of Generated AI in the marketing research process.

Literature Review

In the marketing sector, Generated AI has acquired great importance. There are increasing numbers of literature studies examining the advantages of employing Generated AI tools, particularly ChatGPT, with diverse approaches. The most significant articles in this research are (Brand, 2023), which explored ChatGPT-3.5 as a tool to do market research and verify the outcome of several economics' theories such as the downward-sloping demand curve, the impact of income on demand, and state dependence. For each experiment, they used ChatGPT as a persona or interviewee to respond to the question. The experiment idea was that the prompts asked ChatGPT to simulate a market research study to humans, and the responses indicated the distribution of responses from the consumers that composed its training data.

Another former study did similar experiments by identifying several social experiments on GPT-3, such as social preference and decision-making experiments (Horton, 2023). The outcomes also showed a similar pattern when he compared them to experiments that had been done on humans previously.

The other comprehensive literature review on generative AI, focusing on its characteristics, pointed out that ChatGPT replicates human behavior, including irrational responses to questions related to intuition and cognitive bias (Azaria, 2023) and (Ma, 2023).

The assessments and findings concluded in those studies intrigue this thesis, which proposes conducting customer research through ChatGPT as Generative AI for marketing purposes.

Objective

The main objective of this thesis is to explore the advanced large language model ChatGPT, in the marketing process. As traditional marketing research or surveys typically take some time and could be expensive, this study aims to observe whether Generative AI, specifically ChatGPT, could be an efficient alternative tool for the survey. In particular, this study evaluates whether it can mimic people's responses, hence conducting surveys to ChatGPT rather than people. The research seeks to contribute insights to the practical application of ChatGPT in marketing research practices, addressing its potential capability and practical challenges. To provide a thorough study, this thesis will analyze the use of GPT into marketing research by using it in a practical use case of the automotive sector.

To do so, this experimental study will be conducted in three ways:

- Evaluate whether survey results obtained from ChatGPT are reliable. A comparison with a Market Research published after April 2022 (the most recent data used for training ChatGPT-3.5) is used to validate the results.
- A prospect behavioral economic theory will be applied and verified whether the results match the theory. In particular, the experiment will study whether ChatGPT has traits similar to humans when losses and gains are involved.
- Finally, ChatGPT will be used to obtain an estimation for a price for a new electric car to sell in the Italian market. To do so, a survey asking the willingness to pay of the respondents is carried out. The validation of the results is done in a two-fold strategy:
 - A second survey that does not ask the respondent's willingness to pay but rather whether they will buy the product at a given price. With this survey, we expect consistent results with the previous survey
 - Compare the price of similar products available on the Italian market today

Finally, the insights from the survey with virtual respondents of ChatGPT are used to support proposing marketing and selling strategies for the target product. This analysis could then be extended to other sectors and market researchers.

Methodology

The study will be conducted with some experiments on ChatGPT-3.5. Each experiment will pose different questions, similar to how marketers traditionally conduct marketing surveys directly to humans. In this thesis, the terms experiment, survey and study will be used interchangeably. It will use quantitative method of survey by using AI representation, making ChatGPT as a virtual respondent instead of doing the survey directly to real people.

The first group of surveys aims to analyze and compare with an existing market research to see whether survey results obtained from ChatGPT are reliable or not using the same sample of people surveyed from the actual conducted report of the aforementioned market research. The data analysis technique will be quantitative to virtual respondents personalized to ChatGPT. A comparison of the result between virtual and real respondents will be held to ensure the output accuracy. However, as the selected market research does not provide details of answers, there is a constraint to analyze the result statistically. Hence, the feasible approach is to analyze results from the two different sources differently, such as analyzing the order of answers and looking at the differential percentage. This method is used to generally see whether there is correspondence of the answers between two different sources (people and AI).

For the prospect behavioral economic theory, there is no data that can be used to validate but the validation is done qualitatively by comparing the trends showed by ChatGPT with the trends stated by the theory. In particular, the theory states the people are risk averse when a gain is involved. In other words, they prefer to have a lower gain for sure than risking and not gaining at all. Instead, regarding losses, people show a tendency to be risk prone. In other words, they prefer to risk to lose more with a chance to have a little gain rather than losing less with certainty.

The last experiment imagines to place a product in the Italian market. For this reason, ChatGPT is used to determine the willingness to pay of the people in the Italian market for the given product. To do so, each virtual respondent is assigned an annual income according the Italian annual income distributions. This study will initially survey the virtual respondents to get the willingness to pay value. To validate the results, a similar survey is done, that is the respondent will be asked whether he/she would buy the product at a given price. Consistency is expected to be seen between the two different surveys given that they are a different formulation of the same question. Finally, the results are compared with the prices of similar products already available in the Italian market.

The Automotive Industry: Manufacturing and Relation

The car supply chain entails several issues in the management and research process (Turner, 2005), such as production obstacle of the cars that generally require different specifications (in terms of body, engine, color, etc) and might vary depends on the seasonality, the product delivery barrier that occurs across several hundred dealers in the market for stocking, along with the complexity of consumer behavior in regards to the car purchase and might result in ageing of stock after a long period that forces the dealers to sell cars with a significant discount.

These factors pondered that the automotive industry operates within a quite complex ecosystem as it involves various corporations and parties for the product development. The complexity extends to the customer journey, especially considering the premium nature of the product. Purchasing decisions in this domain typically demand a more deliberative and time-intensive process for most people. Regardless if the car industry could create a mass-produced consumer goods like other type of supply chain, the customer might view each car specification as distinct, even if it pertains to the same model. Hence, the production of car often falls in the middle of integrating characteristics from both functional and innovative products, and the consumer trend and demand (Turner, 2005).

Car manufacturing is a complex sector that involves a dynamic collaboration of some participants such as OEMs, suppliers, logistic providers, and dealers. The cycle in automotive could depend on several influencing factors at different levels (Hirz, 2015). There are three main factors that usually involve the cycle, they are economic cost factors (resource, transport and logistic, profit), social and cultural factors (social and ethical aspects), and ecological factors (environmental impact reduction, materials, technology and optimization). Those three main aspects are consolidated into the long process of automotive lifecycle: from research product until its delivery to the market and after.

Lifecycle of Cars and The Activity Involved

Stage	Details
Research & Pre-development	Research, concept
Series development	Styling, design, calculation, sourcing
Production	Prototype & testing, manufacturing, assembling
Market	Distribution, use & service
Disposal	Liquidation and recycling

Table 4: Lifecycle of Cars. Source: (Hirz, 2015)

The first two stages of research and development plan are essential step in understanding the market and involves an accurate forecasting of the demand in order to determine optimal inventory of products' component to avoid overproduction and overstock. These stages include the designing, sourcing selection to locate the supplier of raw materials, components, and finished products. The calculation regarding price is also considered. The process is continued in with the stage of production that involves assembling, testing, and quality control of the components. Once it is done in the production, the products are delivered from the manufacturing plant to the clients. The automotive supply chain management requires an extensive coordination between brand, manufacturers, dealers, and logistic providers to maintain the production efficiency and answer the consumer demand.

As an illustration, a car brand from Germany could have its research and development within research institution and universities to develop new efficient technology, and source the components from other countries such as Korea and Japan, while the assembling and manufacture located in other counties such as their plants in German and eastern Europe. Then, once the production is finished, the cars are transported from the plants to distribution centers, to be shipped to many dealerships across the world. Hence within this complex supply chain of automotive, the brand and dealers take an important role understanding the market to sell the product and customer service, as then overstocking would lead to disposal. Potential threats include changes in demand, government regulations, environmental rules, and technological advancement that require continuous agility and innovation for long-term sustainability and growth.

Moreover, the customer journey in this sector might be as complex as its supply chain. automotive is considered as durable goods – a product that has a long lifespan or products for deferred use, it is expected that the customers take a long process and time before purchasing a car. From the research phase on online platform, offline to test drive. Perception, personal preference, trade-in service, post purchase offer, and many other factors might influence their decision making.

Research Design

ChatGPT-3.5

This research will use the ChatGPT model from the GPT-3.5 series that was trained with data in early 2022. Specifically, the model gpt-3.5-turbo-1106 is used. The aim is to use ChatGPT to represent human response, hence aiming the prompt results to mimic social dynamics.

GPT Prompt Engineering

A prompt is an input from a user to generate responses from a Language Learning Model (LLM) that could range from a question, statement, or any form of input. According to (Zhou, 2022), the output performance of prompts could be diverse depending on the input quality used to pilot the model and sometimes does not reflect the intended outcome. To achieve the desired result, there shall be some experiments with several ranges of prompts.

OpenAI published a guidance article on getting better results when prompting queries to ChatGPT, called “prompt engineering”. Prompt engineering is a method used with intentional design prompts to obtain a desired outcome from the LLM. There are six strategies with different tactics that OpenAI suggests (OpenAI, Prompt Engineering, 2024). However, the application of strategy depends on the objective approach. In the context for this research purpose, there are at least four tactics that we can apply to the prompt’s implementation, as seen in the following illustration:

Strategies	Tactics	Explanation
Clear Instructions	Include details	Ensure the prompts include all essential details and context to have more accurate responses.
	Adopt a persona	Assign a persona to the model, as the system will serve the purpose of the persona defined in its responses.
	Specify the desired length of input	The targeted output length can be specified in terms of the count of words, sentences, paragraphs, bullet points, etc.
Provide Reference Text	Instruct the model to answer using a reference text	Provide the model with reliable information (reference text) for the query to result in incorporation of the details into its response.

Table 5: Strategies and Tactics for a Better Result on ChatGPT. Source: (OpenAI, Prompt Engineering, 2024)

According to the examples from OpenAI, assigning more details and context in the prompt will increase the chance of getting decent answers. This is an essential point to do the marketing survey experiment. For instance, instead of asking ChatGPT, "How do I add numbers in Excel?", it is better to rephrase it as "How do I add up a row of dollar amounts in Excel? I want to do this automatically for a whole sheet of rows with all the totals ending up on the right in a column called 'Total'".

As explained in the illustration above, assigning a persona in the model can be used to specify the reply. Hence, as this thesis recreates a marketing survey, assigning ChatGPT persona as a survey participant would be convenient. For instance, designate a role of ChatGPT in the prompt "You are a car buyer that wants to purchase a car in the next 24 months...". The aim of this prompt is that the model will answer the questions based on the persona consideration.

It will be helpful to include the length requirement for the output in order to generate a precise answer from ChatGPT. For example, "What would be the top three factors for you in choosing a new car?"

The last related suggestion to enhance this research prompt is using reference text. The example from OpenAI is to prompt, "Use the provided articles delimited by triple quotes to answer questions. If the answer cannot be found in the articles, write "I could not find an answer.". This suggestion can be applied in the marketing survey by instructing sources such as "use sources of U.S., UK, France, Germany, and Italy population" or to combine with the persona "you are a person that is either from U.S., UK, France, Germany, or Italy...".

All prompts for the studies presented in the following sections are reported in [Appendix A](#).

Tokenizer

The text of ChatGPT includes input and output that proceed using tokens, which are the sets of characters in the text. According to OpenAI, the tokenization process may vary between the models (GPT-3.5 or GPT-4); hence, the tokens might be different, employing the same input. The necessity of dealing with the token is related to model efficiency and cost-effectiveness when it is used for prompt engineering construction. It is helpful to manage the conversational length and for API usage.

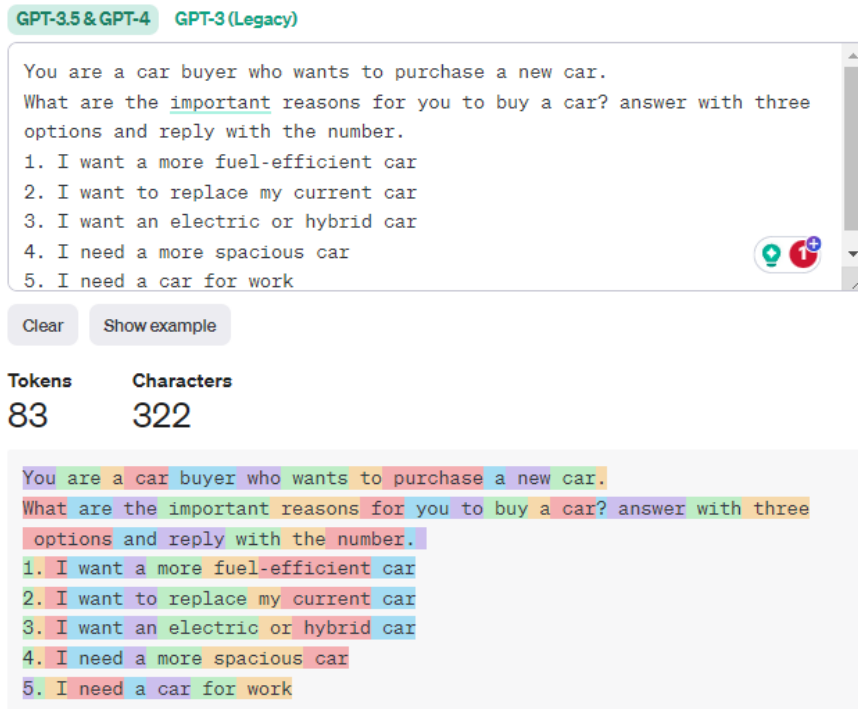


Figure 27: ChatGPT Tokenizer. Source: (OpenAI, Tokenizer, 2024)

OpenAI provides the calculation for prompts exploration on its website (OpenAI, Tokenizer, 2024). For instance, when I put the one prompt for the marketing survey, it leads to the information on how many tokens and characters it comprises, which will be helpful in the cost estimation per query when using the API (Application Programming Interface).

OpenAI API

OpenAI provides access for the public to integrate ChatGPT into any applications, websites, or products with API (Application Programming Interface). As specified on OpenAI's blog, what is accessible is its cutting-edge language and speech-to-text capacity, allowing the users to request a model, generate responses, and leverage the language capabilities based on their needs, such as text generation, summarization, and question-answer model. The advantage of using OpenAI API is the possibility of submitting numerous prompts and receiving responses programmatically faster than doing it manually from the web interface.

The scheme is that developers can use the system of this advanced LLM without the need to train data on their own, and they will be billed based on the number of tokens used. Typically, the developers need to use programming languages like Python to integrate API use.

Querying ChatGPT for Marketing Survey

Given the objective to use ChatGPT as a virtual respondent to do surveys, it must be queried multiple times (thousands) and doing this manually is unfeasible, for this reason I did programmatically.

