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To Infinity and Beyond-The Impact of Knowledge Upload on People and Society

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Abstract

The continuously improving advances in artificial intelligence (AI) technology have been the driving force behind innovative approaches to develop the field of direct knowledge upload between human brains. The results from this research confirm that there is a widening gap between knowledge transfer solutions and associated ethical and social concerns. Implications to the individual and society include technological abuse, data privacy, human intellect intellectual property (IP), prejudice and discrimination. Associated costs suggest that knowledge upload can make the benefits of it upload exclusively available to affluent people. The primary focus of scientists and researchers must place more emphasis on knowledge transfer solutions that are in the best interests of people and society. The current widening collaboration and partnership gaps between developers and scientists must be closed through the sharing of relevant knowledge and insights, setting aside cultural and geographical differences. New legislation is needed to protect people and society in ethics and social concerns. Knowledge upload reversal requires further investigation to prove its impacts/side-effects and to generate acceptable proven solutions to resolve these.

Keywords: Knowledge Upload, Brain-Computer-Interface (BCI), Deep Learning, Neural Plasticity, Ethical and Social Concerns

1. Introduction

1.1 Introduction

The concept of knowledge has attracted attention and interest for more than 2500 years. The definition and perception of what knowledge is has changed over the centuries: Plato (Greek Philosopher, 427-348 BC) defines knowledge as being a factual cognitive state which adheres to the truth, and it is a priori (theoretical deduction). In contrast, Albert Einstein (Theoretical Physicist,1879-1955) suggests that knowledge is experience. Everything else is just information. O'Dell and Grayson (1998) define knowledge as information in action. According to Bates (2005), knowledge is information given meaning and integrated with other contents of understanding. Languages OUP (2024) reports that knowledge is made up of three modes: Mode 1 Explicit, semantic, and verbal knowledge, Mode 2 Implicit, tacit, or intuitive knowledge and Mode 3 Visual, pictorial, or episodic. ResearchGate (2024) defines knowledge as the perception, inference, comparison, and word/testimony of reliable sources. Wikipedia (2024) purports that knowledge is an awareness of facts, a familiarity with individuals and situations, or a practical skill. Business-Online-Learning (2024) considers that knowledge is a familiarity with someone or something which can include information, facts, descriptions, or skills obtained through experience or evaluation. It can refer to the theoretical or practical understanding of a subject.

This research has adopted the following definition of what knowledge management is: 'Knowledge management is getting the right information in front of the right people at the right time' (Petrash, 1996, p. 370). KM is dependent on people. Baloh et al. (2011) report that people are an essential and vital asset to any organization. It is people who, ultimately, create and hold knowledge as part of their daily work activities. It is a necessary business requirement that people have access to knowledge at cross-functional level to create new business opportunities and to drive customer satisfaction improvements. Having, for example, work-related knowledge greatly impacts how successful people will be at work. There is a direct link to people's capability to obtain the right knowledge and how well they can perform their duties. It seems the creation of knowledge directly affects the performance of any organization. Knowledge helps people to understand and respond to information; intelligence is about knowing something, and understanding information for a specific reason, and wisdom is an accumulation of knowledge and experience (Fig.1).

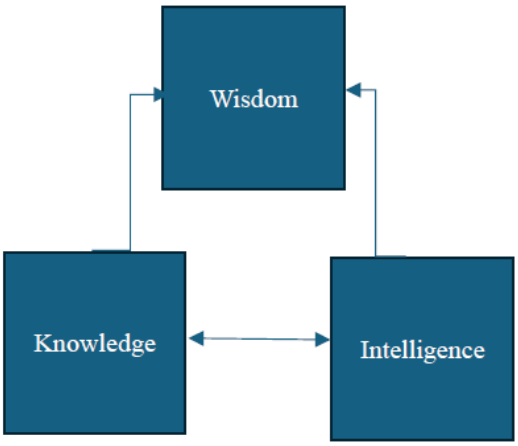

Figure 1. The relationships between Information and Knowledge, adopted from Baloh et al. (2011)

The concept of knowledge upload from one human brain to another has attracted an elevated level of interest recently. Developments in artificial intelligence (AI) capabilities have provided the means to take knowledge transfer to a higher level than could have been imagined only a few years ago. The primary focus of this research is to investigate and explore how knowledge could be transferred in the future by making best use of emerging technologies (describing some of these in sufficient and supportive detail to aid understanding, 1.2.1), and by finding the potential social psychological risks associated with considered knowledge transfer approaches (1.2.2). It appears that, in the context of this research, a closer look at social relevance is justified, including privacy, identity and ethical concerns. This research addresses these difficult to define and resolve issues at both individual and societal levels. The researcher has adopted the following definitions of knowledge upload and brain-computer-interface (BCI): 'A brain stimulation system that can feed information directly into a person's brain' (HRL Laboratories, 2019, adopted by this research as the definition of knowledge upload). Wikipedia (2024) suggests that knowledge can be transferred from one human brain to another human brain in two ways: copy existing knowledge and upload it or copy existing knowledge through the gradual replacement of neurons. Quora (2024) refer to the transfer of knowledge from one human brain to another as knowledge injection, suggesting this can be achieved by converting the knowledge into electrical signals (machine-learning data) and then transferring it to the brain via electrical stimulation. 'A brain-computer interface provides a direct communication pathway between a user's brain and a computer' (Wolpaw et al., 2002).

