

Agency on the Internet

When Does (the Feeling of) Agency Arise
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Abstract

With advances in information technology, human agency and autonomy during the interaction with technological systems seem to be in danger as technology feels “out of control” for many people. Their judgement is based on their sense of agency during the interaction with the technology. Thus, there have been a lot of voices raised, demanding more transparency. This paper investigates users’ sense of agency during the interaction with machines, and proposes criteria, which make up the sense of agency on the internet. On this basis, agency in the context of search is shortly analysed. Results reveal that recommendations in current search systems negatively impact the user’s sense of agency. But the system can, the less instrumental the purpose of the user’s search is, exhibit more agency and autonomy. If the user receives sufficient feedback about the system’s reasoning and intentions, a joint-agency can be experienced. Otherwise, the user’s sense of agency decreases with increasing automation of the system. The criteria are a first proposal to motivate further discussion and research, as well as influence future system’s design.

Keywords: agency; sense of agency; human-machine interaction; AI; search

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1 Introduction

Through digitalisation and the omnipresence of digital tools, people interact with various online platforms every day. In a hyper-connected era, people are increasingly interacting with networks connecting of different people and / or devices (Engen et al., 2016, 96). In light of the also increasing time spent on digital devices (there are estimations of up to 10 hours a day excluding work time), it can be questioned, in how far the human-machine relationship has implications and effects on human autonomy (Madary, 2022, 1). Especially, since people feel that technology is ‘out of their control’. Recently, a publication by Shoshana Zuboff outlined that the goal of powerful players “in Silicon Valley is to predict human behaviour on a large scale by manipulating individual human behaviour” (Madary, 2022, 1).

But apart from worries about autonomy, another worry is raised with regard to user’s abilities to interact with machines in order to reach their goal. Over the last decade, Information Technology (IT) has exponentially become more powerful, culminating in the usage of Artificial Intelligence (AI) (Jiang et al., 2023, 2). An example of IT systems leaving humans behind, can be found in IT security: Secure passwords nowadays should be very difficult (thus difficult to remember), but they should never be written down (Smith, 2003, 75). In software psychology or human-computer interaction, efforts to consider humans and user experience are taken with the aim to develop accepted and usable interfaces to systems (Jiang et al., 2023, 2).

With increasing complexity of the offered online services (like services based on AI), as well as an increasing amount of available information online, calls for transparency and explainability get stronger. This is because users face more risks on the internet than they do in face-to-face interactions and transactions (Harridge-March, 2006, 748). Especially in the context of online shopping, user’s behaviour has been researched. During a buying-processes, consumers have to take decisions, which are heavily influenced by factors such as perceived risk (Harridge-March, 2006, 747; Lăzăroiu et al., 2020, 2).

Often, the mechanisms behind the service and the causality between a user’s action and its effect are unknown or not comprehensible by the user. Dark patters, which are designed to manipulate user’s behaviour against their interest, are often used by social media applications or other attention economy providers (Lukoff et al., 2021, 1f).

Three-quarters of the time, users fail to resist these mechanisms, which leads to a

loss of control and an decreased experience of the sense of agency. This impacts life negatively, such as decreasing social interaction, dissatisfaction, or less sleep (Lukoff et al., 2021, 1). In other cases, users are not in control / do not have agency over their actions, although they feel the sense of agency (Madary, 2022, 2). Thus, this term paper addresses how a sense of agency arises in human-machine interaction in the context of the internet, and what makes up agency on the internet given its increasing relevance for human well-being as well as autonomy.

1.1 Argumentative and Epistemic Goal

The central question and epistemic goal is to investigate when (the sense of) agency arises when using the internet. The subject of the term paper is agency in human-machine interfaces. More specifically, when interaction on the internet feels non-transparent and “out of control”, and what gives users a sense of agency when interacting with services on the internet. In the scope of the term paper, agency concerning search online will be analysed as an example, because it is one of the most frequent actions performed online as usually every browser first opens a search engine. Previous similar research in this area has, for example, analysed the influence of the design of YouTube on user’s sense of agency (see Lukoff et al., 2021).

The paper will unfold as followed: First, *Agency and the Sense of Agency* will be defined and distinguished. Next, *Agency and Human Machine / Computer Interfaces* will be discussed, including research on perceived control, agency, risk, and automation with a focus on the internet. Afterwards, *Criteria Which Make up Agency on the Internet* will be developed. Lastly, with the help of the criteria, *Agency in the Context of Search* is analysed as an example.