A Python program has been developed that uses OpenAI API. Python is an interpreted programming language whose main characteristic is its simplicity who made it a common programming language used in a variety of applications and the programming language of choice of many researchers. The results of this are a huge number of libraries and compatible APIs. In fact, python has been chosen because OpenAI offers python bindings to its API. Each study, or experiment, that is later presented requires some variables, that is the textual prompt that I submit to ChatGPT is not always the same but it may vary according to some rules. Also, ChatGPT may be asked to choose some options from a list, the order of the list is shuffled every time in order to compensate to the biased behavior of ChatGPT that has the tendency to choose the first options (OpenAI, Prompt Engineering, 2024). To this aim, a dedicated configuration of the experiment has been developed to allow flexibility to allow the design of new experiments with no code changes but simply changing the experiment configuration. This offer a scalable program that is not necessarily tailored for this thesis. A detailed description of the code and the experiment configuration is explained in [Appendix B](#).

The code developed, given an experiment configuration, permits to query ChatGPT a very high number of times with variable prompts and the outputs (i.e. the ChatGPT answers) are exported in an excel file for further analysis.

The ChatGPT's temperature variable can control the variability of the answers, in all the experiment a temperature 1 is used, which is the default for ChatGPT.

Data Analysis Process

As described previously, this thesis will analyze the experiment result on ChatGPT-3.5 regarding its capacity to conduct marketing research. There are various methods to analyze whether the outcome affirms the potential tool for doing market research. The method that will be used in this thesis is analyzing the experiment's result concerning existing studies that have been done previously by another author or organization.

There are some credible established research market organizations across the sector; however, for this research, we will use the studies done by GWI. GWI (GlobalWebIndex) is a market research company providing insights and data worldwide for many industries (GWI, GWI Corporation, 2024). The insights offered include consumer behavior, market trends, media trends landscape, and more. Their organization practically supports businesses and marketers with comprehensive data and insights to be used in brand marketing strategies.

Another method to analyze the experiments' results is by analyzing them with economic and behavioral economic theories. The focus of behavioral economics itself is to assess the standard economic models of human behavior. Hence, it involves the psychological and social sciences in economics (Cartwright, 2014).

Each experiment will be analyzed with a specific approach that will be discussed in the implementation part.

Examining ChatGPT by Replicating Insights from GWI Report

The purpose of this section is to use ChatGPT for conducting surveys and perform a comparative analysis to assert whether the results are reliable. The results will be compared with existing research disclosed by GWI about the Automotive Industries (GWI, Insights, 2024).

The report from GWI presents results from online research among internet users aged 16-64 in six countries: the US, the UK, France, Germany, Italy, and China. This report's data source lies in Q1 2023 and includes a sample of 8905 new car buyers and 4841 used car buyers, as sampled by GWI. Five surveys have been selected from GWI report and reproduced. These regard car buyers and their preferences, behavior, and perspective. Among the set of survey questions, we see there is a resembling trend from the majority of questions.

For each survey question recreated from GWI, I asked ChatGPT for a total of more than 1000 virtual respondents. The precise prompts used and the information details are outlined in [Appendix A](#).

The five survey subtopics about car buyers remade from the GWI report are:

1. Car Preferences Among Countries
2. Top priorities for the car buyers [New Cars & Used Car]
 - 2a. Top priorities for new car buyers
 - 2b. Top priorities for used car buyers
3. Research source [Used & Trusted Sources]
 - 3a. Research source that people would used
 - 3b. Research source that people would trust
4. EV Advantages
5. How to sway new buyers

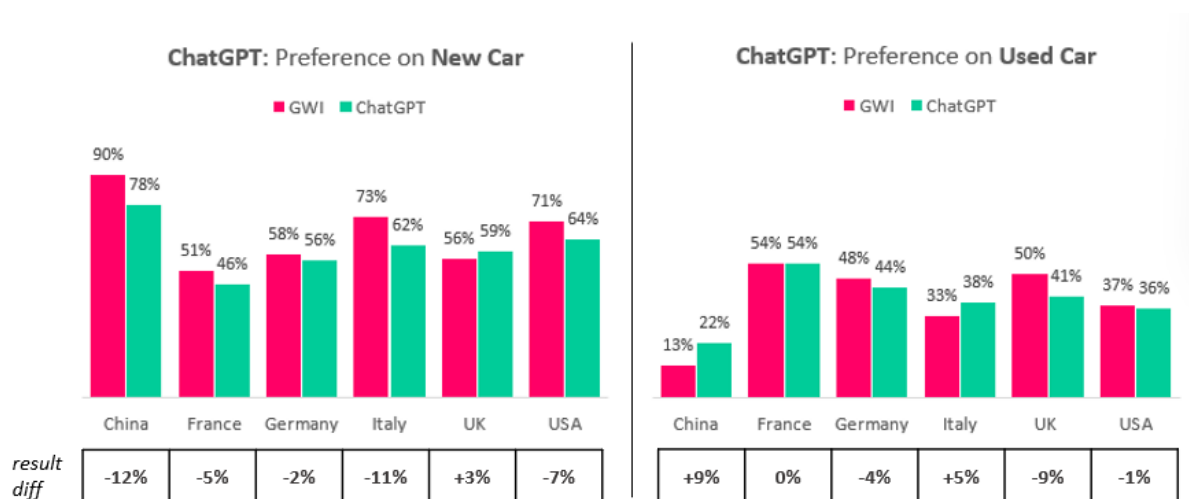
Study 1: Car Preferences Among Countries

This study will analyze car preferences in six countries surveyed by GWI, in particular whether the market desires a new or secondhand car. The study tells that most European countries surveyed by GWI in 2023 showed a decreased enthusiasm for purchasing new cars, such as France, Germany, and the UK, which have an almost balanced ratio of 50% between buying new or used vehicles. Meanwhile, Italy, the USA, and China still have more demand for new cars. However, the data from Chinese respondents showed more significant demand for their interest in new vehicles, placing China as the primary country with the highest interest in new cars.

This study is intriguing because it reveals how some background factors could influence the decision, namely cultural context, perception, economic situation, country regulation, etc. Thus, it would be interesting to replicate this survey to see ChatGPT's capability in understanding market characteristics.

In doing the prompt, I put a context for ChatGPT to represent a person from each country with ages ranging from 16 to 64 years old, with a sampling of 250 respondents each. This question was an optional answer to whether the respondents would like to buy a new car or a used car, and they had to consider some factors behind the answer, including the country where they came from.

Surprisingly, ChatGPT appears capable of representing these markets adequately as it shows a similar answer as demonstrated in the following figure:



Survey Figure 1: Car Type Preference Among Countries

If we compare ChatGPT response and GWI, generally, it shows an average of 5.6% absolute difference and mainly shows comparable results. Both data resources generate a similar group of responses. First, China, Italy, and the USA have a higher market for new cars. Then, Germany and the UK had a slightly higher demand for new vehicles but almost balanced the

preference for the used cars. Meanwhile, France shows moderately higher demand for used vehicles and nearly equal demand for new cars. As assumed previously, some factors could influence how people in different markets react to this question. To understand how ChatGPT modeled the answer to this question, I asked the reason qualitatively, especially for the highest difference between China and other countries.

ChatGPT's response affirmed the assumption that the factors behind countries' preferences vary from the economic conditions, cultural attitudes, government policies, and the availability of financing options. It then explained that China has a high growth of new car demand due to its growing middle class, urbanization, and government incentives to promote electric vehicles. Regardless that there is still demand for used cars, the market may have significant interest in new cars as there is a perception of low-quality used vehicles, limited availability of certified pre-owned (CPO) programs compared to the other markets in this survey, and a cultural aspect that status and prestige is often highly valued in the country hence leading to the stereotype that owning a new car, especially from a reputable brand can be seen as a symbol of success and social status.

Study 2: Top Priorities for The Car Buyers [New Cars & Used Car]

This study targets individuals who intend to purchase a vehicle in the next 24 months. The question focuses on understanding the purchase reasons for buying a new car (study 2A) or a used car (study 2B) with the target segmentation of the GWI research. To ensure comparability between ChatGPT and GWI respondents, I hereby mention the same segmentation of the country market, age, and intention to buy a car when prompting the context for ChatGPT. I gave ChatGPT context information that the question is for marketing research, and it shall impersonate humans in responding to their main reasons to buy a car.

There are seven possible choices presented for ChatGPT to answer. It can answer multiple options but shall only choose the priority of how humans would assess this question. The optional answers are “more fuel-efficient car”, “replace current car”, “electric or hybrid car”, “more spacious car”, “a car to go to work”, “cheaper to maintain”, and “avoid public transportation”.

All the details above were included in the context and prompts when doing the survey to ChatGPT. The only main difference was the car status to buy in study A and B:

2A: to buy a new car (not secondhand)

2B: to buy a used car (pre-owned)

Study 2A: Top Priorities for New Car Buyers

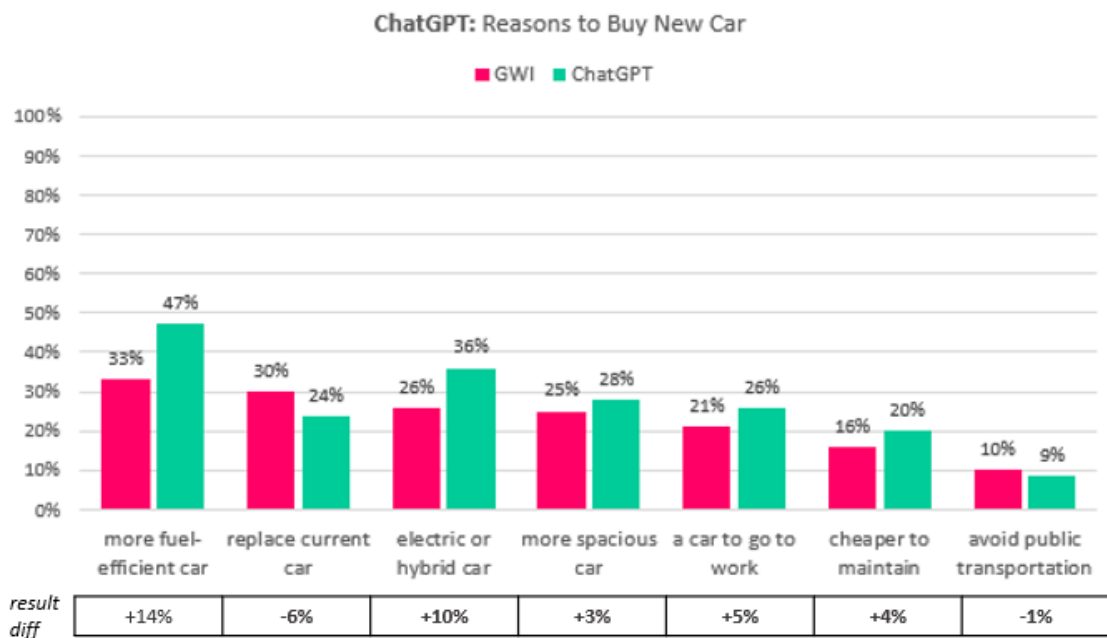
The exploration of this question with ChatGPT was interesting. As shown in ‘survey figure 2’, it took me three trials to finally get the desired result. The problem that I analyzed from the 1st trial and 2nd trial was that there was not enough context on the question from GWI whether the respondents wanted to buy a car as their first car or not. The context omitted information regarding current car ownership; this should not be necessary because the respondent might or might not own a car. Nevertheless, ChatGPT demonstrated that there might be some bias in omitted information. The assumption is that, in general, the respondent might want to buy or look for a car for someone else. For instance, to buy a car for their family – the husband looks for a vehicle for the wife.

Hence without this detailed information about the buyers, the first trial response was almost as aligned as GWI report, except for three answers: “replace current car”, “a car to go to work”, and “avoid public transportation”. I considered ChatGPT might have been positioned as a person who wants to buy a car for the first time – or did not have another car at home to use.

For the second trial, I tried to put the information “you might already own a car” inside the prompt question. It lowered down the responses on the three related answers (“replace current car”, “a car to go to work”, and “avoid public transportation”), however it was still not sufficient.

As the next trial, the context information has been randomized by proving the extra information “you might already own a car” with a probability of 25% to appear in the prompt queried to ChatGPT.

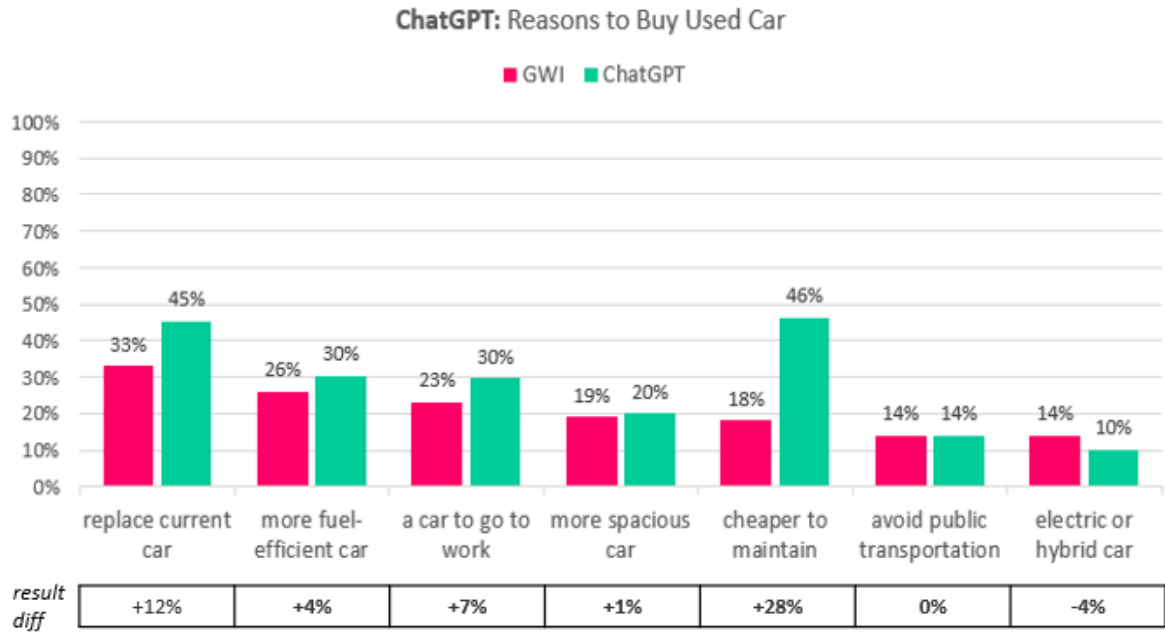
The result from the third trial illustrates a similar approach of GWI respondents:



Survey Figure 2: Reasons to Buy New Car

The context, prompt, and variable given above when I asked ChatGPT resulted in a response similar to the GWI report, with an average of 6.14% absolute differences in all answers. The answer distribution in general is well aligned from the highest to lowest, only the optional answer “replace current car” is not well-aligned. However, it could make sense as we don’t know the exact detailed background of GWI respondents. Meanwhile, GPT possibly represented more people who wanted to buy a car for the first time, leading to a lower response on replacing current vehicles. It is important to stress that for this experiment the prompt has been engineered to match the results of GWI, highlighting this biased behavior of ChatGPT with omitted information.