The literature review is shown next, followed by the research questions and the knowledge gap. These portray the theoretical support structure of this research. Methodology follows, together with the results, discussion, and conclusion sections.

1.2 Literature Review

1.2.1 Knowledge Transfer Approach

According to Telegraph Reporters (2016), transferring knowledge into a human brain is no longer fiction. It will be possible for a developed simulator to upload knowledge directly into a human being's brain to, for example, teach people new skills in a much shorter time as compared to conventional training methods. The result will be instant learning at the touch of a button. HRL Laboratories (2019) in California claim to have found a way to amplify learning. Applying brain stimulation via electrode-embedded head caps will improve direct and instant learning capabilities within human beings. Over time, it will be feasible to extend learning capabilities to a multitude of practical applications such as learning to drive, training pilots, exam preparation and language learning. Chan (2023) suggests that it is possible to transfer any kind of information into a human brain instantly. So-called brain-computer-interfaces can measure brainwaves and electrical signals. It is possible to extract thoughts by applying machine learning. Equally, it is possible to upload information into a brain, by translating knowledge into electric signals and then deposit these into the brain using electrical simulation (reverse logic). Knowledge could be understood instantly. How does it work? Brain signals are collected, interpreted, and resulting outputs (commands) are sent to an interface. It is possible to understand specific thoughts and commands the brain is executing through the method of machine learning. Brain waves can be tracked to establish, for example, what the pattern is between brain activities and what people were asked to think about during trial tests. As a result, a large data base can be developed that demonstrates the correlation between brain activity and thought. It appears to be possible to reverse engineering electrical signals of knowledge by feeding the information back into the brain. The neuronal network would adjust itself (plasticity) and the receiving brain would comprehend the new knowledge immediately. An example of the practical application of uploaded knowledge (HRL Laboratories) relates to the training of inexperienced pilots. Electrical signals and states of the brains of experienced pilots were uploaded into the brains of the novice pilots. The results confirmed that the effectiveness of the new pilots improved significantly, including higher landing consistency levels and lower skill variance levels. It appears that this proves that the human brain's plasticity capability welcomes uploaded information/knowledge and rises to the challenge. Chan points out that the current brain upload capability needs further understanding and progress, particularly in extracting information from the brain. Current success rates between 70-80 require much higher accuracy levels. The method of extraction needs to be improved significantly so that the accuracy of uploaded information rises proportionately. Further work needs to be done to improve understanding how to convert knowledge/information into electrical signals/brain waves. Unrestricted knowledge and limitless power to communicate are the potential future capabilities of the human brain. Dalhoumi et al. (2021) claim that electroencephalography (EEG)-based brain-computer- interfaces encountered major challenges in the past to try and reduce calibration time whilst, at the same time, aiming to reduce classification accuracy (see Noble & Blundell, 2013). A subject-independent classification model applied for multiple users' classified data of future users. Dalhoumi et al developed a new model that does not

rely on the assumptions considered in previous approaches. It allows for inter-subject classification without assumptions. The new approach adopts multiple feature representations and classification models that can then be adapted to the person-specific brain activities pattern of each user. As a result, it is possible to transfer knowledge between BCI users more effectively and accurately. Early results confirm that this new approach has closed the shortfall of previous approaches successfully when a small amount of labelled data has been involved. Li et al. (2024) suggest that the concept of BCI should be a considered option to manage human-computer interactions. It is possible that BCI could replace, improve, fix, and supplement the normal outputs of the central nervous system (Fig.2).

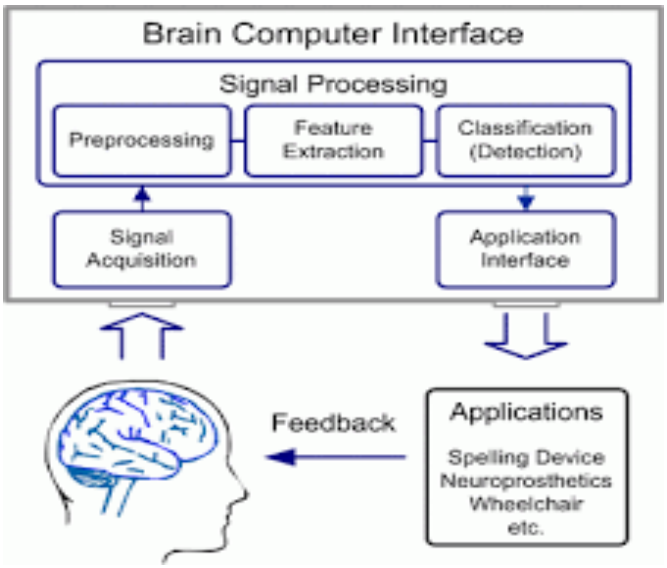

Figure 2. Simple Brain Computer Interface Diagram (Research Gate, 2024)