2 Agency

In the following chapter, agency will be introduced. There are multiple theories concerning agency, having a slightly different view on the notion of agency. In general, it can be said that agency describes the capacity of an agent or actor (human or non-human) to perform different actions in an environment, which are in line with an intention or goal and have an effect (Engen et al., 2016, 99). Agency is described to be composed of mainly four factors (Engen et al., 2016, 98): 1. Intentionality, – The ability to choose the action and behaviour in a certain way. 2. Forethought – A

temporal aspect of intentionality, which includes setting goals and predicting effects. 3- Self-reactiveness – The ability to adapt to the environment to achieve the desired goals. 4. Self-reflectiveness – The ability to evaluate cause and effects, as well as one’s own impact and the anticipated outcome. A strongly linked concept to agency is *Situational Awareness* (SA). It is defined as the perception of the environment and its elements within a frame of time and space, the comprehension and interpretation of the meaning, and, lastly, the projection of the elements’ state in future (Jiang et al., 2023, 3).

According to the *Actor-Network Theory* (ANT), agency only exists in forms of relations: “in and through networks of action in which both humans and non-humans participate” (Suchman, 1998, 9). In ANT, the actor is semiotically defined. Thus, it is the actant, something that either acts or is granted activity by others independent of motivation and intention. It can be anything that is granted to be the origin of an action (Suchman, 1998, 11).

Other theories focus more on the single entity or individual and do not define agency depending on other entities. The views on agency evolve towards models with conscious and creative human beings, capable to set and strive for goals deduced from their belief system, which drives their behaviour (Engen et al., 2016, 98). In modern epistemologies, agency is regarded as something inherent to singular entities (human or non-human), at the same time independent of as well as contained within these (Suchman, 1998, 9). In *Structuration Theory* (ST), agency refers to the “capability to make a difference”, whereas it refers to intentionally performed acts in *Social Cognitive Theory* (SCT) (Engen et al., 2016, 98).

Nowadays, agency is distinguished in three types, depending on the amount of agents involved, as well as their relation (Engen et al., 2016, 99):

- *direct personal agency*, which refers to the agency outlined in the paragraph above. It is the ability to act in order to reach a goal and make a difference, inherent to a single agent.
- *proxy agency*, which describes mediated agency and requires social interaction. The agent needs and utilises resources as well as other agent’s knowledge to achieve his goal, because he or she is unable to reach it on its own. It is the most common form of human-machine interaction at the moment.
- *collective agency*, which describes a mode of agency that is “only achievable via socially interdependent effort”. For example, if two persons want to carry a

piano. They have the same intention, need to cooperate to succeed, and can only do so together.

3 The Sense of Agency

The sense of agency is different from agency, as it describes the perceived agency. Agency and the sense of agency do not always go hand in hand (Madary, 2022, 1). An agent can have a sense of agency, although he or she has no agency, or he or she can have no sense of agency, although he or she has agency. As opposed to agency, which can be objectively determined, the “sense of agency is a subjective feeling” (Wen and Imamizu, 2022, 212). Apart from this major difference, the make-up of agency and the sense of agency is very similar. Three major factors underlay the sense of agency: intention (the state that is strived for), action (the awareness of one’s deliberate actions), and effect (the consequences of the actions) (Wen and Imamizu, 2022, 211).

Generally, the sense of agency can be defined as the individual’s experience or feeling of being the source of their deliberate actions, by controlling their own body as well as the external environment (Limerick et al., 2014, 1; Lukoff et al., 2021, 3; Madary, 2022, 1; Wen and Imamizu, 2022, 211). The sense of agency can be further distinguished. There is the *feeling of agency*, which describes the ad hoc, in-the-moment perception of control, and there is the *judgement of agency*, describing the post hoc evaluation of the event, ascribing the action to oneself or others (Lukoff et al., 2021, 3). Moreover, a sense of agency is not limited to one individual, but can be experiences beyond the own body as e.g. with virtual characters in computer games (Wen and Imamizu, 2022, 211).