Study 2B: Top Priorities for Used Car Buyers



Survey Figure 3: Reasons to Buy Used Car

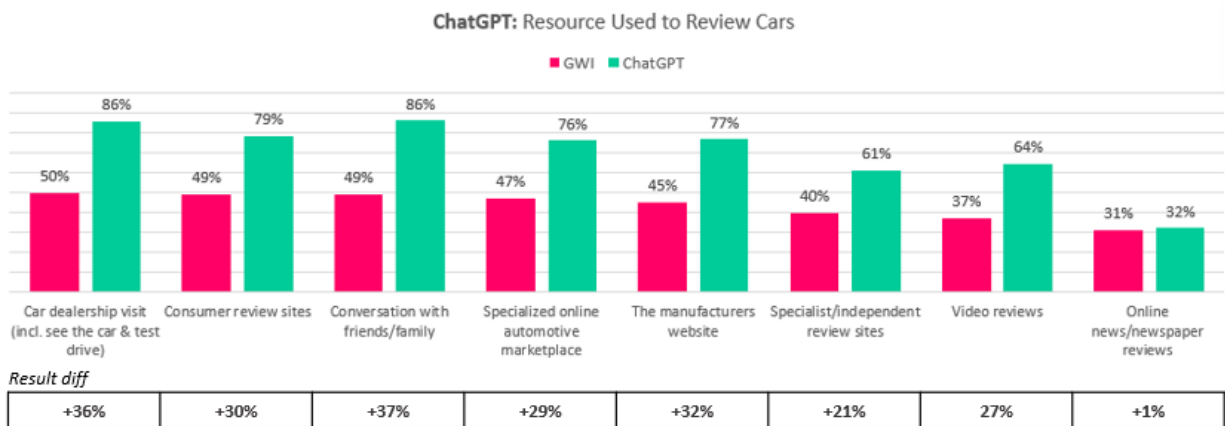
Similar to the factors in buying a new car, ChatGPT also shows a similar pattern in the order of GWI answers. There is only one answer, "cheaper to maintain," that was not spot on, with a difference of 28% higher than GWI's report, while the average absolute difference for all answers is 8%. However, this significant difference in option cheaper to maintain could be mistaken from ChatGPT by understanding the "cheaper" context in general – as for maintenance price, a used car could cost more than a new one depending on the car's condition.

Study 3: Research Source [Used & Trusted Sources]

This study entails understanding car buyer preferences and looking up information about the vehicle before purchasing. As discussed in the consumer journey of automotive, people generally take a long and careful process to buy a car, as it is a durable good. Accordingly, we would like to gain more insights of what mediums are most used by the customers to connect to the information and whether they would be provoked or not.

The prompt that will be queried to ChatGPT in this context is separated into two questions: the first one is to generate answers of what source people used to review the car, and the second one is to know if they genuinely trust the source or not. There are eight optional answers that ChatGPT may choose, with a note that it shall consider sources that might lack credibility, are subjective, are unreliable, are paid advertisements, and have other factors that may not be easily trusted. In both study cases, ChatGPT shall impersonate a random person with an age range from 16-64 who can be from the U.S., UK, China, France, Germany, or Italy.

Study 3A: Research Source That People Would Use



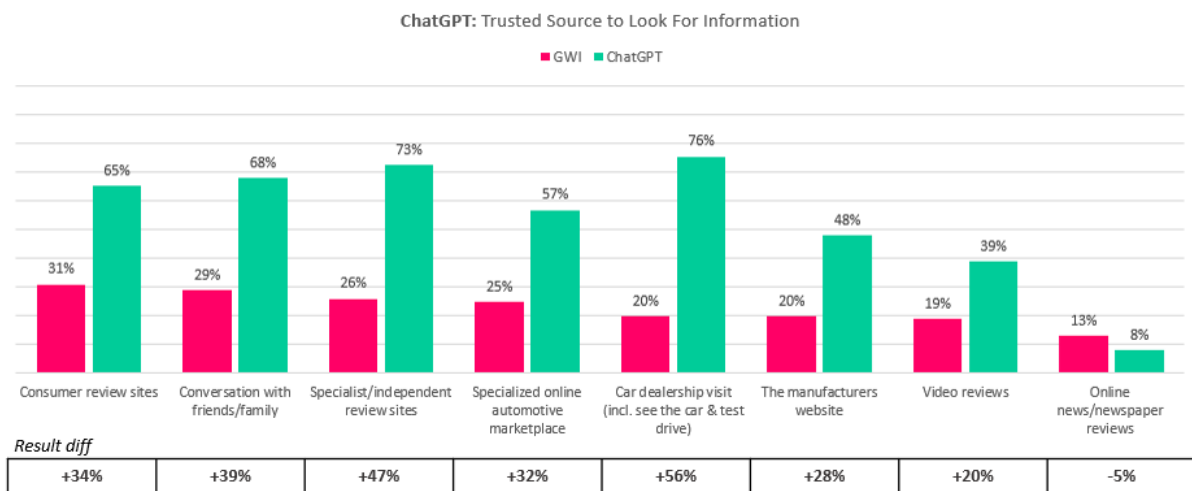
Survey Figure 4: Sources Used on Reviewing Car

For this survey, the results are not all aligned with the GWI report if we see in terms of orders. However, the results are quite similar in the bigger picture. I asked ChatGPT for two trials for this question to get the final result above. The first attempt was made with the exact optional answers wording as the GWI report. I did not mention in option A that the car dealership includes seeing the car and test driving. Hence, the first trial result had a very low response on “Car Dealership Visit”.

It could be because ChatGPT needs more resources for this and a clearer understanding of what people could do in local car dealerships. Therefore, I launched the second experiment with detailed information for option A, “Car dealership visit (incl. See the car & test drive)”, which then showed increment of the voting and became the top answer.

After this adjustment, the answer of ChatGPT is more proportional to GWI, with an average absolute difference in all answers of 26.6%. The only contrast is the least chosen answer of both sources, “online news/newspaper reviews,” with only a 1% difference. Yet again, this could be because of the source limitation of ChatGPT about offline media, or the answer was unclear. The difference of 26.6% might seem more extensive compared to the previous study case, however, if we disregard the last option (online news/newspaper reviews) for the reason mentioned above, we can calculate that it has 12% difference in terms of declining percentage from the highest to lowest answer. To specify, the GWI report range from 50% to 37% (13% interval), and ChatGPT (25% interval) range from 86%-61%, resulting in a 12% point of interval differentiation.

Study 3B: Research Source That People Would Trust



Survey Figure 5: Trusted Source to Look for Information

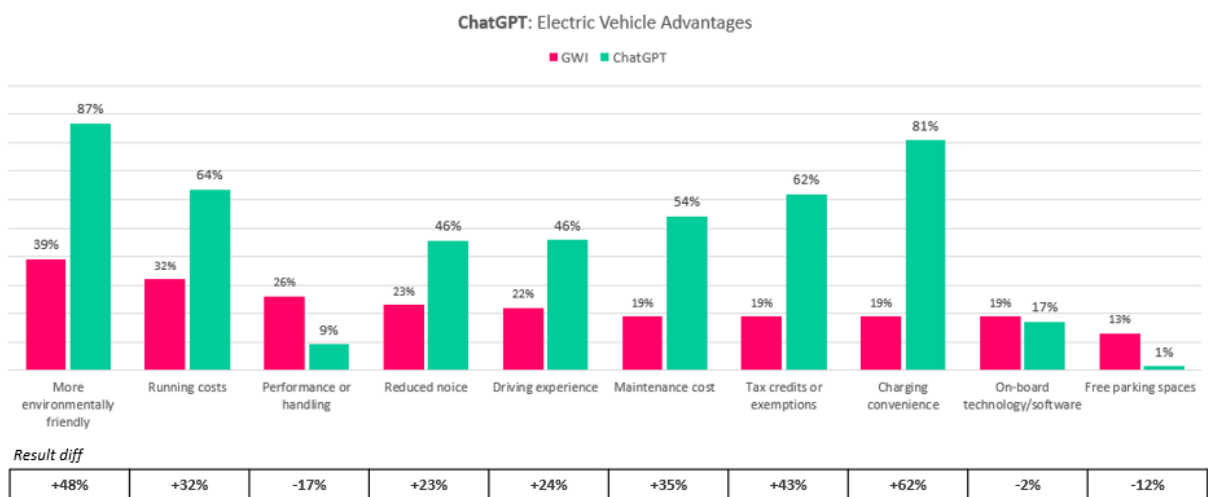
ChatGPT responses in this prompt almost show the same order of answers as GWI. One big difference in the result of this question is that “car dealership visit (incl. See the car & test drive)” answer remained high as the source that people would trust. The average absolute difference in answers between ChatGPT and GWI is 32.6%. Align with the previous prompt regarding the source people would use, the answer of “online news/newspaper reviews” also remained as the only answer with slight contrast to the actual survey. Ignoring that option, this survey has 25% difference in terms of declining percentage from the highest to lowest answer between two the sources (range answer of GWI: 19-31% and ChatGPT 39-76%).

Study 4: Electric Vehicle (EV) Advantages

In the previous survey, the top three factors in buying a new car for the market includes that they would want to have an electric or hybrid car. It shows how big the market for electric cars in the future is, along with positive perception from the customer and value it gives to the environment. As for marketers, there could be numerous approaches in positioning the value for the marketing campaign. Therefore, it would be helpful to comprehend the actual merits of having an electric vehicle from the current user perspective as a consideration to refresh marketing strategy periodically.

Within this study, GWI surveyed electric vehicle owners aged 16-64 in 6 markets (GWI base: 1671 people). The question to the contributor was concerning the main advantages of owning an electric vehicle/hybrid vehicle. There are ten optional answers in this question, and as their report, the factor that the car is more environmentally friendly placed first place followed by the running cost.

I queried the same question and answers to ChatGPT a thousand times, giving it the same segmentation and persona of GWI audience. The details of the responses show below:



Survey Figure 6: The Advantages of Owning Electric Vehicle

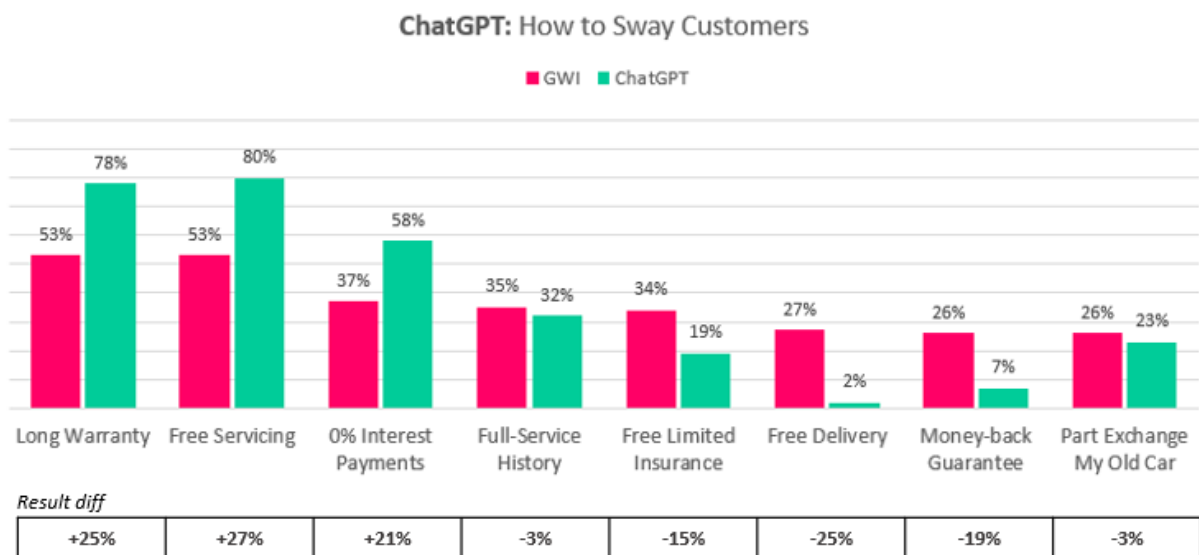
This survey question is marked to be the prompt surveyed with ChatGPT with the most optional answers (10 choices). ChatGPT was given instructions to represent people who owned electric vehicles and had to answer questions about what the advantages are for them. It turned out that the answers were more spread out among many choices compared to the GWI report. However, ChatGPT and GWI have the same “most and least” choices.

Study 5: How to Sway New Buyers

A promotion in the automotive sector is also essential to gain customers' interest apart from the brand value and quality. Particularly in this sector, several promotions could be offered, from aspects regarding the product itself or even the service, such as offering free service after the purchase. Thus, this study aims to understand what kind of promotions customers prefer that would impact their purchase decisions.

The audience base of GWI is the new car buyers aged 16-64 in 6 markets: the US, UK, France, Germany, Italy, and China. The respondents were given eight optional answers to choose as promotions for a car product that would increase their likelihood of buying the car. I then recreated this query to ChatGPT, giving it the same persona as GWI respondents.

The answers to this question are illustrated in the following graph:



Survey Figure 7: Customer Preference on Marketing Promotion of New Car

In terms of order, ChatGPT's response in this survey shows a misalignment in the last three answers. The average absolute difference of both reports is 17.3%. As noticeable, the range of each question is quite distant, from 3% to 27%. This concludes that the response distribution of ChatGPT is quite inconsistent for this survey question, regardless that the top five answers align with GWI survey.

Behavioral Economics Theory and ChatGPT

The previous section examined whether ChatGPT could be helpful in conducting a marketing survey compared to the marketing research company report. The questions generally emphasized customer preferences, behavior, and perspective without considering the product's price and the consumer's economic situation.

To complement the analysis of ChatGPT's ability for marketing research, this section will investigate whether ChatGPT complies with the prospect theory of behavioral economics. According to prospect theory, generally, people are risk averse, but it suggests that individuals are also more willing to take financial risks when they are in a situation of potential loss as opposed to potential gain to anticipate losses. In this marketing case, the prospect theory could be helpful as to how the communication framing of a brand or product is essential in winning the market. Marketers can shape consumer behavior by implementing framing strategies and tactics based on prospect theory (Paul D Berger, 1998).

Study 6: Prospect Theory

Prospect theory highlights the irrational behavior of humans to weight gains and losses differently. Over the years, this led to several marketing strategies, such as a money-back guarantee and free trial. Although it is a well-known theory that has led to several successful solutions in this work, this study intends to investigate if ChatGPT models the irrational behavior of humans. This section will analyze whether ChatGPT also presents similar behavior and logic.