Li et al. (2023) define BCI as a system that enables communication between the human brain and an external device. For example, a BCI makes it possible for communication to take place between a paralyzed person and the real world (Hoffman et al., 2008). One way of resolving this problem is through the application of cross-subject EEG classification, including a cross-subject EEG decoding method. In addition, Li et al. suggest that a so-called EEG captures the electrical activities within the human brain. In this context, the EEG decoding problem is crucial (insufficient training data and testing data may be different). To address and fix this problem, Li et al. suggest that a semi-supervised meta learning method (SSML) is applied fur subject-transfer EEG coding. A so-called subject calibration problem develops when current models (good for existing subjects) are applied on new subject matter. Using labelled and unlabeled subject matter sample, the SSML method learns to calibrate the target subject. According to Wei et al. (2018) EEG signals carry inter-subject and intra-subject variations due to influences such as spatial origins, mental conditions, and brain shapes. One way of resolving this problem is through the application of cross-subject EEG classification, including a cross-subject EEG decoding method.

In contrast, Mellen (2023) proposes that it is not possible yet to instantly transfer knowledge

into a human brain. It may become available in the future. All the information humans may need can be accessed via smartphones and Internet search engines such as Google. Learning new things, for example, takes time. Simply plugging into a system stays utopia for now. Azab et al. (2018) purport that the use of so-called brain-computer interfaces (BCI) carries many challenges that need to be addressed. Any applied system requires re-calibration after each session or subject, and it needs to become familiar with each user's brain patterns and then calibrate the system accordingly. It typically takes about 20-30 minutes before calibration has been completed and the session can begin. Calibration takes a lot of time, mainly due to the following factors:

1. EEG signals are very noisy and highly dimensional
2. It is difficult to estimate probability distributions of the features due to a lack of useable EEG signals
3. Every user's psychological and mental state differs
4. Physical variants such as sweating may affect the measurements
5. Each participant has a different brain pattern

It is for these reasons that it is not possible to calibrate a BCI model for a new participant, based on the collected data from earlier participants. It appears that the concept of transfer learning has the potential to fix this problem. Transferring useful information from different domains improves the overall accuracy of applying BCI. Further research will be necessary to explore options to improve this current lack of accuracy. Noble & Blundell (2013) report that brain information processing can be achieved through the method of synchronized oscillations of large neuronal groups. Dynamic neuronal interactions are dependent on neuronal synchrony. This correlates strongly with cognitive functions such as perception, learning, memory, and decision-making. These oscillations have a direct impact on 'encoding representations, coordinating neuronal communication and regulating synaptic plasticity' (p.9). Noble & Blundell hypothesize that coherence is a vital element of dynamic brain information processing, covering the whole spectrum of neuronal organization.

According to Llang et al. (2024), the concept of brain-computer-interface has gained significant interest globally. EEG is applied in BCI and is a safe and portable method. Electrical impulses generated by neural activity in the human brain are detected by electrodes attached to the scalp. These impulses are amplified and then filtered to create complex wave forms. Typical tasks within EEG include motor imagery and visual evocations. It is thus possible to prove the operational state of the brain. In turn, this provides the means for the brain to control external devices. This approach acts as an alternative to the normal physiological neural pathways.

AWS (2024) defines deep learning as a means of teaching computers to process data in such a way that the information can readily be accepted by the human brain. The associated brain-inspired computing (BIC) concept can produce, for example, theories, models, and application systems associated with general Artificial Intelligence (AI), by learning from the

biological nervous system's information processing capabilities and related structures/functions.

Oxford Languages (2024) describes deep learning as 'a type of machine learning based on artificial neural networks in which multiple layers of processing are used to extract progressively higher-level features from data.

Malik & Bzdok (2022) argue that deep learning (Fig.3) has gained positive impact momentum in areas such as image and wider classification, natural language processing and audio recognition (Lecun et al., 2015). In addition, the so-called medical imaging has experienced significant success applying deep learning (Biswas et al., 2019). In this context, Malik & Bzdok report that deep neural networks (DNN) need to process substantial data to be able to produce effective forecasts that are difficult to achieve in many areas including brain imaging. The challenge is to create larger datasets for use in DNNs to make the best use of non-linear models so that DNNs can be trained to improve brain imaging despite lack of data. The concept of transfer learning is based on using previously learned knowledge to aid in the learning of any new or different task.

Wikipedia (2024) suggests that deep neural networks are defined as being an artificial neural network with several layers between input and output layers. Science Direct (2024) report that DNNs are made up of non-linear computational units or neurons organized so that they extract high-level, deeper, robust, and discriminative features from the underlying data.