As previously outlined, agency and the sense of agency can diverge. There are pathological disorders of agency such as Schizophrenia, Depersonalisation Disorder, the Anarchic Hand Syndrome, Utilisation or Imitation Behaviour and the Environmental Dependency Syndrome (Madary, 2022, 2f). But there also are non-pathological illusions of agency in every human as Ideomotor Actions, Developmental Illusions of Agency, the “I Spy” Scenario and Human Error. Human Error is especially common. It occurs if attentional supervision of actions fail and automatic motor responses are executed. For example, if a person wants to buy bread on the way home from work, and he or she arrives home, just to realise that he or she forgot to stop at the bakery. The non-pathological illusions of agency are interesting, because every person can be subject to them and the person’s behaviour is driven by environmental affordances

(Madary, 2022, 3f).

For humans, the sense of agency is very important. During development of motor control, the ability to attribute consequences of actions to oneself might be important in the organisation and development of voluntary motor control. In adults, the sense of agency influences action selection and action execution: what action should be executed how (Wen and Imamizu, 2022, 215). It is a part of human consciousness and heavily influences self-awareness (Limerick et al., 2014, 1). Furthermore, it is associated with goal-directed behaviour, motivated exploration, as well as social cognition, which is associated with the sense of identity and autonomy. People, who feel in control of their actions and their consequences, experience freedom to decide and act. This also allows for crucial insights into responsibility and autonomy in philosophy and ethics (Wen and Imamizu, 2022, 216).

3.1 Models of the Sense of Agency

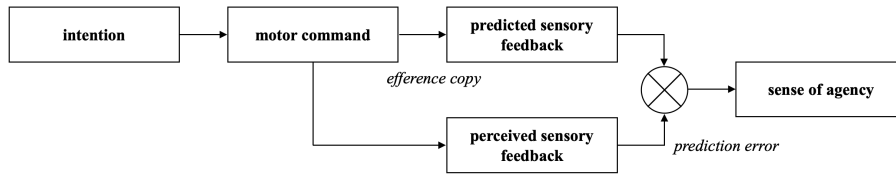
After outlining the general definition of the sense of agency, concrete models will be introduced. Two different types of cues are differentiated and used in the models. First, there is a comparison between the expected or foreseen observation / sensory outcome of an action and the actual effect of the action. Overall, the sense of agency can be said to describe a statistical relationship between actions and effect (Limerick et al., 2014, 2). Second, the cognitive effort is evaluated. If actions can be fluently and effortlessly selected, the sense of agency is greater (Madary, 2022, 7).

Figure 1 shows three models of the sense of agency. The best known and most widely accepted model, is the *comparator model* (on the top) (Madary, 2022, 8). Depending on the congruency of predicted outcome and actual sensory outcome, the sense of agency rises or decreases. In this case, it is based on the sensor-motor incongruence and prediction error. Empirical studies found a lot of support for this model (Wen and Imamizu, 2022, 217).

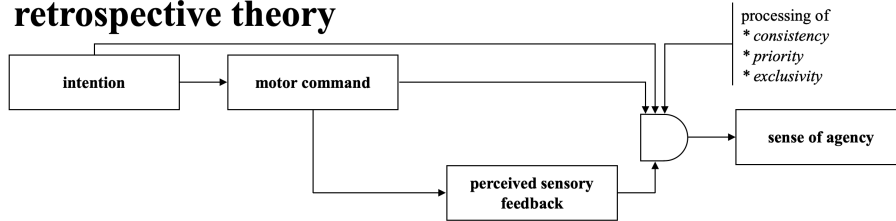
Although the comparator model is well-known, there is evidence for another model, which is called the *retrospective theory* (see Figure 1). It proposes that the sense of agency arises from the inference that one's thoughts caused one's action. The action has to be **consistent** with the effect, it has to happen before the outcome (**priority**) and it has to be **exclusive**, meaning that nothing – except the own action – was the cause for the effect. This makes prediction superfluous, and exploration of actions with uncertain predictions can still create a sense of agency (Wen and

Imamizu, 2022, 217f).

comparator model



retrospective theory



Bayesian integration model

$$p(\text{self} | \text{outcome}) = p(\text{outcome} | \text{self}) \times p(\text{self}) / p(\text{outcome})$$