This experiment will apply the exact persona of the other studies. ChatGPT shall represent 900 respondents aged 16- 64 who want to purchase a new car, with random sampling from the US, UK, France, Germany, Italy, or China. In answering the questions, it must reason about the financial situation and personal needs.

To illustrate the theory, this study will hold two survey questions corresponding to the gain and loss prompts. When prompting ChatGPT, more detailed context regarding this research is mentioned – that is ChatGPT as respondents have found the car that they want to buy and received promotion offers from the car dealer. The promotions are given two optional offers: the first without risk and the second with risk. These two options are the important base for understanding and generating the prospect theory visually.

Regarding the prompt engineered for the gain analysis, ChatGPT was presented with two choices. The first option was to have an immediate discount for sure, the second option was to wait a month to pay the car with a probability of 50% to have doubled the discount and 50% of probability to have no discount at all. As you can see, the two expected gains are probabilistically equal. To analyze how the trend varies, different discounts values have been used.

An example of the choices of the prompt for the gain analysis are the following:

- A) have an immediate discount of 20% on the car price
- B) buy the car next month with a probability to have a discount of 40% or none. The car dealer informs you that there is a probability of 50% that such a discount is applicable next month.

For the loss analysis. ChatGPT was also presented with two choices. The first option was to buy the car immediately and pay additional tax. The second option was to wait a month with a probability of 50% to get some percentage of fiscal incentive, or 50% to pay additional tax such that the expected loss is equal to the loss of the first option.

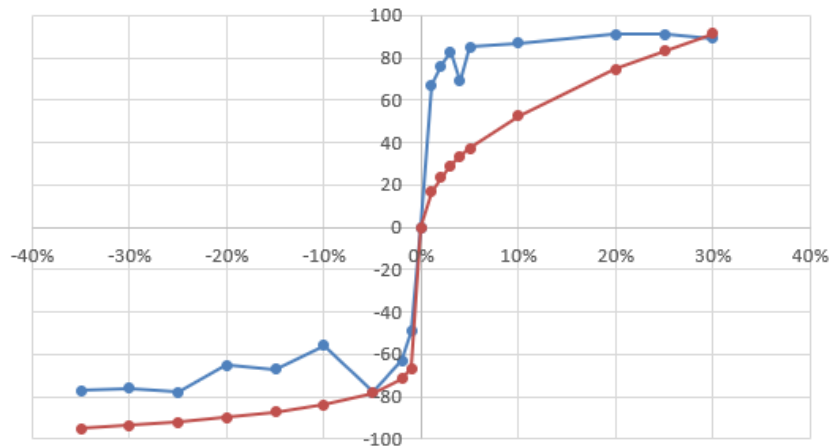
An example of the choices of the prompt for the loss analysis are the following

- A) if you buy the car now you have to pay an additional tax such that you will end up paying 10% more than the car nominal value,
- B) if you wait one month, there is a probability of 50% you get 16% fiscal incentive from the government such that you will end up paying the car 16% less than its nominal value, a probability of 50% that you have to pay an additional tax such that you will end up paying 36% more than the car nominal value.

Option A has a loss that will happen with a 100% probability, while choice B has a loss with a probability of 50% and a gain with a probability of 50%. The expected loss is the same for both options. A loss averse behavior will result in a tendency to take the risk to lose more rather than choose a lower but certain loss. To study the trend several values of gain and losses are considered such that the expected loss is equal to the certain loss of option A.

In the following image the result of the prompts is illustrated:

ChatGPT Prospect Theory: Gain & Loss



Survey Figure 8: The Prospect Theory Line vs ChatGPT Respondents on The Survey

In Survey Figure 8, the blue line represents ChatGPT responses on this survey. The X-axis represents the discounts; the discounts may be favorable for gains and negative for losses. The graph is divided into two parts:

- On the favorable discounts (gain), the Y value represents the normalized percentage. ChatGPT chose the first option (option A), which is the conservative one (less risk-seeking).
- On the negative discounts (loss), the Y value represents the normalized percentage. ChatGPT chose the second option of the question, which is the risky option (risk seeking).

The red line displays the expected trend from the prospect theory model (the predicted trend is meant to be analyzed qualitatively and not quantitatively, given that the value function is unknown). In particular, the theory says that people tend to hate losses more than they love gains. This behavior is translated on the red line with a curve on the losses part of the graph steeper than the curve on the gains part.

From the graph, we can say that the trend of ChatGPT is coherent with what the theory says. In particular, ChatGPT is also risk-seeking regarding losses. On the other hand, for the gains, it sticks with the conservative choice regardless of the gain amount, that is it is less risk seeking than expected regarding gains. From this analysis, we can say that ChatGPT reproduces the irrational human behavior modeled by the prospect theory.

Willingness to Pay Represented by ChatGPT

There are several essential factors in determining the price of a product: fixed and variable costs, market competition, and product value, which are derived from customer preferences. Understanding the target market and their price acceptance should be necessary before publishing the price to the public, especially for premium products.

For this reason, to assess whether ChatGPT could be a valid tool in assisting marketing research with this task, this section presents an analysis that seeks to determine the price that people in the Italian market are willing to pay for a newly launched economy electric car by using ChatGPT as an impersonator of the people in the target market. I specifically choose electric cars because their demand is increasing in the market, which is also confirmed based on the second study case of the factors of buying a new car.

As this analysis focuses on the Italian market, I specified the details on the prompt that ChatGPT shall represent a random person aged 16-64 years old who lives and works in Italy. Other factors must also be considered in answering the question, such as financial situation and personal needs according to annual income. To model the annual income correctly, the prompts have fetched and modeled the most recent available data regarding annual income in Italy. The information regarding the base of annual income in Italy is obtained from Intwig website (INTWIG, 2024).

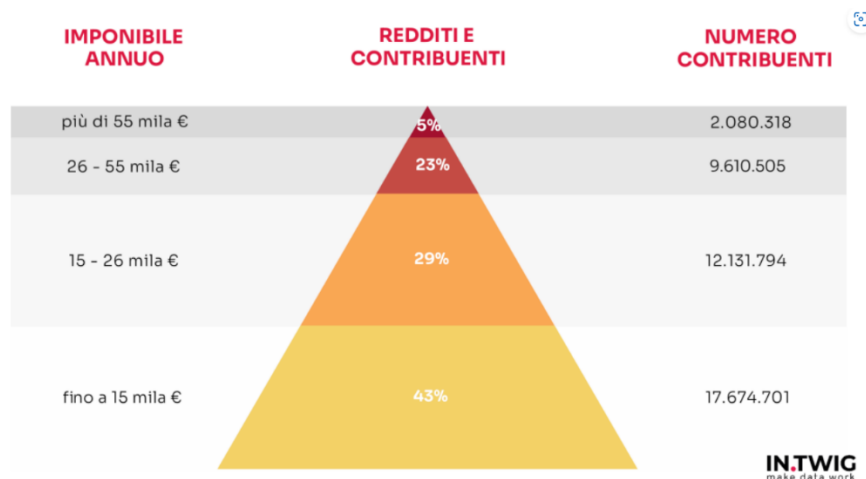
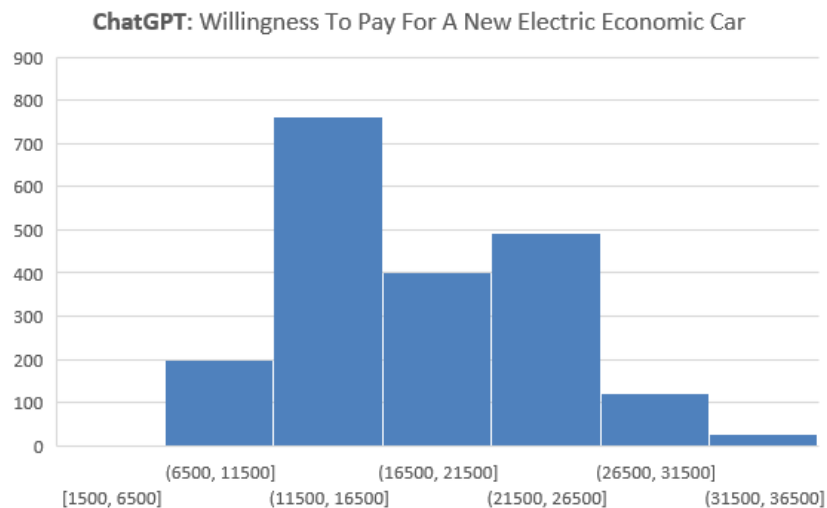


Figure 28: Annual Income Distribution in Italy, 2020. Source: (INTWIG, 2024)

This study will perform two related analyses. The first one aims to determine how much people would pay for an electric car given their income; then, the answer will be validated with the second analysis, which uses a surveying approach to price demand.

Study 7: Willingness to Pay

This first experiment seeks information on the maximum price people would pay to buy a new electric economy car. Apart from the audience segmentation, I also put a random distribution of annual net income based on *intwig* report, and they are either less than 15000€, 15000€-26000€, 26000€-55000€, or more than 55000€. This prompt was queried 2000 times, and I retrieved the willingness to pay for the proposed car and obtain a histogram.



Survey Figure 9: ChatGPT responses on Maximum Price to Pay for A New Electric Economic Car

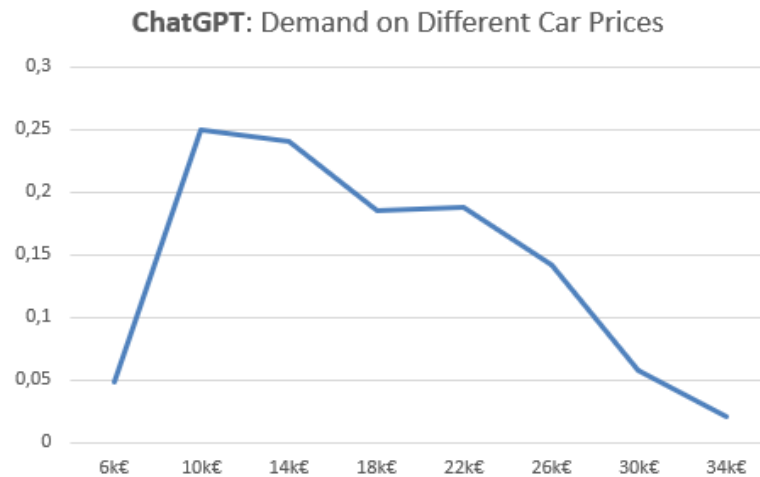
This graphical illustration shows a histogram of how much ChatGPT would pay for a new electric economy car. Of the 2000 respondents, the majority responded that they would pay the maximum price of around 14000 euros, followed by another group that would pay a maximum of 24000 euros.

To validate the results of the first analysis, I query ChatGPT differently by checking the “impact of income on demand”. In this second experiment, ChatGPT was asked a closed question, that is whether it would buy a new economy electric car for a given price. Eight prices have been used for a total of 6000 respondents, signifying that for each fixed price, there are about 750 respondents.

ChatGPT shall represent the target customers who earn a certain amount of annual salary and are being offered to purchase a new electric economy car for a specific price. It has to answer whether he wants to buy the car or not, considering the price given and its salary.

The car price used for the prompt’s ranges from 6k€ to 34k€ with a step of 4k€. Meanwhile, the same range of salaries from *Intwig* is used: they are either less than 15000€, 15000€-16000€, 26000€-55000€, or more than 55000€.

The following image shows the percentage of respondents that would buy the car at a given price.



Survey Figure 10: ChatGPT Demand Responses to Purchase Car at A Certain Price. The vertical axis represents the car price in k€, the vertical axis represents the percentage of the respondents that would buy the car at that price, where 1 corresponds to 100%.

We can see that the highest answered falls in around 10000 and 22000.

The previous study, when I asked ChatGPT openly what is the maximum price it would pay, showed a similar result, which was around 24,000€ (considering the center of the histogram bin 21,5-26,5 k€). The two graphs are anyway different. The previous analysis tells us only the maximum price a respondent would pay; he would probably also buy a car for less than the WTP value he answered. Hence, to analyze the correlation between the two graphs, we have to analyze the trend. Given the results from the open survey, we expect to see a peak in demand between 6,5k€ and 16,5k€ and a drop in demand after 16,5k€.

Similarly, the demand shall increase again when approaching 24k€, and after that, it shall drop again. This is what the graph obtained by this survey is showing. Hence, the conclusion between the two surveys of “willingness to pay” and “demand on car prices” shows a correlation, proving that the results are coherent.

Nevertheless, this comparison does not really validate the results because relies solely on ChatGPT. To improve the validation, I compare the results with prices of economy electric cars sold in the Italian market. Then, I try to compare those two surveys with ChatGPT to the actual market price of economy electric vehicles in Italy, specifically the “electric economy car,” which also shows a correlation between the price responded by ChatGPT with the Italian market price:

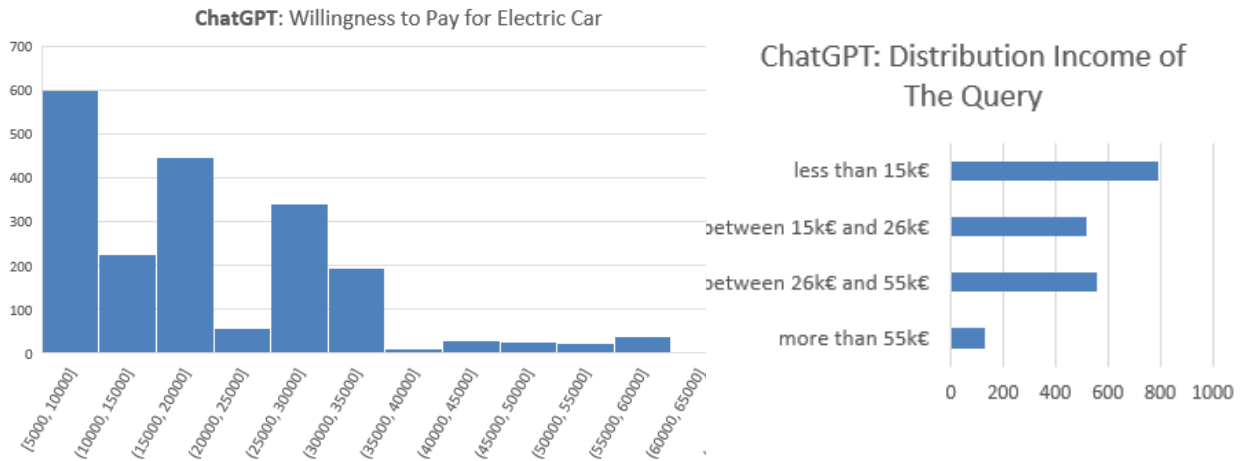
Car Model	Starting Price [k€]	Starting Price with Estimated Incentives [k€]
Dacia Spring	22,00	16,00
Renault Twingo Z.E	23,00	17,00
Volkswagen e-up	24,00	18,00
Smart ForTwo Coupé	25,00	19,00
Smart ForFour	25,65	19,65
Renault Zoe	25,90	19,90
DR Evo Electric	29,00	23,00

Table 6: Price of Electric Economy Cars in Italy (AutoScout24, Pricelist of Electric Car, 2024). The right most column shows the starting price of car reduced by the mean Italian government incentives for electric car which on average corresponds to 5k€ (AutoScout24, Italian Incentive Program, 2024). This is a very approximative data because there also other factors to take into account that could reduce the car price.