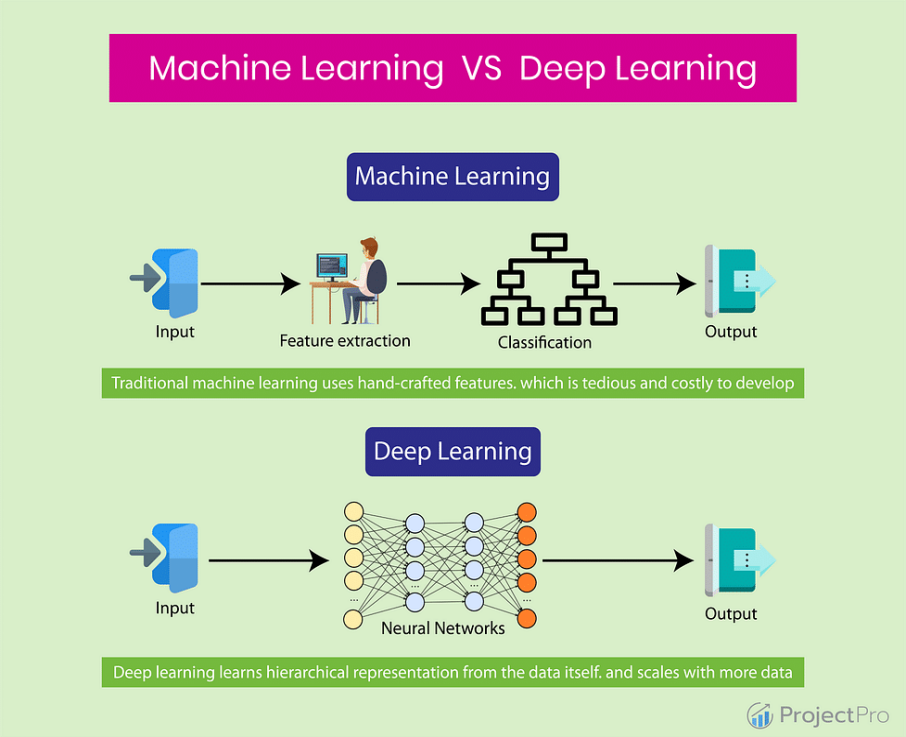

Figure 3. Machine Learning v Deep Learning, AIThority (2024)

Feng et al. (2024) argue that the recently developed concept of 'learn genes' should be

adopted to avoid the transfer of any knowledge that is not needed (negative transfer). It carries distinct advantages over conventional methods such as the use of large-scale datasets:

1. Only essential coded knowledge is transferred
2. Copying the structures of natural genes into neural networks has the advantage of enabling learning to be passed on to next generations
3. Instincts and strong learning abilities can be transferred to new post-transfer neural networks, providing flexible parameters including improved scalability and adaptability

Adopting this approach would enable knowledge to be transferred in such a way that the local neural network can enhance knowledge in future by providing the means to do so. This would overcome the current shortfall of transferring knowledge as a fixed entity, without the means of evolutionary improvements.

1.2.2 Individual and Societal Level Impacts

Leadbeater (1999, p.29) purports that 'information can be transferred abundantly without creating any understanding or knowledge. And knowledge cannot be transferred, it can only be put into practice through the process of understanding (people interpret information and then make judgements based on their interpretations). The creation of knowledge is human-based and not technology-based. In addition, Rikowaski (2011), concludes that knowledge transfer does not necessarily work well across diverse cultures. What works well in one culture does not work equally well in another. Any form of knowledge transfer will help some people at the expense of other people. Financially well-off people will benefit at the expense of poor people. It will not be possible to get it right for everyone nor to please everyone.

Lloyd (2007) argues that people often focus primarily on technology rather than considering the concept of wisdom in the context of knowledge management. Wisdom incorporates value judgements (rightness or wrongness of something or someone), useful when aligned to people's subjective experiences. Wisdom carries a long shelf-life (useful knowledge), knowledge is based on useful information, with a shorter shelf-life compared to wisdom. Knowledge is information in use. Using this information leads to the creation of further information. In turn, this creates more valid knowledge. It is a dynamic process. Human beings create wisdom by combining personal values into the decision-making process. How people use knowledge depends on the values people hold. People move down from wisdom to knowledge (not from knowledge up to wisdom). It is of paramount importance that the core of knowledge (experience of history into knowledge) is preserved for the benefit of future generations. If not followed, this will lead to the ignoring of learning experiences from thousands of years ago. It is imperative that human beings take the concept of wisdom seriously and pay more attention to its application. It appears that current operational knowledge transfer methods include mentorship, simulation, transfer knowledge process, practical knowledge application, coaching, documentation, presentations, sharing what has been learned and work shadowing.

Desouza and Paquette (2011) report that some knowledge can be transferred easily from one person to another (codified knowledge such as best practice or policies). Other forms of knowledge that cannot be codified and therefore transferred easily), are much more difficult to convey, using, for example, non-technological approaches. Desouza (2011) considers that knowledge management (KM) has gained in popularity in recent years. It is a vital ingredient of the effective running and management of organizations. Prosperous companies focus their attention on developing plans for how to become effective at knowledge management. They make time and effort available to achieve their goal. It is a cross-functional and inter-disciplinary approach that involves many people (Fig.4).