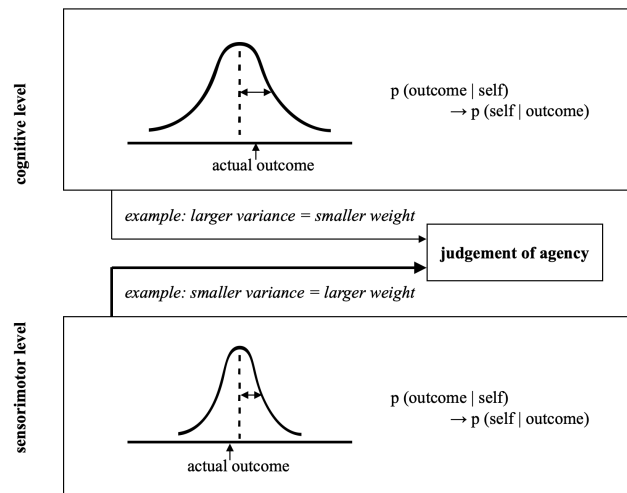


Figure 1: The models of the sense of agency: **The comparator model** claims that the sense of agency arises from the comparison of expected and actual outcome. **The retrospective theory** does not share the assumption that the sense of agency arises from a prediction, but it suggests that the sense of agency results if the effect of an action is consistent, timely and exclusive with regard to the action. **The Bayesian integration framework** combines cognitive and sensorimotor levels to judges about agency, by weighting the variabilities of the prior distributions of effect and action. (Figure taken from [Wen and Imamizu, 2022](#), 217, fig. 5)

Although both previously mentioned models have some empiric evidence, there

are factors concerning the sense of agency neglected in both. These aspects include task performance, social interaction or the mental state: people in the presence of other people, for example, often report a less strong sense of agency. The Bayesian Integration Model (see Figure 1 at the bottom), integrates more factors than the other two models. The underlying assumption is that the sense of agency results from computations on the sensorimotor and cognitive level. On the cognitive level, factors unlinked to cause and effect, but rather connected to intention, expectation and inference are relevant. The sensorimotor level, on the other hand, has a strong link to actions and their outcome. By applying Bayes' rule at each level, using the prior distributions of outcomes and the actual input outcomes, the probability of a sense of agency can be calculated (Wen and Imamizu, 2022, 218).

4 Agency and Human Machine / Computer Interaction

After a general overview of agency and the sense of agency, agency and the sense of agency concerning human-machine or human-computer interaction is discussed. Studying the sense of agency aims at understanding the sensation, but it also aims to research applied areas (Wen and Imamizu, 2022, 219). Because of the increasing interaction with machines as well as the advances of technology, another objective is to research, how real-life situations of human-human and human-machine interaction affect the sense of agency (Wen and Imamizu, 2022, 219).

In *Human-Machine Interaction* (HMI), including *Human-Computer Interaction* (HCI), *Human-Robot Interaction* (HRI), or *Human-AI Collaboration* (HAIC) research, the question of agency and the sense of agency in humans during the interaction with machines is studied. The HCAI community stands up for “empowering humans and preserving human agency in AI design” (Jiang et al., 2023, 14). Early attempts to develop design guidelines also emphasise the freedom of the user in controlling interfaces. However, a lot of techniques have been developed over the last years which negatively impact control (Bergström et al., 2022, 3).

After the short introduction of human agency during interaction with machines, the next sections will deal with the sense of agency in HCI, automation and AI in detail. In contrast to the sense of agency, agency of interfaces is easier to evaluate objectively. Since the sense of agency is very subjective, it is difficult to measure it

objectively. Thus, it is mainly assessed with questionnaires (Bergström et al., 2022, 2). But there are also indirect measurements of the sense of agency (Wen and Imamizu, 2022, 212). As human decisions are mainly made based on perceived control, and the aim of HMI research is to increase user’s acceptance and optimal use (Bergström et al., 2022, 20; Lăzăroiu et al., 2020, 2), the sense of agency is more relevant to HMI than agency.

4.1 The Sense of Agency in HCI

The design and structure of an interface influences the perception of functionality and usability, which forms a user’s attitude towards a system (Gillan, 1997, 387). It has been found that there is a relation between user experience and the sense of agency (Bergström et al., 2022, 20). Thus, the sense of agency has become a core aspect of HCI research. Schneiderman and Plaisant (2004) created a guide for interface design, emphasising that an interface should “support an internal locus of control” as users “strongly desire the sense that they are in charge of the system and that the system responds to their actions” (Limerick et al., 2014, 1; Lukoff et al., 2021, 3). The more users use technology such as the internet, the more he or she realises possible problems (Harridge-March, 2006, 756).