The prices of the table below are coherent with the price the virtual respondents are willing to pay although a bit higher. It must be taken into account that there exist also other factors that can reduce the price of a car, a part the government incentives, and often changes case by case. It is safe to say that real price, the one that the customer is actually going to pay, of economy electric cars in Italy could be less than the one reported. As said, there exists some correlation with prices of car on the real market but a deeper analysis should be carried out to have a better understanding, such analysis would also consider the number of cars sold per model to understand the distribution of the prices the customers paid.

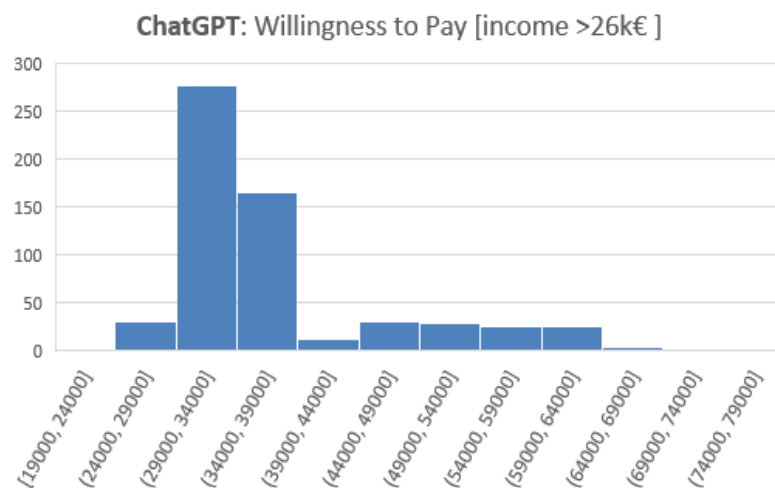
As explained before, the analysis beforehand was done for the “economy” electric car, which refers to the low cost of electric vehicles. To better comprehend the market, it would also be ideal to extend the survey to all-electric vehicle markets. Hence, I rerun the survey to ChatGPT following the same segmentation, persona, and income with a question about their willingness to pay for “electric cars.” It should be that if we ask about electric cars (instead of economy electric cars), ChatGPT shall consider that this question category refers to all types of electric vehicles, including those from low price to high prices, such as luxury cars. Therefore, the assumption should show a higher range of prices that ChatGPT would pay for the car.

The graphic below illustrates the responses from ChatGPT:



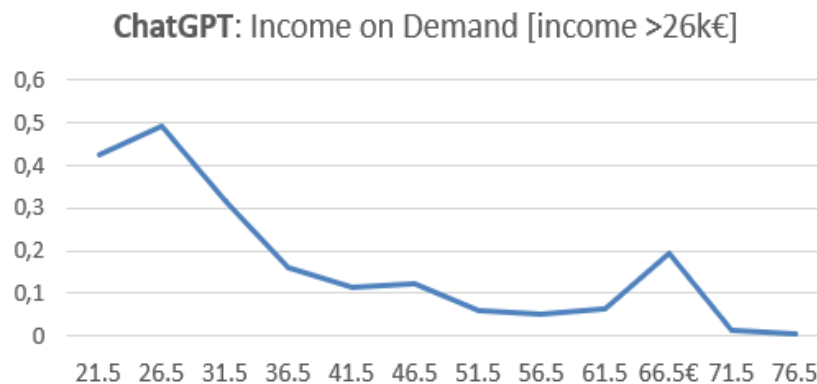
Survey Figure 11: ChatGPT Responses on Willingness to Pay for a General Electric Car

As expected, the willingness to pay for a generic electric car increase. Anyhow, it is worth noting that most people still would pay a price that is not very different from the previous experiment. This is correlated to the income distribution. The number of respondents based on their income is shown on the right side of the chart above. It is clear that the majority of the respondents are low-income people (with an annual income lower than 26k€). Considering electric cars usually have high-income people as the target market, these categories are worth analyzing. The graphic below shows the willingness to pay for a generic electric car considering 477 respondents with an annual income between 26k€ and 55€ and 123 respondents of people with an income of more than 55k€.



Survey Figure 12: ChatGPT Responses on Willingness to Pay for an Electric Car (respondent with income >26k euro)

As noticeable, the willingness to pay is strictly related to the income. Most of the respondent anyway answered with a value between 29k€ and 39k€. To validate the results, as done for the economy electric cars, the same respondents are considered and they are asked whether they would buy an electric car for a given price. The same question is asked multiple times by varying the car price.



Survey Figure 13: ChatGPT Demand Responses For Acertain Electric Car Price (respondent income >26k euro). The vertical axis represents the car price in k€, the vertical axis represents the percentage of the respondents that would buy the car at that price, where 1 correspondes to 100%.

The above graph shows the demand for a generic electric car based on the price. We would expect to have peaks in the demand in the proximity of the center of the bins of the WTP histogram with low bins on their right. That is, we should see peak demand around 31.5 k € and 61.5 k €. In this case, we can observe that results are a bit shifted, about 5k€, but they are still correlated with the previous analysis.

These prices are coherent with the price of generic electric cars available in the market as reported in the following table.

Car Model	Starting Price [k€]	Starting Price with Estimated Incentives [k€]
Opel Corsa-e	31,50	26,50
Peugeot e-208	33,50	28,50
Mini Cooper SE	34,00	29,00
Mazda MX-30	35,00	30,00
Honda e	35,50	30,50
Nissan Leaf	35,50	30,50
Volkswagen ID.3	38,00	33,00
Hyundai Kona EV	38,50	33,50
Peugeot e-2008	39,00	34,00
DS 3 Crossback E-Tense	39,50	34,50
Kia Soul EV	39,90	34,90
Kia Niro EV	39,90	34,90

BMW i3	40,50	35,50
Ford Mustang Mach-E	50,00	45,00
Tesla Model 3	50,50	45,50
Volvo XC40 EV	59,40	54,40
BMW iX	73,00	68,00
Audi e-tr	73,00	68,00
Mercedes EQ	79,00	74,00
Jaguar I-Pa	81,50	76,50
Tesla Model S	89,90	84,90
Tesla Model X	95,40	90,40
Porsche Ta	112,00	107,00

Table 7: Price of Electric Cars in Italy ((AutoScout24, Pricelist of Electric Car, 2024). There right most column shows the starting price of car reduced by the mean Italian government incentives for electric car which on average corresponds to 5k€ (AutoScout24, Italian Incentive Program, 2024). This is a very approximative data because there also other factors to take into account that could reduce the car price.

It is interesting noting that there are some price gaps between about 55 to 68 k€ and 35 to 45 k€, and that the demand (Survey Figure 13) reaches local minimums at 41.5 and 56.5 k€.

This comparison could be further improved by considering also the number of units sold for each of these cars to better correlated the willingness to pay reported by the virtual respondents.

5. Analysis of Findings

Overall, ChatGPT conducted this experiment competently by replicating an actual survey, remarkably with a positive impression. Indeed, some areas needed improvement. However, by and large, the result shows a strong point to consider of its capability to be used for marketing surveys in the future. If everything is well-structured, marketers could be helped by ChatGPT to build a survey platform with its fast-paced and low-cost benefits compared to holding an actual survey that usually takes longer time and requires more expenses, which could save up a brand's marketing budget and efficiency. To keep informed, all of the surveys that were done in this thesis costed \$5.18, including trials and errors, with a high speed of generating thousands of answers. However, it is essential to highlight that this study was done with ChatGPT based on a version of GPT 3.5 (specifically, the model gpt-3.5-turbo-1106 was used) as at the time I was doing this thesis has a significantly lower API price than using the most updated versions based on of GPT 4.

When conducting this marketing survey with ChatGPT, the most critical insight was that the prompt, including the context and task we give to ChatGPT, must be well structured with precise information to ascertain that ChatGPT understands what the survey question meant. As mentioned in the report analysis, in some cases, I had to change the phrase and formulation to be precise and generate the desired result. Hence, the choice of wording and information matters. This is doable only if you have ground truth data, which was my case. In real scenarios, it is not easy to understand if the prompt is correctly engineered for the desired task.

ChatGPT also shows responses to its irrational behavior mimicking humans, which could be helpful for marketers in developing marketing strategies on promotional matters. In this case, the human behavior described by the prospect theory is tested, and ChatGPT shows coherent behavior, although it tends to be more risk-averse than humans regarding gains. Instead, regarding losses, ChatGPT shows a risk-prone behavior aligned with human behavior. In another case, ChatGPT shows its capacity to consider cultural aspects when asked to impersonate a respondent from a specific country. However, it did not show a good result when ChatGPT was queried with a survey regarding the advantages of owning an electric car. This is explainable by the fact that these advantages do not necessarily have only a rational choice but also an irrational component that either ChatGPT could not model or the prompt was not well structured enough.

To demonstrate how this research would support businesses in creating a strategy, I describe some possible suggestions based on the queried survey with the virtual respondents.

First, according to the customer's factors in buying a new car, a new type of electric/hybrid car with a fuel-efficient system would have a higher demand; hence, in deciding what product to sell, it would be good for the automotive brand to focus on this segment to widen the market. The final price to sell on the market could be decided by considering its fixed and variable cost of car production, price acceptance by the target market by looking at the survey with ChatGPT on willingness to pay from the market, and also consideration comparing price with competitor price in the same segment.

Then, we can assume that for this sector, the dealers are essential as the point of purchase place. Not only that, a dealer visit is also important for the target market in the purchase decision as they could see the car directly and do a test drive. It is an insight that among all online medium used to review the car, they still need assurance of the car visual and feel in reality. It could then be suggested to "place" the car closer to the target market by having location-based marketing, for instance, car displays or car exhibitions in high-traffic areas inside a mall or city center. A localized marketing of the dealer's location and activity could also be communicated.

Lastly, it is essential to establish the brand's online presence, as most of the user research journey process takes place in online media. Besides the usual advertisement to gain awareness, pushing more information regarding the car as an advertorial and car review content is essential. It could be published on owned media; video platforms such as YouTube, or automotive car review platforms. Several platforms could be used, and the brand could decide on the websites based on the high traffic/visitors, relevancy, and index for the target audience. For the promotional message, the brand could focus on a long warranty and free service program for new buyers. In addition, based on the study regarding prospect theory, a marketing strategy based on surveys conducted with ChatGPT would suggest the consumers would rather have an immediate discount or benefits than have benefits with uncertainty. This could also drive the promotional strategy.

The explanation above illustrates some potential actions that can be taken along with the marketing survey done in this thesis. However, it is essential to highlight that the survey could help support business strategies, yet it is not the only source to ponder. Hence, in the actual marketing practice, it is important to consider the other crucial market considerations, factors, and insights the brand might have.

Limitations

Regardless of the fact that most surveys explored with ChatGPT portray accommodated satisfaction, some areas needed improvement in this study to generate a more precise answer. First, limitation concerns the possibility of some errors coming from the misinterpretation of phrases used. As mentioned in the study case report, in some cases, I had to query ChatGPT several times to find the word, or omitted information, which led ChatGPT to answer very differently from the validation data. It means there could always be a high chance of errors in a question and a negative impact on the result quality due to the language barrier. It is, therefore, essential to carefully analyze all elements concerning the question and answer, whether it would make sense for ChatGPT.

Another constraint in this project is that the respondents I got do not have detailed information about the virtual respondents, such as the exact sampling distribution across respondents. Regardless, when prompting ChatGPT in the surveys, I have always mentioned that it has to represent a person from a particular market (country, age, income) and specific context about the characteristics it has to represent; the unfilled gap in this study is there was no exact information of the respondent's allocation, compared if a marketing research company did the survey. That being the case, it is suggested for future experiments to have a more structured survey considering the way of sampling with a statistic approach, as it seems possible to create a better coding version.

Future Works

As highlighted, some limitations require further study to assert until extended ChatGPT can be used to replace actual respondents. In particular, irrational components must be addressed to understand for which kind of questions ChatGPT is reliable.

Another future work is to focus on providing a model to create surveys. In particular, the model will concentrate on how to give the correct contextual information to ChatGPT to represent a real respondent.

Finally, many other LLM models and newer versions of ChatGPT exist. Similar research shall be carried out on each model to assert whether they have similar behavior and how they can be used in synergy to compensate for some eventual limitations specific to a model.

Integrating ChatGPT in Marketing Research

This section provides a strategy to integrate ChatGPT and other LLM models within the marketing research process based on the use of ChatGPT presented in this thesis.

To get better insights into marketing research, it is essential to follow the process for developing the research thoroughly. The critical aspects start from defining the problem, including target population, approach formulation, and research design selection, which entails defining the objective, choosing the methods, sampling strategy, data collection procedures, and pilot testing. Some methods can be used in the research, such as online/web surveys, in-person interviews, mobile surveys, phone surveys, or observation. Once the method is decided, the survey shall be conducted with participants' data collection. The last stages remaining are for data processing and analyzing the report.

In the current landscape, several research companies worldwide serve market data and insights based on online research for clients across diverse industries, including marketing. From a business point of view, this research is essential to support the decision-making process. The common services include consumer behavior, market trends, and competitive landscape.

Amazon Mechanical Turk, for example, is a crowdsourcing service provided by Amazon that connects thousands of people to contribute to a project in exchange for incentives. The projects are diverse, involving data transcription, comparing items and data records, evaluating items for quality, data collection, and many others. The idea is that using crowdsourcing could save the company a lot of working time and be affordable. This way, Mechanical Turk could also be used for the public to use the source as a respondent of surveys, such as marketing research and customer preference surveys.

Though the online survey is done differently than the traditional one, the research company shall also apply adequate research design and process. Private research companies offering insight and data solutions for marketers usually have their standards in doing the survey. For this case, GWI, as the source I used in this thesis, has its source of respondents. GWI works with some industry-leading panel providers that have their base of respondents to manage filling up the survey; it can also be the case that they invite people to join the survey through online ads, sponsored posts, online messaging, and partnerships with other websites in exchange for some incentives. The participants shall register on their system with the basic demographic information: age, gender, location, education, etc. All the contributions from these sources are then analyzed and proceed as information and insights that subscribed marketers could access.