Figure 4. The concept of Knowledge Management, Alamy (2024)

Laakuso et al. (2021) suggest that copying parts of the human brain (including knowledge) has been a human dream for a long time. Making a digital copy of, for example, the knowledge that is contained within the human brain, carries some potential major risks such as misuse by selfish and criminal people who then exploit this capability for their own personal benefit. Such misuse could ultimately also affect the welfare of the society people live in. It is important to understand people's position about knowledge transfer, whether, for example, their position (in favor of knowledge upload) is driven by a primary disregard for others. It may be a necessary requirement to develop and strengthen people's favorable views about knowledge upload by addressing their utilitarian moral attitudes first. This would reduce concerns raised by artificial intelligence (AI) researchers (Laakuso et al., 2021; Desouza & Paquette, 2011; Lloyd, 2007) who purport knowledge upload could be misused disproportionately by people with antisocial attitudes. Such an approach would have a good chance of success to enhance people's capabilities through technological innovation without violating basic human rights, including privacy, personal security, and equal treatment.

According to Gankhuu (2022), the concept of mind uploading is one step to replace the human body with artificial technologies including artificial narrow intelligence (ANI), artificial general intelligence (AGI) and artificial superior intelligence (ASI). It is possible to preserve people's personal identity, but it is equally impossible to keep personal identities outside of biological organisms. Chalmers (2010) reports that any instant upload is likely to be the safest way of preserving personal identity. Gankhuu questions whether someone's character, personality, and perceptions of the world remain after, for example, any knowledge upload has been completed. It is questionable whether what makes a person unique is kept after such a transfer, and whether the uniqueness of the individual has been preserved. Personal identity should not be compromised. The same applies to people's legal identity and social identity. It is imperative that a practical approach to resolve this issue is considered, such as using a person's identity to make them morally and legally responsible for what they do in social situations. The uploading of knowledge, for example, to another human brain then raises the question of how this upload alters the anatomical composition of the receiving brain. In turn, this highlights some ethical concerns about the unique identity of people. Over time, will knowledge upload affect the quality of what differentiates one person from another? More research needs to be conducted in this field to verify and confirm whether knowledge upload, in future, preserves people's unique identities. One final concern raised by Gankhuu queries the impact any upload may have on people's biological approach. Biological life is vital for people's continuity and identity. Human beings are living organisms, and there is a risk that their functions as an individual are threatened by direct uploading of knowledge from one human brain to another (threat to the internal genetic plan).

Sharma (2023) suggests that knowledge is of immense value to both individuals and to societies. It enables people to develop improved decision-making based on the acquisition of right and relevant knowledge. It leads to better understanding of complex problems and their resolution. In addition, people can develop their skills further and move up the career ladder much faster. The benefits to societies include making faster progress, introducing innovation more rapidly, enhancing living standards and driving forward social and economic growth. This approach to continuous improvement is of benefit to both people and the societies they live in. It provides the means for competitive advancements and keeps healthy mind sets towards change. Members are more willing to learn from the mistakes they made, are more open to seeking help when needed and are not afraid to try out innovative ideas. Put together, knowledge and innovation can create substantial benefits to both individuals and societies. At a personal level, people can become more successful in their endeavors and societies can progress to master future challenges more effectively.

Dong (2023) considers that the acquisition of knowledge is paramount to a person's capabilities and to improve their edge over other people. With the arrival of developing Artificial Intelligence (AI) systems, significant changes are obvious that separate the person who continues to obtain new knowledge from those who remain dormant. For example, it appears that AI can already perform the basic activities that accountants and lawyers complete. To outcompete others as so-called knowledge workers such as physicians, engineers, and scientists), it will be necessary to improve skills, judgement, and execution

levels so that technological exploitation can influence their execution ultimate success. It is important, in this context, that people focus their attention on what suits them and what they can do best. In the current information-based society, knowledge leads to power. It provides the means to have an advantage over others. Creating life-like knowledge has the potential of being adopted by the mind as being real. The cost of knowledge transfer has a noticeably short payback period. Current estimates suggest that the value added, for example, of using generative AI to achieve knowledge transfer, could add trillions of dollars to a country's economy.

In addition, the application of advanced software programs such as GPT-4, can progress the concepts of knowledge transfer significantly. It will be important to understand the limitations of this software, such as hallucinations and data privacy concerns.

1.3 Main Research Questions

The main research questions for this research are:

1. Is direct brain-to-brain knowledge transfer possible? If so, how?
2. What is generally known about direct brain to brain knowledge transfer?
3. What is the relationship between known theory and expected practical application of knowledge upload?
4. What are the risks and ethical concerns related to direct knowledge transfer between human brains?

1.4 Knowledge Gap

There appears to be a need for faster and more effective direct knowledge transfer between human brains. Missing is a combined understanding of how knowledge upload could be achieved directly from one human brain to another. Subject matter experts have expressed different views on how this could be achieved or not. Absent are positions/views relating to associated ethical and social psychological concerns. There appears to be a lack of understanding what the relationship is between theory and practice when applying the concept of knowledge upload. The aim of this research is to fill this shortfall and present recommendations on how to advance the field of direct knowledge upload between human brains for the benefit of people and society.

2. Research Methodology

The researcher considered that the adoption and application of a mixed research method, made up of a literature review and a quasi-thematic analysis, was most suitable for this research. It is important in research to collect and analyze all data in a systematic and well-organized manner, in congruence with the chosen research paradigm. This allows the researcher to draw verifiable conclusions. The collected data, its analysis and the development and verification of the resulting conclusions interrelate and interact. It was indispensable to categorize, make connections and produce evidence and facts to support, disprove, or weigh competing theories. It was, therefore, possible to assign meaning to the

data to arrive at justified conclusions.