Users do not interact with a system, but with their mental model of the system (Gillan, 1997, 386). Every input method and interface, usable to control technology, therefore has to bridge the so-called “Gulf of Execution”, that is the discrepancy between the system’s state and the user’s intention (Limerick et al., 2014, 3). This means that complex systems might not necessarily be complex to use, but in other cases users can face *equi-finality* or *multi-finality*, which means that there can be multiple possibilities for them to reach their goal or there can be multiple different outcomes for the same action (Jiang et al., 2023, 12). Overall, a computer interface should ease control and enhance the user’s feeling of control, which requires the display of feedback as well as information to the user, and the user’s input itself (Limerick et al., 2014, 3). There also is the “Gulf of Evaluation” after interaction, which describes the difference between the user’s perception of the system’s state after input and the actual state of the system (Limerick et al., 2014, 5).

Sometimes, computer interfaces create a false sense of agency and users misattribute agency to themselves, although the effect was caused by another agent (Limerick et al., 2014, 5). Other times, the false sense of agency results from affordances by the

environment and the users is actually only reacting to stimuli (Madary, 2022, 1). This is, for example, the case when users pick up their phone with a specific intention and spending a lot more time doing different things, forgetting their original intention. Nowadays, device engagement has often also turned into ritualised habitual behaviour (Madary, 2022, 11).

To summarise this section, there are a lot of attempts in HCI research to increase and improve the sense of agency, because it increases user experience and secures optimal ongoing use. But there are nonetheless manipulations and an erroneous sense of agency can arise in HCI. A lot of users are unaware, do not understand or care about risks like an illusionary sense of agency (Harridge-March, 2006, 748). Yet, it has been found that losing control and a sense of agency is key to problematic technology use (Lukoff et al., 2021, 1): (1) having a lack of control, (2) negative effects on life, and (3) affecting human autonomy, “one of the three basic human needs outlined in self-determination theory” (Lukoff et al., 2021, 3).

4.2 The Sense of Agency and Automation

Previously, computer and machine interfaces and the sense of agency were considered without distinguishing different forms of interfaces. This section will introduce the sense of agency in relation to automation, and the next section will then continue with the currently most complex systems there are nowadays, AI systems. “Automation is a technique, method or system of operating a controlling process by automatic means such as by algorithm or digital device, therefore reducing or replacing human intervention” (Jiang et al., 2023, 8). Computers are build to assist humans, but they can do so in varying degrees. From “low assistance” such as simple text input, up to “high assistance” automatised routines as autonomous cars, automation and autonomy of the computer / machine differ greatly (Limerick et al., 2014, 6). There is a tension between human agency and automation: the more automated a system is, the more difficult it is for users to understand it and control it. Figure 2 shows the different levels of automation by Sheridan and Verplank (1978). Users mistrust complex systems, because the system is more difficult to understand, which requires users to invest more cognitive effort as well as it decreases users’ knowledge and abilities, harming their performance and lowering control (Jiang et al., 2023, 8).

10 levels of automation

- | | |
|--|--|
| 1 The computer offers no assistance:
Human must take all decisions and actions | 6 The computer allows the human a restricted
time to veto before automatic execution |
| 2 The computer offers a complete set of
decisions/actions | 7 The computer executes automatically,
then necessarily informs humans |
| 3 The computer narrows the selection of
decisions/actions down to a few | 8 The computer informs the human,
only if asked |
| 4 The computer suggests one alternative | 9 The computer informs the human,
only if it the computer decides to |
| 5 The computer executes a suggestion,
if the human approves | 10 The computer decides everything and
acts autonomously ignoring the human |

Figure 2: **The 10 levels of automation** by Sheridan and Verplank from 1978 (figure taken from [Jiang et al., 2023](#), 8, table 1)

There are opposing theories, challenging the view that the need for human input decreases with increasing automation. These theories claim that the need for human input transforms from simple to complex inputs, since simpler routines are automatized first, requiring humans to have more complex, in-depth knowledge and abilities ([Jiang et al., 2023](#), 9). Currently, humans still dominate control and automated systems only take over partial control to reduce human error ([Wen and Imamizu, 2022](#), 219). Nevertheless, it has to be considered that the automation-control trade-off has long been subject to discussion and fully automated systems according to the 10 levels of automation will lead to a complete loss of human control ([Jiang et al., 2023](#), 9), and therefore endanger human’s sense of agency.