In the following, a proposal of the integration of ChatGPT, within the presented marketing research process with a focus on the data collection stage is presented. What is proposed is not tailored for ChatGPT but for LLM models in general.

LLMs are suggested to be used for **automated surveying**. Thus, marketers can use this additional source for data collection that surveys virtual respondents with the benefit of gathering a vast amount of data responses at a low price and at a high speed. The crucial part of collecting a vast amount of data is to query virtual respondents that represent the distribution of actual respondents.

As mentioned in the “Limitations” section, contextual information is crucial for LLMs to understand the task. Considering that ChatGPT and many other LLMs can process very long prompts, it is advisable to exploit this feature to our advantage. For instance, the version gpt-3.5-turbo-1106 can process up to 16385 tokens (OpenAI, GPT 3.5 Turbo Model, 2024), which is roughly 65 thousand words. Creating such a rich prompt manually is unrealistic. Instead, it is realistic considering to exploit a software able to fill in all the omitted information on the survey, as similarly done by the code developed for this thesis but at a bigger scale.

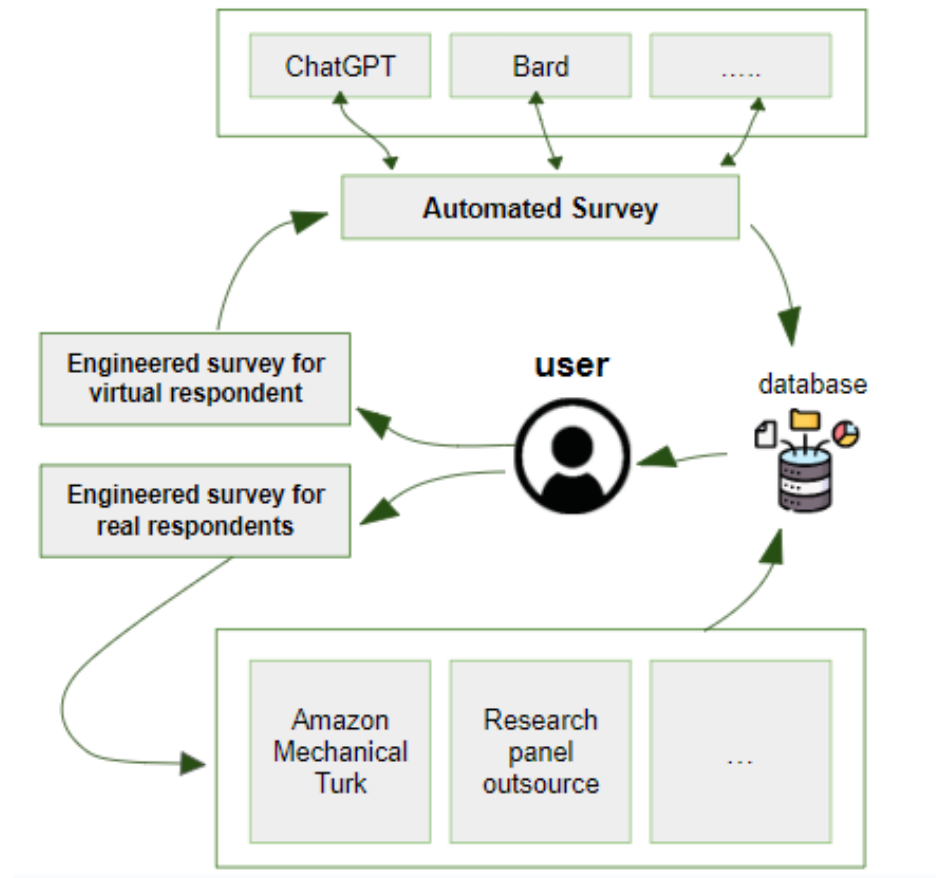
As mentioned, a wide variety of LLMs exist, similar to ChatGPT, both commercial and open source. Many are being developed, and we will likely see many new LLMs in the near future. Some of these models will suffer from limitations that others do not. It is therefore suggested that an automatic surveying strategy that exploits multiple models is used to mitigate the constraints and increase the diversity of the virtual respondents.

On the other hand, it is not suggested to trust solely virtual respondents, but a subset of the respondents used for market research shall be actual respondents who shall work as red flags in case there is a significant mismatch between real and virtual respondents. This corresponds to a **hybrid sourcing strategy**. In case such a red flag is raised, it may be that the real respondent subset is too small or not representative of the market, or on the other hand, the prompt used for the survey is not being engineered correctly.

Moreover, as mentioned in the findings, irrational behaviors might not be well reproduced by ChatGPT. To overcome this limitation, different surveying strategies shall be adopted based on the questions. For instance, when it is foreseen that a question might touch a more irrational behavior of people, it is advisable to survey actual respondents rather than virtual ones. This

corresponds to the **survey engineering phase**, where some surveys might be engineered differently according to whether the respondent is virtual or real.

The below diagram shows a simplification of this new workflow with LLM models integrated for data collection.



*Figure 29: Marketing Research Workflow Integrated with LLM Models on Data Collection.
Source: created by the author*

With this scenario, it is anticipated to see commercial software in the near future that provides support for market researchers and services such as automatic surveys. Automating the surveying and prompting, based on multiple LLMs as sources, will lead to high-speed and cheap research that will impact how market research is done.

6. Conclusion

Artificial Intelligence (AI) has changed how industries worldwide work, from healthcare, finance, automotive, manufacturing, retail, and marketing. The adoption of AI, particularly machine learning, for the marketing sector has been growing in the past years, controlling big data for marketing and advertising purposes. Its constant evolution came to a peak of enthusiasm when ChatGPT, a Large Language Model (LLM) from OpenAI, launched for public use in late 2022. With its advanced natural language processing capabilities, ChatGPT is widely used to support businesses in marketing content creation and customer engagement. Its ability to generate human-like responses at a fast pace and on a larger scale is revolutionizing brand interaction with customers and the workflow in this sector.

This research focuses on the other potential use of ChatGPT (in particular GPT 3.5) for marketing research. Marketing research plays a pivotal role in businesses to generate insights for developing marketing strategies and making decisions. Generally, there are several ways of doing the research, including the traditional method of survey, online survey, and direct interview. Nonetheless, this thesis centers on using ChatGPT as a virtual respondent for a marketing survey by giving it a persona and background about the respondents it shall impersonate. ChatGPT has the advantage of processing and responding to a high volume of queries at a high speed; hence, it has the potential to assess this activity to represent thousands of people in a survey with a faster process and lower cost; this is done programmatically by using the API of OpenAI.

This research aims to verify the accuracy of ChatGPT's responses by comparing its survey results with those obtained from a human-conducted market survey, analyze the traits similarity to human of the prospect theory, and validate that it has a human sense of price acceptance of a product.

The result shows that ChatGPT replicated most of the surveys done to humans positively, though there are a few discrepant answers towards some keywords, creating some bias in the answers. The prospect theory case also shows similar behavior to humans when gains are proposed in a promotional message, and it also shows a similar behavior to humans when facing losses. ChatGPT could also make sense in responding to price acceptance of a product. In general, ChatGPT still shows more positive results in replicating human thinking despite some misalignment in its responses. The experiments done in this research show the great potential of ChatGPT eventually for marketing research.

This thesis also envisions how the ChatGPT, and other LLM models, can be integrated within the current workflow of general marketing research focusing on the data collection part. Future research using ChatGPT in marketing research requires a more comprehensive survey method with a better sampling distribution for the virtual respondents. This would allow more accurate data collection for the survey analysis, resulting in valuable insight to contribute to marketers' work in creating marketing strategy and making decisions.

This field is growing quickly, and many new LLM models are being released yearly. A similar study shall be performed also with other and newer LLMs models.

To conclude, the most probable scenario is that commercial automated software will be developed to help marketing researchers performing data collection by using several LLM models to mitigate biases and reach a distribution of answers closer to human ones to ultimately speed up the data collection stage by replacing part of the respondents with virtual ones.

Appendix A – Example of prompts and configurations

This appendix includes example of the prompts for each of the study together with the configuration JSON files.

Study 1: Car Preferences Among Countries

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice

User Role / Prompt

You are a person from France who wants to buy a car in the next 24 months. Which car would you like to buy?

A) New Car

B) Used Car

You can only have one answer.

Configuration JSON file

```
{
  "name": "Preferences",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64. The answer to the questions must be formatted in JSON as {\\"choice\\": X} where X is the letter of the choice",
    "prompt": "You are a person from ${country} who wants to buy a car in the next 24 months. Which car would you like to buy? ${choices} \n You can only have one answer.",
    "temperature": 1,
    "iterations": 50,
    "num_of_choices": 5,
    "variables": [
      {
        "name": "country",
        "values": [
          "Italy",
          "China",
          "France",
          "Germany",
          "UK",
          "USA"
        ]
      }
    ]
  },
  "choices": [
    "A) New Car",
    "B) Used Car"
  ],
  "outputs": [
    "choice"
  ]
}
```

Study 2: Top Priorities for The Car Buyers [New Cars & Used Car]

System Role / Context

Source market: U.S, UK, France, Germany, Italy and China only. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice.

User Role / Prompt

I am doing market research. You are a person that wants to purchase a new car in two years (not secondhand). What are the important purchase reasons for you to buy the car?

F) I want a car that is cheaper to maintain

B) I want to replace current car

A) I want a more fuel-efficient car

D) I want a more spacious car

E) I want a car to go to work

C) I want an electric or hybrid car

G) I want to avoid public transportation

You can answer more than one option, but only choose what you think best.

For the used car the prompt is analogous.

Configuration JSON file

```
{
  "name": "Priorities",
  "experiment": {
    "context": "Source market: U.S, UK, France, Germany, Italy and China only. The answer to the questions must be formatted in JSON as {\"choice\": X} where X is the letter of the choice",
    "prompt": "I am doing market research. You are a person that wants to purchase a new car in two years (not secondhand). ${extra_context}What are the important purchase reasons for you to buy the car? ${choices} \n You can answer more than one option, but only choose what you think best.",
    "temperature": 1,
    "iterations": 50,
    "num_of_choices": 5,
    "variables": [
      {
        "name": "extra_context",
        "type": "single",
        "values": [
          "You might already own a car. ",
          "",
          "",
          ""
        ]
      }
    ]
  },
  "choices": [
    "A) I want a more fuel-efficient car",
    "B) I want to replace current car",
    "C) I want an electric or hybrid car",
    "D) I want a more spacious car",
    "E) I want a car to go to work",
    "F) I want a car that is cheaper to maintain",
    "G) I want to avoid public transportation"
  ],
  "outputs": [
    "choice"
  ]
}
```


Study 3: Research Source That People Would Use or Trust

Research Source That People Would Use

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, China, France, Germany, and Italy. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice

User Role / Prompt

You could be either a person who owns a car or is looking to buy a car. What are the resources you would use for the research?

D) Specialized online automotive marketplace

G) Video reviews

F) Specialist/independent review sites

H) Online news/newspaper reviews

E) The manufacturers website

A) car dealership visit (includes see and observe the car directly, and do test drive)

B) Consumer review sites

C) Conversation with friends/family

You can answer more than one option, including none or all. Consider that typically, a person has multiple considerations on the source to use.

Configuration JSON file

```
{
  "name": "Used sources",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, China, France, Germany, and Italy. The answer to the questions must be formatted in JSON as {\"choice\": X} where X is the letter of the choice",
    "prompt": "You could be either a person who owns a car or is looking to buy a car. What are the resources you would use for the research? ${choices} \n You can answer more than one option, including none or all. Consider that typically, a person has multiple considerations on the source to use.",
    "temperature": 1,
    "iterations": 50,
    "num_of_choices": 5,
    "variables": [
    ],
    "choices": [
      "A) car dealership visit (includes see and observe the car directly, and do test drive)",
      "B) Consumer review sites",
      "C) Conversation with friends/family",
      "D) Specialized online automotive marketplace",
      "E) The manufacturers website",
      "F) Specialist/independent review sites",
      "G) Video reviews",
      "H) Online news/newspaper reviews"
    ],
    "outputs": [
      "choice"
    ]
  }
}
```

Research Source That People Would Trust

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, China, France, Germany, and Italy. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice.

User Role / Prompt

You could be either a person who owns a car or is looking to buy a car. Which resources would you TRUST? Trust in this context, means that you believe and use the information for your car buying

D) Specialized online automotive marketplace

E) The manufacturers website

F) Specialist/independent review sites

G) Video reviews

A) car dealership visit (includes to see and observe the car directly, and do test drive)

B) Consumer review sites

H) Online news/newspaper reviews

C) Conversation with friends/family

You can answer more than one option, including none or all. Consider that typically, some resources might lack credibility, subjective, unreliable, paid advertisement, and other factors that may not be easily trusted.

Configuration JSON file

```
{
  "name": "Trusted source",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, China, France, Germany, and Italy. The answer to the questions must be formatted in JSON as {\\"choice\\": X} where X is the letter of the choice",
    "prompt": "You could be either a person who owns a car or is looking to buy a car. Which resources would you TRUST? Trust in this context, means that you believe and use the information for your car buying ${choices} \n You can answer more than one option, including none or all. Consider that typically, some resources might lack credibility, subjective, unreliable, paid advertisement, and other factors that may not be easily trusted.",
    "temperature": 1,
    "iterations": 50,
    "num_of_choices": 5,
    "variables": [
    ],
    "choices": [
      "A) car dealership visit (includes to see and observe the car directly, and do test drive)",
      "B) Consumer review sites",
      "C) Conversation with friends/family",
      "D) Specialized online automotive marketplace",
      "E) The manufacturers website",
      "F) Specialist/independent review sites",
      "G) Video reviews",
      "H) Online news/newspaper reviews"
    ],
    "outputs": [
      [
        "choice"
      ]
    ]
  }
}
```

Study 4: Electric Vehicle (EV) Advantages

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, China, France, Germany, and Italy. Each country could have their own rule about electric vehicle. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice.

User Role / Prompt

You are a person who owns an electronic vehicle (such as electric car). What are the advantages of owning an electric/hybrid vehicle for you?

- H) Convenient charging access or stations
- A) More environmentally friendly
- I) On-board digital features
- G) Tax savings
- J) Free parking spaces
- F) Maintenance cost
- C) Driving performance
- D) Reduced noise
- E) Driving experience
- B) Running costs

You can answer more than one option, including none or all. Consider that typically, a person has multiple things they consider as advantages regarding their experience with the car and regulation of electric vehicles in their country.