A comprehensive literature review established what was already known about the subject matter under investigation. Its primary emphasis was on capturing the published theoretical and practical experiences of researchers engaged in AI research. Their subjective experiences were of paramount importance to establish what was feasible and what was still beyond human reach at least for now. The primary focus of the literature review was on current publications between 2020 and 2024 to ascertain the most contemporary positions of researchers in the chosen research topic. In addition, the researcher considered that it would be beneficial to capture some of the historical views and positions of the AI research community to provide insights of how perceptions of the use of AI in knowledge transfer changed over the years.

The researcher divided the literature review into two sub-domains:

1. Knowledge Transfer Approach (how can/could knowledge be transferred from one human brain to another)
2. Individual and Societal Impacts (how does/will knowledge transfer impact on people and the societies they live in)

The chosen literature incorporated topic-specific, relevant publications to generate valid and reliable data. The researcher's aim was to capture, organize and then evaluate the potential theoretical and practical applications for the construction of practical AI solutions in the two chosen sub-domain areas.

A quantitative investigation completed a statistical analysis to establish the knowledge transfer approach impacts, both negative and positive, including those at individual and societal level. This included how many times authors expressed positive (pro) and negative (con) views/positions on knowledge transfer approaches. Each view/position was ranked (range 1-10) against the following two criteria: value and importance. These were multiplied by each other to calculate the total score for each pro/con approach. Table 3 is a summary of the weighted pro and con impact analysis by topic/theme.

The quasi-thematic analysis pointed out common themes and the relationships between the two sub-domains. As a result, the researcher was able to interpret all research data optimally. The quasi-thematic analysis approach (the generated research data did not warrant the full use of coding) provided the foundation for the separation of relevant and irrelevant research data for this research. These insights enabled the researcher to develop a theory of understanding rather than relying on prediction.

The considered research approach assisted in the answering of the research questions (1.3).

3. Results

Rapid advancements in AI technology offer enhanced technological capabilities to take the concept of direct brain-to-brain knowledge transfer further. It appears that previous technological restrictions and limitations have been overcome. Scientists are now in a leading

position to develop approaches that have the potential to realize direct knowledge transfer between two or more human brains. There are currently two opposing scientific positions relating to knowledge transfer. A general preference for the application of a so-called BCI appears to be the favorable solution to make direct knowledge transfer possible. Some scientists propose that it is not possible to transfer knowledge into the human brain. They consider this to be a utopian approach. Many of the identified challenges associated with BCI need to be addressed before this can progress any further. In contrast, other scientists suggest that direct knowledge transfer will be of immense value to both people and society. It will enhance people's skills and enable them to solve more complex problems much faster and more effectively. At the societal level, this could lead to more rapid introductions of innovations. There is a direct relationship between obtained knowledge and success at work. In addition, wisdom forms value judgements and is applied in decision-making processes. It is vital to the preservation of the core of knowledge. Ethical and social concerns are missing from across the reviewed literature. Table 1 depicts the main advantages and disadvantages of the contemporary method of sharing and transferring knowledge between human beings. The pros and cons for each approach present an equal balance (7 and 7). Table 2 shows the main advantages and disadvantages of considered future knowledge upload approaches. The pros and cons for each approach are balanced (7 and 9). Table 3 summarizes the main findings from a quasi-thematic analysis that analyzed the positive and negative impacts of knowledge transfer approaches (pro score 482, con score 362) and individual and societal impacts (pro score 226, con score 648). The overall con score outweighs the overall pro score (708 v 1010). Special attention should be given to some specific high ranked con impacts such as negative knowledge transfer, calibration issues with new topics and knowledge transfer rather than wisdom transfer.

Table 1. Advantages/Disadvantages of contemporary Knowledge Transfer

Advantages	Disadvantages
Improved productivity	Time consuming
Collaboration	Repetitive
Company culture enhancement Intellectual property	Lessons not learned Match requirements with ability
Helps people to learn and develop	Team management
Fit for intended purpose	Lack of knowledge integration
Challenge the status quo/question validity	Incomplete knowledge transfer
Safe (cannot be hacked into)	Lack of knowledge map (who knows what)

Table 2. Knowledge Upload-Future Approach

Advantages	Disadvantages
Instant-no delay	Can be hacked into
Upgradeable-at any time	No interhuman learning interactions
Any topic, any time	No trial-and-error approaches to reinforce learning
Specific and filtered to meet purpose	Privacy invasion/safety/misuse
Topic interchange for best mix	Indoctrination
Available anywhere, any time	Knowledge control/manipulation
Cost implications	Data protection
	Intellectual property (IP)-who is the owner?
	Well-off people will have more knowledge than less well-off people