4.3 The Sense of Agency During Interaction With AI Agents

As outlined in the previous section, machines can have different degrees of autonomy. In general, computers and systems can be roughly put into two groups, the first being assisting systems, and the second group, consisting of autonomous systems, can be attributed agency ([Limerick et al., 2014](#), 2). When humans interact with machines, human as well as machine agency can be scoped by three aspects: (1) what actions they can take, (2) the kind of actions, and (3) whether they can interact with others ([Engen et al., 2016](#), 99).

On a wall in Pompeii from 79 AD, one of the “oldest documented example of an assistive technology with agency” can be found: a picture of a guide dog ([Mathewson et al., 2022](#), 9). In modern approaches, sociotechnical systems consider humans and technological agents to complete another in complex system through interaction

(Jiang et al., 2023, 5). The idea is that humans and machines share agency, combining human abilities and machine intelligence (Mathewson et al., 2022, 2). Whether their situational awareness, and hence sense of agency overlaps, depends on their goal (Jiang et al., 2023, 6). Through communication or so-called communicative capital (something that builds over time when interacting together), they can compensate for another and perform tasks exceeding each agent’s individual abilities (Jiang et al., 2023, 6; Mathewson et al., 2022, 2).

Mainly three tensions, that affect the human sense of agency, exist in human-AI interaction. The first tension is between automation and human agency, the second is between user confidence and system uncertainty, and the third is between the user’s perceived complexity of the system and the system’s objective complexity (Jiang et al., 2023, 7). During joint control with two human agents, humans usually have a lower sense of agency due to the presence of the other agent, because the other agent increases the amount of uncertainty and makes predictions more difficult, resulting in lower control and sense of agency (Wen and Imamizu, 2022, 219). Non-biological actions are perceived as different to the self, leading to challenges in human-machine collaboration. An opposing view claims that humans automatically regard computers as social actors, as humans act similarly towards machines (Limerick et al., 2014, 8). One key finding suggests, that humans implicitly very differently judge human-human from human-machine joint action (Limerick et al., 2014, 7). It has been found in cognitive studies that a “we-mode” can maintain a sense-of agency in joint (human-human as well as human-machine) interaction, requiring joint perspective, intentions and attention in a task. For example, if two people carry a piano together (Wen and Imamizu, 2022, 219).

To allow for joint interaction of humans and machines, a system should provide information to be transparent (Jiang et al., 2023, 10): First, it should share its goals, action, state and plans. This allows humans to perceive the agent and is an integral part to contribute to humans’ situational awareness. Second, the system should inform the human about its reasoning, as well as constraints and conditions that afford the system’s plan. This way, humans can understand the system, also enhancing humans’ situational awareness and thus control over the situation. Lastly, the system should inform about future projections and predictions.

5 Criteria Which Make up the Sense of Agency on the Internet

The previous chapters dealt with agency, the sense of agency, and more specifically the sense of agency in human-machine interaction. This allows to transfer what makes up a sense of agency on the internet. One definition of the internet is, that it is an interconnected world-wide network, which allows servers to communicate efficiently according to a certain protocol and offers services such as the web, messaging or group discussions ¹. Another definition focuses on the subjective experience of the internet, claiming that “the notion of a singular internet that is the object of everyone’s experience is no longer useful [... it is rather] a more fragmented and enclaved experience of digital services than is allowed by the notion of *the* internet” (Dourish, 2022, 171).

Although often invisible, the internet is omnipresent in applications on PCs, smartphones, IoT-devices, etc. Almost no complex system runs without the internet. As the internet is a large interconnected network, it is very complex as well as difficult to understand and hence often feels uncontrollable to users. In the following, criteria which make up the sense of agency on the internet will be outlined.

1. **The right amount of cognitive load.** The first criterion concerns the fact, that the cognitive load humans encounter during interaction with the internet strongly influences their sense of agency. If the system is too complex, uncertain or transparent, humans are overtaxed and feel incapable to deal with the situation. This results in a loss of control. A good example of a reduced sense of agency, because of too much transparency, can be found in prompts about cookie-preferences. Although it aims at making everything more transparent and giving the user control, the user usually does not completely understand all cookies and also feels a loss of control, because of certain limitations in his choice of cookies. On the other hand, if the interaction is too easy or there is not enough transparency or complexity, humans will reduce their attention or fell unable to control the situation, resulting in a reduced sense of agency.
2. **Users should be enabled to realise their goals.** The next aspect deals with the fact, that a sense of agency arises, if humans are able to act goal-oriented on the internet. Reaching goals, being able to realise intentions and

¹Internet – Définition. 14.05.2020. <https://www.insee.fr/fr/metadonnees/definition/c1864>. Last access: 6th June 2023, 3:43 pm

knowing how to easily achieve these, influences control and human autonomy. This also requires appropriate feedback from the system, as all models of the sense of agency rely on the effect of the action for a sense of agency to arise. Reaction times of internet services such as success or error notifications are good examples for this criterion.