Configuration JSON file

```
{
  "name": "EV advantages",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, China, France, Germany, and Italy. Each country could have their own rule about electric vehicle. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice",
    "prompt": "You are a person who owns an electronic vehicle (such as electric car). What are the advantages of owning an electric/hybrid vehicle for you? ${choices} \n You can answer more than one option, including none or all. Consider that typically, a person has multiple things they consider as advantages regarding their experience with the car and regulation of electric vehicles in their country.",
    "temperature": 1,
    "iterations": 50,
    "num_of_choices": 5,
    "variables": [
    ],
    "choices": [
      "A) More environmentally friendly",
      "B) Running costs",
      "C) Driving performance",
      "D) Reduced noise",
      "E) Driving experience",
      "F) Maintenance cost",
      "G) Tax savings",
      "H) Convenient charging access or stations",
      "I) On-board digital features",
      "J) Free parking spaces"
    ],
    "outputs": [
      "choice"
    ]
  }
}
```

Study 5: How to Sway New Buyers

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, France, Germany, Italy and China. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice

User Role / Prompt

You are a person who wants to purchase a car in two years. What are the additional benefits that may make you to purchase a new car?

- C) free maintenance for a limited time
- H) get a discount if you give your current car to the dealer
- A) long warranty
- D) full record of maintenance and service (in case you want to buy a secondhand car)
- F) free delivery of the car to your house
- G) money-back guarantee within a period
- B) have a loan with 0% interest payment
- E) free limited insurance

You can answer with any number of options, including none or all. Consider that typically a person has multiple things that can catch his attention.

Configuration JSON file

```
{
  "name": "sway",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, France, Germany, Italy and China. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {\"choice\": X} where X is the letter of the choice",
    "prompt": "You are a person who wants to purchase a car in two years. What are the additional benefits that may make you to purchase a new car? ${choices} \n You can answer with any number of options, including none or all. Consider that typically a person has multiple things that can catch his attention.",
    "temperature": 1,
    "iterations": 50,
    "num_of_choices": 20,
    "variables": [],
    "choices": [
      "A) long warranty",
      "B) have a loan with 0% interest payment",
      "C) free maintenance for a limited time",
      "D) full record of maintenance and service (in case you want to buy a second hand car)",
      "E) free limited insurance",
      "F) free delivery of the car to your house",
      "G) money-back guarantee within a period",
      "H) get a discount if you give your current car to the dealer"
    ],
    "outputs": [
      "choice"
    ]
  }
}
```

Study 6: Prospect Theory

Gains

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, France, Germany, Italy and China. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice.

User Role / Prompt

You are a car buyer who wants to purchase a new car. You have found the car that meets your needs and the car dealer presents you with the following buying options:
A) have an immediate discount of 30% on the car
B) buy the car next month with a probability to have a discount of 60% or none. The car dealer informs you that there is a probability of 50% that such a discount is applicable next month.
You can answer with only one choice.

Configuration JSON file

```
{
  "name": "gain",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, France, Germany, Italy and China. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {\"choice\": X} where X is the letter of the choice.",
    "prompt": "You are a car buyer who wants to purchase a new car. You have found the car that meets your needs and the car dealer presents you with the following buying options: ${choices} \nYou can answer with only one choice.",
    "temperature": 1,
    "iterations": 90,
    "num_of_choices": 10,
    "sampling": "progressive",
    "variables": [
      {
        "name": "discount",
        "type": "tuple",
        "values": [
          ["1%", "2%"],
          ["2%", "4%"],
          ["3%", "6%"],
          ["4%", "8%"],
          ["5%", "10%"],
          ["10%", "20%"],
          ["20%", "40%"],
          ["25%", "50%"],
          ["30%", "60%"]
        ]
      }
    ]
  },
  "choices": [
    "A) have an immediate discount of ${discount:0} on the car",
    "B) buy the car next month with a probability to have a discount of ${discount:1} or none. The car dealer informs you that there is a probability of 50% that such a discount is applicable next month."
  ],
  "outputs": [
    "choice"
  ]
}
```

Losses

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, France, Germany, Italy and China. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {"choice": X} where X is the letter of the choice.

User Role / Prompt

You are a car buyer who wants to purchase a new car. You have found the car that meets your needs and the car dealer presents you with the following buying options:
 A) if you buy the car now you have to pay an additional tax such that you will end up paying 15% more than the car nominal value
 B) if you wait one month, there is a probability of 50% you get 18% fiscal incentive from the government such that you will end up paying the car 18% less than its nominal value, a probability of 50% that you have to pay an additional tax such that you will end up paying 48% more than the car nominal value
 You can answer with only one choice.

Configuration JSON file

```
{
  "name": "loss_equal_prob",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who can be from U.S, UK, France, Germany, Italy and China. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {\\"choice\\": X} where X is the letter of the choice.",
    "prompt": "You are a car buyer who wants to purchase a new car. You have found the car that meets your needs and the car dealer presents you with the following buying options:{{choices}} \nYou can answer with only one choice.",
    "temperature": 1,
    "iterations": 90,
    "num_of_choices": 10,
    "sampling": "progressive",
    "variables": [
      {
        "name": "gain_loss",
        "type": "tuple",
        "values": [
          ["1%", "10%", "12%"],
          ["2%", "12%", "16%"],
          ["5%", "14%", "24%"],
          ["10%", "16%", "36%"],
          ["15%", "18%", "48%"],
          ["20%", "20%", "60%"],
          ["25%", "22%", "72%"],
          ["30%", "24%", "84%"],
          ["35%", "26%", "96%"]
        ]
      }
    ]
  },
  "choices": [
    "A) if you buy the car now you have to pay an additional tax such that you will end up paying ${gain_loss:0} more than the car nominal value",
    "B) if you wait one month, there is a probability of 50% you get ${gain_loss:1} fiscal incentive from the government such that you will end up paying the car ${gain_loss:1} less than its nominal value, a probability of 50% that you have to pay an additional tax such that you will end up paying ${gain_loss:2} more than the car nominal value"
  ],
  "outputs": [
    "choice"
  ]
}
```

Study 7: Willingness To Pay

In the following the prompts for the willingness to pay and the income demand are reported for the economy car. For the non-economy car, the prompt are analogous.

Willingness to Pay

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who lives and work in Italy. You are asked how many euros you are willing to pay for the presented product. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {"wtp": X} where X is the price in euros you are willing to pay.

User Role / Prompt

You are a car buyer who wants to purchase a new car and you are randomly selected for this survey and your annual net income is more than 55k€. What is the maximum price you would be willing to pay for a new electric economy car? You must answer with a single number.

Configuration JSON file

```
{
  "name": "wtp",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who lives and work in Italy. You are asked how many euros you are willing to pay for the presented product. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {\\"wtp\\": X} where X is the price in euros you are willing to pay.",
    "prompt": "You are a car buyer who wants to purchase a new car and you are randomly selected for this survey and your annual net income is ${income}. What is the maximum price you would be willing to pay for the new electric economy car? You must answer with a single number.",
    "temperature": 1,
    "iterations": 200,
    "num_of_choices": 10,
    "sampling": "uniform",
    "variables": [
      {
        "name": "income",
        "type": "single",
        "values": [
          "more than 55k\u20ac",
          "between 26k\u20ac and 55k\u20ac", "between 26k\u20ac and 55k\u20ac",
          "between 26k\u20ac and 55k\u20ac", "between 26k\u20ac and 55k\u20ac",
          "between 26k\u20ac and 55k\u20ac",
          "between 15k\u20ac and 26k\u20ac", "between 15k\u20ac and 26k\u20ac", "between 15k\u20ac and 26k\u20ac",
          "between 15k\u20ac and 26k\u20ac", "between 15k\u20ac and 26k\u20ac", "between 15k\u20ac and 26k\u20ac",
          "less than 15k\u20ac", "less than 15k\u20ac", "less than 15k\u20ac", "less than 15k\u20ac", "less than 15k\u20ac",
          "less than 15k\u20ac", "less than 15k\u20ac", "less than 15k\u20ac"
        ]
      }
    ]
  },
  "choices": [
  ],
  "outputs": [
    "wtp"
  ]
}
```

Income Demand

System Role / Context

You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who lives and work in Italy. You are asked if you would buy the presented product for the given price. You have to reason about your financial

situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {"buy": X} where X is the 1 if you are going to buy it or 0 if you don't.

User Role / Prompt

You are a car buyer who wants to purchase a new car and you are randomly selected for this survey and your annual net income is less than 15k€. Would you buy a new electric economy car for 14k€?

Configuration JSON file

```
{
  "name": "income_demand",
  "experiment": {
    "context": "You will be asked to answer a question and you have to impersonate a random person with age ranging from 16-64 who lives and work in Italy. You are asked if you would buy the presented product for the given price. You have to reason about your financial situation and personal needs before deciding which choices are suitable to your situation. The answer to the questions must be formatted in JSON as {\"buy\": X} where X is the 1 if you are going to buy it or 0 if you don't.",
    "prompt": "You are a car buyer who wants to purchase a new car and you are randomly selected for this survey and your annual net income is ${income}. Would you buy a new electric economy car for ${price} ?",
    "temperature": 1,
    "iterations": 1000,
    "num_of_choices": 6,
    "sampling": "uniform",
    "variables": [
      {
        "name": "income",
        "type": "single",
        "values": [
          "more than 55k€",
          "between 26k€ and 55k€", "between 26k€ and 55k€", "between 26k€ and 55k€",
          "between 26k€ and 55k€", "between 26k€ and 55k€",
          "between 15k€ and 26k€", "between 15k€ and 26k€", "between 15k€ and 26k€",
          "between 15k€ and 26k€", "between 15k€ and 26k€", "between 15k€ and 26k€",
          "less than 15k€", "less than 15k€", "less than 15k€",
          "less than 15k€", "less than 15k€", "less than 15k€",
          "less than 15k€", "less than 15k€"
        ]
      },
      {
        "name": "price",
        "type": "single",
        "values": [ "6k€", "10k€", "14k€", "18k€", "22k€", "26k€", "30k€", "34k€", "38k€" ]
      }
    ]
  },
  "choices": [
  ],
  "outputs": [
    "buy"
  ]
}
```


Appendix B – Code

This appendix describes the code developed to programmatically query ChatGPT.

The code is divided in three modules:

- **Client:** this module provides a class to query ChatGPT and parse the output
- **Exporter:** this module implements a class to export the data in an Excel file such that it can be directly analyzed
- **Experiment:** this module provides a class to read a configuration file that defines how the experiment is configured

Experiment configuration

The experiment configuration is interesting because defines a model to create variable prompts. In [Appendix A](#) the reader can find the configuration for each study. An experiment is characterized by the following fields:

- **temperature:** the temperature is related to the creativity of the answers of ChatGPT. In more technical words it relates to the sample strategy of the tokens. To have a very variable results the user should put a temperature greater than 1, to have a determinist response it shall be set to 0. In all the experiments reported in this thesis the temperature is set to 1.
- **iterations:** this refers to the number of prompts generated and queried to ChatGPT.
- **num_of_choices:** this is the number of choices of ChatGPT. A choice in this case corresponds to an answer of ChatGPT. For the same prompt there could be different choices, i.e. different answers. For an experiment, the total number of output data is given by $iterations \cdot choices$, minus the answers that could not be parsed.
- **context:** This context is a string that provides context to ChatGPT and normally contains also how the output shall be formatted. It corresponds to a message with role “system” as defined by ChatGPT API. In this code, the output data is supposed to be formatted as JSON (JavaScript Object Notation) to ease the data parsing.
- **prompt:** The prompt is a string corresponding to the question asked to ChatGPT. It corresponds to a message with role “user” as defined by ChatGPT API. A prompt is then, optionally, composed of variables and choice list. Variables are elements whose value may vary between one prompt and the other (a more detailed explanation will follow). A choice list instead is a list of answers ChatGPT is supposed to choose. These answers are fixed and the only random variable here is the fact that at every prompt the choices are shuffled in order to avoid biases of

ChatGPT. As previously cited, ChatGPT showed to have a bias to select the first options in a list.

- **variables:** this is a list of variables, where each variable is defined by
 - **name:** each variable must have a unique name
 - **type:** there are two type of variables is this model:
 - **single:** means that each sampled value has a unique value
 - **tuple:** means that each sampled value is composed of multiple values
 - **values:** this is the list that the variable might have. Each time we sample a value from this variable it will be sampled from this list. Variable values are strings (i.e. text). This means that they can be number expressed as text or even words or sentences.

A single variable is inserted in the prompt when the following text pattern is encountered in the prompt: $\${name}$ where name is the variable's name. For instance, consider the following prompt

“Would you buy a car at a price of $\${price}$?”

and a variable defined as:

- name: “price”
- type: “single”
- values: [“25k€”, “30k€”, “35k€”]

A possible prompt is the following:

“Would you buy a car at a price of $\${price}$?”

A tuple variable is inserted in the prompt when the following text pattern is encountered in the prompt: $\${name:i}$ where name is the variable's name and “i” is the index of its value. For instance, consider the following prompt

“Would you buy a car for $\${price:1}$ considering one month ago was sold for $\${price:0}$?”

and a variable defined as:

- name: “price”
- type: “tuple”
- values: [[“20k€”, “25k€”], [“25k€”, “30k€”], [“32.5k€”, “35k€”]]

A possible resulting prompt is the following:

“Would you buy a car for 30k€ considering one month ago was sold for 25k€?”

As you can notice, this variable type is useful to insert correlated data in the prompt. This is necessary because, to foster variability in the prompt, each variable is sampled from a uniform independent distribution.

Given this model the user can define very complex prompts by simply combining several variables. An example is the following:

“You are a buyer from $\${country}$ who wants to buy a $\${type}$ car. Would you buy the car at a price of $\${price:1}$ considering one month ago was sold for $\${price:0}$?”

In this prompt there are two single variables and one tuple variable.

- **choices:** this a list of choices that can be put substitute in the survey. For every prompt generated the choices are always the same but the other they are presented is randomly shuffled. This is done as workaround about the biased behavior of ChatGPT which shows a tendency to select the first choices, as reported by the API itself. In addition, the choices could also include variability by adding a variable reference as done in the prompt (see [Appendix A - Prospect Theory](#)).

Choices are inserted in the prompt when the following text pattern is encountered in the prompt: $\${choices}$. For instance, consider the following prompt

“You want to buy a car, what would you buy? \n $\${choices}$ ” and “choices” defined by the following list of options:

- A) petrol car
- B) electric car

A possible prompt is the following:

“You want to buy a car, what would you buy?