Table 3. Knowledge Transfer Weighted Pro and Con Impact Analysis

1.2.1(Knowledge Transfer Approach)-Pro	Source	Value	Importance	Total
Instant learning	Telegraph Reporters, 2016	9	9	81
Extension of many practical applications	HRL Laboratories, 2019	9	8	72
Neural network adjustment	Chan, 2023	9	9	81
Person-specific application	Dalhoumi, 2021	8	8	64
Strong cognitive function correlation	Noble & Blundell, 2013	8	8	64
Brain can control external devices	Llang et al., 2024	9	9	81
BCI and AI capabilities	AWS, 2024	8	8	64
Deep learning	Malik & Bzdok, 2022	8	7	56
			Sub-total:	482
1.2.1(Knowledge Transfer Approach)-Con				
Calibration time too long, classification accuracy too low	Dalhoumi et al., 2021	8	8	64
Instant knowledge transfer not possible yet	Mellen, 2023	9	9	72
Lack of accuracy	Mellen, 2023	8	8	64
Negative knowledge transfer	Feng et al., 2024	9	9	81
Calibration issues with new topics	Li et al., 2024	9	9	81
			Sub-total:	362
1.2.2 (Individual and Societal Impacts)-Pro				
Knowledge of excellent value to individuals and society	Sharma, 2023	10	9	90
Enhancing personal capabilities	Dong, 2023	8	8	64
Knowledge vital to people and business	Baloh et al., 2011	9	8	72
			Sub-total:	226
1.2.2 (Individual and Societal Impacts)-Con				
Non-codable knowledge is more difficult to transfer	Desouza & Paquette, 2011	9	8	72
Knowledge transfer rather than wisdom transfer	Lloyd, 2007	10	9	90
Knowledge is human-based, not technology-based	Leadbeater, 1999	9	9	81
Misuse by selfish and criminal people	Laakuso et al. (2021)	9	9	81
Personal Identity v loss of biological organism	Gankhuu (2022)	9	9	81
			Sub-total:	648

4. Discussion

Technological advancements such as knowledge transfer move faster than associated ethical and social concerns. More emphasis needs to be placed on these to slow down and balance technology so that the best interests of people and society are upheld. Fast progress in AI technologies has made it possible to advance innovative technological approaches and ideas, including the direct transfer of knowledge from one human brain to another. It will be possible soon to replace conventional knowledge transfer such as simulation, coaching and mentoring, with instant anytime and anywhere, fit for intended purpose knowledge. The quasi-thematic analysis of this research proved that the positive aspects of a direct brain-to-brain knowledge upload outweigh the negative impacts (Table 3). It appears that the associated technological developments' major focus is on the solution. What is missing is an emphasis on related ethical issues and social concerns that affect both the individual and society, considering diverse cultural practices across geographies. This includes the exploitation by criminally minded people and those who generate anti-social attitude issues.

Current knowledge is human-based and includes so-called value judgements (wisdom). At the human level, people use knowledge depending on their personal values. It appears that it is not possible now to transfer wisdom in addition to knowledge during knowledge upload. The loss of human wisdom, based on thousands of years' experience, could be lost if this core knowledge is not preserved during knowledge upload. Contemporary data privacy legislation has not caught up with ethical and social concerns relating to the concept of knowledge upload. It is essential to hold discussions that address issues such as knowledge ownership of the intellectual property (IP), the availability of knowledge transfer irrespective of financial standings, privacy invasion, ownership of the uploaded body of knowledge and clear definitions of how uploaded knowledge has been obtained, distributed, and applied. In addition, uploaded knowledge seems to be fixed. It is also possible that a loss of personal identity within current biological organisms (human beings) could affect each person's individual and unique genetic plan.

More research is needed to show whether uploaded knowledge is fixed or whether future post-upload subjective experiences will enhance the uploaded knowledge. It is not clear from the current literature review what the negative impacts are of knowledge upload approaches, including hacking, indoctrination, and lack of trial-and-error steps to reinforce learning. The safety of instant knowledge uploading should be questioned and challenged. How can human beings be sure that this approach is safe and does not carry any side effects when, for example, practiced regularly. It may be necessary to reverse any uploaded knowledge for technical or ethical reasons. More research needs to be conducted and shared to investigate this critical issue further.

Consideration should be given to the notion that schools could become redundant if everyone can upload knowledge on an equal basis (not rich v poor). People who had some knowledge uploaded into their brain have a distinct advantage over those who did not have any knowledge upload, losing out on jobs and promotions at work, including loss of income. Would knowledge upload, ultimately, lead to the elimination of teachers, or at least a substantial reduction in the number of teachers needed? What is the potential impact on people and society? Loss of or lack of status within people's peer groups is another area of concern, as this could lead to potential losses of or reductions in people's social or professional positions. On the positive side, this has the potential to stop constant re-learning of existing passed-on knowledge. It opens opportunities to engage pupils in further research/information gathering, for example, outer space or other planets, and then transfer any new knowledge/wisdom to the home planet so that people's knowledge can be updated for moving science forward by producing satisfactory results that promote the well-being of people and society. Knowledge upload could potentially solve and overcome the general issue of out-of-date and inadequate systems preventing the sharing of knowledge. Making knowledge easily accessible will improve the effectiveness and efficiency of working people and thus provide substantial benefits to society.