3. **The subjective feeling of agency should arise, but agency should also be attributed to the self after interaction.** This criterion addresses the fact that a sense of agency can be generated in the moment of interaction, e.g. affordances of the environment, but in retrospective the moment is judged and evaluated as a moment without the possession of agency. Consequently, there is no sense of agency afterwards. Hence, this criterion addresses both, the ad-hoc feeling of agency and the post-hoc judgement of agency, requiring both for a proper sense of agency to arise.
4. **With increasing amount of autonomous systems, joint-agency should be experienced.** The last criterion addresses the increasing autonomy as well as agency of machines. On the internet, a lot of services exhibiting autonomy can be found. This decreases the sense of agency in humans, except if there is a so-called “we-mode” and humans perceive the interaction as joint. As a consequence, the system has to be able to agree upon decisions with the user. But this does not necessitate that users need a complete understanding of the system to experience a sense of agency.

6 Agency in the Context of Search

Having put forward criteria which make up the sense of agency on the internet allows analysing the sense of agency experienced with regard to interactions on the internet. A study in 2020 by the Central Statistics Office Ireland (see Figure 3) revealed that the three most common internet activities are (1) Sending and receiving e-mails, (2) Finding information on goods and services, and (3) Instant messaging. Sending e-mails as well as messaging are usually done intentionally and goal-directed. The sense of agency is determined by the perceived usability and control users have over the interface. It is a bit different for finding information on goods and services, which equals online search. Searching can happen in a goal-directed manner, but also in the form of explorative interaction. Furthermore, the outcomes, that users' actions have, can differ greatly. With new AI systems and recommendations, it is likely that

search is more susceptible to a decrease of the sense of agency in humans. Thus, search on the internet will be analysed according to the previously posed criteria, similar to an analysis of how YouTube’s design influences user’s sense of agency by Lukoff et al. (2021). YouTube also offers a search feature to browse through the digital video contents they offer. But this analysis will also consider other scenarios as the search for news, information, restaurants, recipes, weather, people, videos, online commerce, local “offline” commerce, etc.

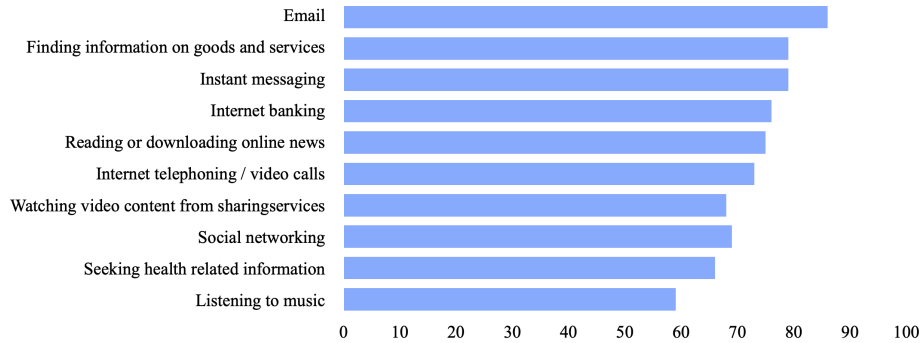


Figure 3: **Most common types of activities when on the internet**, table taken from <https://www.cso.ie/en/releasesandpublications/ep/p-isslh/informationstistics-households2020/typeofinternetactivities/>. Central Statistics Office Ireland. *Individuals who used the internet in the last 3 months classified by types of internet activities*. 2020. Last access: 9th July 2023, 12:21 am

In the study by Lukoff et al. (2021) it has been found that specific mechanisms of YouTube, which are common to other search systems as well, decrease or increase perceived control and thus users’ belief with respect to their possibilities to act and access to resources (Giantari et al., 2013, 31). Users were especially frustrated by recommendations. Either recommendation were not good, which raised the wish to be able to modify and individualise recommendations, or recommendation were too good, which made people struggle to choose (Lukoff et al., 2021, 12). Recommendations are not exclusive to search in media providers as YouTube. They also are often encountered in online clothes shops, online libraries, online newspapers, etc.