A) petrol car

B) electric car”

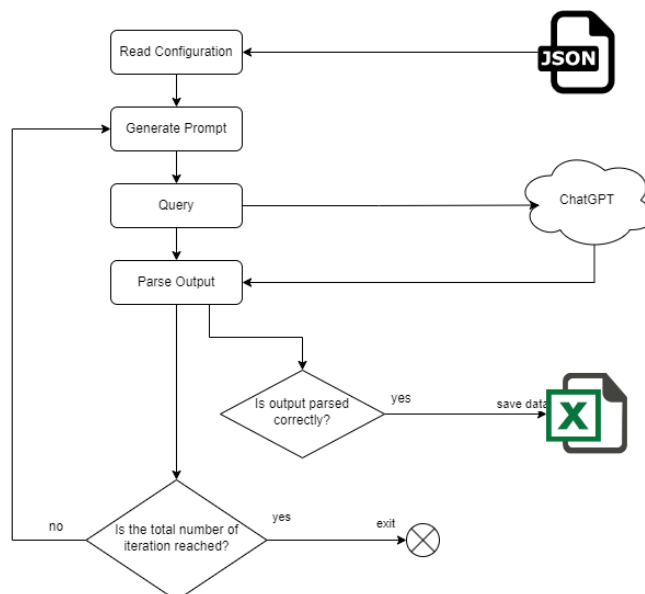
- **sampling:** Each value of a variable can be sampled according to two strategies:

- **uniform:** each value is selected from the value list according to a uniform distribution. A non-uniform distribution of the values can be modelled by simply creating a value list with values that repeats
- **progressive:** at every sampling the value sampled is the one of the lists after the previous sampling. This could be handy for some kind of experiments.

Source Code

The source code is written in Python 3.10 and is divided in 4 files:

- **experiment.py:** This module provides a class to read an experiment configuration expressed as defined above in JSON format. Given the configuration it generates the prompts. This module can also be run as executable to test the prompts that can be generated given an experiment configuration file. This was used during the prompt engineering phase prior launching the experiment with a lot of iterations with ChatGPT.
- **client.py:** provide two simple classes as a wrapped to two clients, a fake client for testing and a client to open a chat with ChatGPT.
- **exporter.py:** this module provides a simple class to export the data to an excel file. In particular, for every iteration, the value of the variables and the output values are exported in the excel file
- **main.py:** this module is the orchestrator that connects the aforementioned modules and classes. The workflow is depicted in the scheme below.



experiment.py

```
import re, json, itertools, random
import numpy as np
```

```

class VariableSampler:
    def __init__(self, name, type, sampling, values=list[str]):
        self.values = values
        self.sampling = sampling
        self.name = name
        self.type = type
        self.id = 0

    def sample(self):
        if self.sampling == "uniform":
            return random.choice(self.values)
        elif self.sampling == "progressive":
            val = self.values[self.id]
            self.id += 1
            if self.id >= len(self.values):
                self.id = 0
            return val
        else:
            raise Exception(f"Sampling strategy {self.sampling} not supported")

class ChoicesSampler:
    def __init__(self, choices = list[str]):
        self.choices = choices

    def sample(self):
        ids = [i for i in range(len(self.choices))]
        random.shuffle(ids)
        return [self.choices[i] for i in ids], ids

    def map(self, ids, id):
        return ids[id]

class Experiment:
    def __init__(self, stream:str):
        self.config = json.load(stream)
        self.name = self.config["name"]
        self.experiment = self.config["experiment"]
        self.sampling = "uniform" if not "sampling" in self.experiment.keys() else self.experiment["sampling"]
        self.temperature = self.experiment["temperature"] if "temperature" in self.experiment.keys() else 1
        self.variables = []
        for v in self.experiment["variables"]:
            type_ = "free" if not "type" in v.keys() else v["type"]
            self.variables.append(VariableSampler(v["name"], type_, self.sampling, v["values"]))

        self.iterations = self.experiment["iterations"]
        self.outputs = self.config["experiment"]["outputs"]
        self.choices = ChoicesSampler(self.experiment["choices"]) if "choices" in self.experiment.keys() else None
        if "num_of_choices" in self.config["experiment"].keys():
            self.nchoices = self.config["experiment"]["num_of_choices"]
        else:
            self.nchoices = 1
        pass

    def sample_prompt(self) -> tuple:
        prompt = self.experiment["prompt"]
        # substitute choices
        choices = None
        if self.choices:
            choices, choices_ids = self.choices.sample()
            choices = "\n" + "\n".join(choices)
            regex = r"\$\{choices\}"
            prompt = re.sub(regex, choices, prompt, flags=re.I)

        values = []
        # substitute variable
        for v in self.variables:
            if v.type == "single":
                value = v.sample()
                values.append(value)
                regex = r"\$\{" + v.name + r"\}"
                prompt = re.sub(regex, value, prompt, flags=re.I)
            elif v.type == "tuple":
                for i, value in enumerate(v.sample()):
                    values.append(value)
                    regex = r"\$\{" + v.name + f":{i}" + r"\}"
                    prompt = re.sub(regex, value, prompt, flags=re.I)
            else:
                raise Exception(f"Variable type \"{v.type}\" not supported")

        return values, prompt, choices

    def next(self) -> str:
        for i in range(self.iterations):
            yield self.sample_prompt()

    def __len__(self):
        return self.iterations

```

```

def __iter__(self):
    return self.next()

if __name__ == "__main__":
    import tqdm
    import argparse
    parser = argparse.ArgumentParser(description="Test program to test possible prompt created by an experiment
configuration")
    parser.add_argument("--exp", "-e", required=True, type=str, help="Experiment configuration .json file")
    parser.add_argument("--num", "-n", default=None, type=int, help="Number of samples to print, if empty it prints as
many configuration as iterations configured")
    args = parser.parse_args()
    exp = Experiment(open(args.exp))
    if args.num is None:
        for v, p, c in tqdm.tqdm(exp):
            print(f"\n{v} -> {p}\n")
    else:
        for i in range(args.num):
            v, p, c = exp.sample_prompt()
            print(f"\n{v} -> {p}\n")

```

client.py

```

from openai import OpenAI
from exporter import Exporter
from experiment import Experiment
import json

class ClientOpenAI:
    def __init__(self, model="gpt-3.5-turbo-1106"):
        self.client = OpenAI()
        self.usages = []
        self.model = model
        self.total_tokens = 0

    def query(self, user, system=None, n:int = 1, temperature : float = 1):
        messages = []
        if system is not None:
            messages.append({"role": "system", "content": system})

        messages.append({"role": "user", "content": user })
        response_format={"type": "json_object" }
        response = self.client.chat.completions.create(
            model=self.model,
            response_format=response_format,
            # frequency_penalty=0.0,
            # presence_penalty=0.0,
            # max_tokens=30,
            # top_p=1,
            n=n,
            temperature=temperature,
            messages=messages)
        self.total_tokens += response.usage.total_tokens
        self.usages.append(response.usage)
        return [c.message.content for c in response.choices]

class FakeClientOpenAI:
    def __init__(self, model="gpt-3.5-turbo-1106"):
        load_dotenv(dotenv_path=".vars")
        self.client = OpenAI()
        self.usages = []
        self.model = model
        self.total_tokens = 0

    def query(self, user, system=None, n:int = 1, temperature:float=1):
        import random
        self.total_tokens += int(random.random()*25)
        return [json.dumps({"number": str(int(random.random()*9 + 1)), "city" : "Milan"}, indent=4) for i in range(n)]

```

exporter.py

```

from openpyxl import Workbook, load_workbook
from pathlib import Path
import time, shutil, os
import json

class Exporter:
    def __init__(self, filename :str, headers :list[str]):
        path = Path(filename)
        if path.suffix == ".xlsx":
            self.filename = path
        elif path.suffix == '':
            self.filename = path.with_suffix(".xlsx")
        else:

```

```

        print(f"Not valid filename {filename}")
        exit(1)

    print(f"Exp {self.filename}")
    self.headers = headers

    if self.filename.exists():
        # create a copy of the file for backup
        shutil.copy(self.filename, self.filename.with_stem(self.filename.stem + '_backup'))
        self.workbook = load_workbook(filename=self.filename)
    else:
        self.workbook = Workbook()
        self.sheet = self.workbook.active

    def SetExperiment(self, name, overwrite = False):
        if name in self.workbook.sheetnames:
            if not overwrite:
                k = ''
                while not k.lower() in ['y','n']:
                    k = input(f"The excel file ${self.filename} already has a sheet called {name}, do you want to
overwrite it? [Y/n] (old data will be lost)")
                if k == 'n':
                    print("Exiting...")
                    exit(0)
                else:
                    msg = f"Overwriting sheet {name}"
                    for i in range(5):
                        print(msg + '.'.join(['.']*i), end='\n')
                        time.sleep(1)
                    print("Overwritten")
                    self.workbook.remove(self.workbook[name])

            self.workbook.create_sheet(name)
            self.sheet = self.workbook[name]
            self.sheet.title = name
            self.sheet.append(self.headers)

        pass

    def WriteData(self, data):
        self.sheet.append(data)
        self.workbook.save(filename=self.filename)

```

main.py

```

import traceback
from exporter import Exporter, QueriesFile
from experiment import Experiment
from client import ClientOpenAI, FakeClientOpenAI
from tqdm import tqdm
import openai
import argparse, os, time
import json
from dotenv import load_dotenv

def parse_args():
    parser = argparse.ArgumentParser(description="Run an experiment querying chatgpt",
formatter_class=argparse.ArgumentDefaultsHelpFormatter)
    parser.add_argument("--exp", "-e", type=str, help=".json file of the experiment", required=True)
    parser.add_argument("--client", "-c", type=str, help="ChatGPT client type", choices=['openai', 'fake'],
default='fake')
    parser.add_argument("--model", "-m", type=str, help="ChatGPT model", choices=[ m.id for m in
openai.OpenAI().models.list().data ], default='gpt-3.5-turbo-1106')
    parser.add_argument("--excel", "-E", type=str, help="Excel output file. The suffix .xlsx will be automatically
appended if missing", default=None)
    parser.add_argument("--sleep", "-s", type=float, help="Seconds to sleep between consecutive queries", default=1)
    parser.add_argument("--overwrite", "-o", help="Overwrite experiment if presents in the excel sheet",
action="store_true")
    parser.add_argument("--verbose", "-v", help="Whether to run the code in verbose mode", action="store_true")
    return parser.parse_args()

if __name__ == '__main__':
    load_dotenv(dotenv_path=".vars")

    args = parse_args()
    exp_filename = args.exp
    if not os.path.exists(exp_filename):
        print(f"File {exp_filename} does not exist")
        exit(1)

    if args.client == 'fake':
        client = FakeClientOpenAI()
    elif args.client == 'openai':

```

```

client = ClientOpenAI(model = args.model)

experiment = Experiment(open(exp_filename))
db = QueriesFile(experiment.name)
varname = [ v.name for v in experiment.variables]
experiment_choices = [ c[0] for c in experiment.choices.choices]
if args.excel:
    exporter = Exporter(filename=args.excel, headers= varname + experiment.outputs + experiment_choices)
    exporter.SetExperiment(name=experiment.name, overwrite=args.overwrite)
else:
    args.verbose = True

results = []
#df = pd.DataFrame( columns = experiment.outputs )
pbar = tqdm(total=experiment.nchoices * experiment.iterations)
total_samples = 0
pbar.desc = f"Tokens: {client.total_tokens}"
for vars, prompt, choices in experiment:
    responses = client.query(prompt, experiment.experiment["context"], experiment.nchoices,
experiment.temperature)

    for i, response in enumerate(responses):
        if args.verbose:
            print(f"#choice{i} - {vars} -> {prompt} : answer from client {response}")
        db.Insert(prompt, response)
        try:
            reponse_json = json.loads(response)
        except:
            print(f"Cannot decode the client's response: {response}")
            pass

        result = []
        keys = reponse_json.keys()
        for r in experiment.outputs:
            if not r in keys:
                print(f"Output variable {r} not found. Available keys are: {keys}")
                result.append(None)
            else:
                try:
                    res = reponse_json[r]
                    choices_cnt = None
                    if r == "choice":
                        choices_cnt = ["0"] * len(experiment_choices)
                        for i, c in enumerate(experiment_choices):
                            if c.lower() in [x.lower() for x in res]:
                                choices_cnt[i] = "1"

                    if type(res) is list:
                        res = [", ".join(res)]
                    elif res :
                        res = [res]

                    # if there are more outputs we are overwriting them
                    if choices_cnt is not None:
                        result = res + choices_cnt
                    else:
                        if type(res) is not list:
                            result = [res]
                        else:
                            result = res
                except:
                    print(traceback.print_exc())

        results.append(result)
        if args.excel:
            try:
                exporter.WriteData( vars + result)
                total_samples += 1
            except:
                print(traceback.print_exc())
        else:
            total_samples += 1
        pbar.desc = f"Tokens: {client.total_tokens} samples: {total_samples}"
        pbar.update()

time.sleep(args.sleep)

print(f"Total Tokens: {client.total_tokens}")

```


How to use the code

The code is tested with Python 3.10. The following libraries are needed to be installed in the python environment.

- numpy==1.26.3
- openai==1.6.1
- openpyxl==3.1.2
- python-dotenv==1.0.0
- tqdm=4.66.2

Next, you should retrieve the API KEY from your OpenAI account following their instructions. The API KEY shall be stored in an environment variable named “OPENAI_API_KEY”.

At this point the code provides two executables:

- `experiment.py` prompts examples of prompts that can be generated from a given configuraton file. The user can launch it as follows:

```
$ python src\experiment.py -h
usage: experiment.py [-h] --exp EXP [--num NUM]
```

Test program to test possible prompt created by an experiment configuration

options:

```
-h, --help            show this help message and exit
--exp EXP, -e EXP     Experiment configuration .json file
--num NUM, -n NUM    Number of samples to print, if empty it prints as many configuration as iterations
                    configured
```

- `main.py` permits to launch an experiment by querying ChatGPT:

```
$ python src\main.py -h
usage: main.py [-h] --exp EXP [--client {openai,fake}]
              [--model ]
              [--excel EXCEL] [--sleep SLEEP] [--overwrite] [--verbose]
```

Run an experiment querying chatgpt

options:

```
-h, --help            show this help message and exit
--exp EXP, -e EXP     .json file of the experiment (default: None)
--client {openai,fake}, -c {openai,fake}
                    ChatGPT client type (default: fake)
--model              ChatGPT model (default: gpt-3.5-turbo-1106)
--excel EXCEL, -E EXCEL
                    Excel output file. The suffix .xlsx will be automatically appended if missing
                    (default: None)
--sleep SLEEP, -s SLEEP
                    Seconds to sleep between consecutive queries (default: 1)
--overwrite, -o      Overwrite experiment if presents in the excel sheet (default: False)
--verbose, -v        Whether to run the code in verbose mode (default: False)
```

An example of a launch of an experiment is the following command:

```
python src\main.py -e study1.json -E study1.xlsx --client openai
```

When the experiment is done the file `study1.xlsx` will contain a sheet named as the experiment with the data.

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