Some authors such as Telegraph Reporters (2016) and Chan (2023) express a positive prejudice towards the concept of knowledge upload. They consider that knowledge upload is possible instantly and because it is reversible (feeding information back into the brain via the

brain's plasticity), it is acceptable to proceed without further hindrance. In contrast, other authors such as Dalhoumi et al. (2012), Mellen (2023), Wei et al. (2018) and Llang et al. (2024) express caution. Collectivley, they suggest that knowledge transfer initiatives (using a brain computer interface or BCI) have experienced many problems in the past and that any development work to advance knowledge transfer from one human brain to another should be attempted mindfully. Leadbeater (1999), one of the early pioneers of knowledge transfer, made it clear that categorically that knowledge transfer will not be possible. Mellen (2023) is of the opinion that human beings have access to all knowledge via their smartphones/search engines such as Google, why is it necessary for human beings to engage in activities such as knowledge upload? Feng et al. (2024) suggest that people should focus on exactly what knowledge is needed to be transferred. It appears that they express concern that too many people focus their attention on transferring everything that can be transferred rather than focus only on what is necessary to transfer. Lloyd (2007) expressed a clear bias towards transferring wisdom and not just knowledge. Most recent views suggest that knowledge transfer has a positive role to play in better decision-making (Sharma, 2023). Dong (2023) states that AI technology is the right way forward to transfer life-like knowledge. In summary, it appears that, generally, the most recent authors evoke the view that AI technology is positive and that it will help human beings to move to another level in human life evolution. The concerns raised by authors have been noted and should be taken into consideration during early AI development initiatives to find the optimum solution to transfer both knowledge and wisdom from one human brain to another.

5. Conclusions

Technological advances in AI have made it possible for the concept of knowledge upload to become the accepted standard for transferring knowledge directly between human brains. The results from this research brought together what is known about the conventional and future approaches of knowledge transfer. More action is needed at global level to address the ethical and social concerns raised. The introduction of right legislation and lofty standards of good, fair, and honest. Moral behavior must be encouraged and executed with regular legal reviews.

The application of a quasi-thematic analysis allowed the researcher to combine and generate new insights to reach the following conclusions:

- Ethical concerns such as technological abuse, data privacy and favoritism/nepotism must be considered and prevented during knowledge transfer development stages
- Social concerns such as prejudice, discrimination, limited access to technology and digital privacy issues must be considered during the development phases of knowledge upload
- The individual identity of people must be kept at both biological and genetic level (more research needed)
- Commercial exploitation of knowledge transfer must be avoided at individual and societal levels to protect people's integrity in terms of corruption and hypocrisy
- Direct knowledge transfer should not be motivated by the financial standing of individuals. It should be made available irrespective of people's financial status

- New knowledge upload legislation needs to be developed to safeguard the best interests of people and society
- Further investigations are needed to prove anti-social attitudes/criminal minds and how to manage these
- The potential issues associated with knowledge upload reversal must be found and an action plan needs to be put together how to resolve/address these issues

The topic of knowledge upload reversal needs to be addressed to assess its potential consequences. In addition, further research is recommended to produce more insights in the subject matter under investigation, by completing face-to-face interviews with the community of practice and a focus group meeting that consists of the most relevant contributors from the interviews. It appears that knowledge upload has the potential to make a major impact on everyday life situations, both at work and at home. The researcher considered the following six major impact areas where knowledge upload would make a substantial contribution to move current best practices forward to another level. Of the six propositions, medicine, education and business were ranked highest (10/10) whereas the remaining three other propositions were ranked lower (sport=8/10, aviation=7/10 and motoring=6/10), including the researcher's subjective perceptions from personal experiences and views of life (Table 4).

Table 4. Knowledge Upload Impact Areas by Domain (Fisher, 2024)

Impact Area	**Practical Application**	**Ranking (0-10)**
Medicine	Create specialists and specialist knowledge much quicker, sharing of knowledge and wisdom to benefit society, speeding up the process to train medical professionals such as doctors and dentists.	10
Education	Instant learning and knowledge transfer, providing the right knowledge at the right time at the right level, exam preparation via ChatGPT, learning foreign languages at an instant as spoken by natives.	10
Business	Improve informed decision-making by transferring the knowledge required to make work faster and more efficiently and reliably compared to conventional methods, improved understanding of complex business ideas and concepts in an instant, focus on what is important and will make a difference, enhanced knowledge and innovation can drive people and societies to new levels of success, improved knowledge leads to higher levels of power.	10
Sport	To transfer direct subjective experience, for example, to enhance a football team's performance based on personal experiences of high performing players, upload optimum individual performance data from an AI-driven sports camera.	8
Aviation	Training pilots, providing direct experiences, shortening the time it takes to train a pilot, higher landing consistency levels, lower skill variance levels.	7
Motoring	Instant ability to drive a car, learning how to fix common car (engine and other) problems, negates the need for a theoretical test.	6

The researcher confirms that the research questions (1.3) have been answered by this research.

Competing interests

The authors declare that they have no known competing financial interests or personal

relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

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The Publication Ethics Committee of the Macrothink Institute.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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