Recommendations should facilitate exploration and search, but if they are too unrelated, users are neither faster nor do they find aspects that they search there. If recommendations are not good enough, it violates the second criterion that users are unable to realise their goal. But if recommendations are too good, they violate the

first criterion. The cognitive load is too high for users. They struggle to decide what to select, leaving them feeling overwhelmed. Of course, if recommendations become too good, cognitive load is endangered again, because users will rely on the system, not questioning it any more and running in the danger of human error – being steered by environmental stimuli. At the same time, recommendations bear the danger of feeling agency at the moment, but not judging to have had agency post-hoc (criterion 3).

Another problem of recommendations is, that they rely on behaviourism. Hence, “recommendations largely neglect explicit preferences and instead rely on behaviour traces (‘what users do’)” (Lukoff et al., 2021, 12). This is why users cannot define and control what they get recommended. Furthermore, they cannot create their ‘aspirational self’ and use recommendation to achieve long-term goals, violating criterion 2, because recommender systems reinforce user’s past behaviour. Another problem inherit to recommendation is, that it can influence and form users’ opinion as users become biased towards one object, if they had to make a difficult choice between two items, that were equally preferred (Luo and Yu, 2017, 1).

Advertisement goes hand in hand with recommendations and has similar effects as recommendations, reducing users’ sense of agency. This is obvious since advertisement is very similar to recommendations: they are also “recommended” with the difference, that the recommendation comes from a subset of all possible results and companies paid for them to be recommended.

Other mechanisms seem to increase the sense of agency. Users experience more control with free-text search fields, being able to subscribe to specific information channels or have a look at their history or statistics (Lukoff et al., 2021, 11). Interestingly, users are often willing to decrease their agency themselves, to avoid features, that decrease their sense of agency. For example, they disallow all entertainment activities using application usage monitors, because they feel incapable of addressing the problem in a targeted manner.

Search is also used in various contexts, but user’s searching behaviour usually exhibits two forms. Either users search in a goal-oriented manner, having a specific item in mind (e.g. searching for a specific recipe one has already used before), or by searching for specific information they do not know yet (e.g. the height of the Eiffel tour). In other cases, users want to explore knowledge and search unspecifically. This is, for example, the case, if people browse through t-shirts or do research for their next summer holiday. Usually a search is used, but the search is not directed at one

particular specific item or information. This has a strong relation to criterion 4. If search is very specific, instrumental and goal-oriented, the search system is regarded as assisting technology and the intention guiding actions has to be the user's intention on both sides (human and system) for a we-mode to arise. But the system can be more autonomous in exploratory search as long as it is either controllable (see the aspects discussed with regard to recommendations) or the system makes its goals and reasoning visible. People prefer higher-control, if they have a very specific intention in mind, as opposed to lower-control in situations with non-specific intentions (Lukoff et al., 2021, 13).

Overall, search currently exhibits mechanisms that decrease the sense of agency in users, such as not comprehensible, not controllable, and not influenceable recommendations, advertisement, and even the search results itself are generated in a way, users cannot really gain a feeling of control over them. The same search query, for example, gives different results at different time points. It is important to distinguish between modes of search, when designing the interface of a search system: instrumental and exploratory search, as it strongly influences the user's perception and weighting of the different criteria.

7 Discussion and Outlook

Agency and the sense of agency are two factors, crucial to the current advances in technology. With regard to user experience, satisfaction and well-being, as well as control, the sense of agency is more relevant. From an ethical standpoint, it is important to focus on the sense of agency in human-machine interaction, especially the more automation and AI advance, since it will influence human's felt responsibility and engagement in tasks. Furthermore, it has an impact on human autonomy.

On the basis of previous research about the sense of agency in HMI, the present paper presents four criteria, which make up the sense of agency on the internet. These take cognitive load, human's intention, the ad-hoc feeling and the post-hoc judgement of agency, and joint-agency of humans and advanced autonomous artificial agents into consideration. This is a first attempt to formalise criteria, usable to analyse the sense of agency. Contrary to current calls for transparency and explainability, the criteria also allow for only partially transparent systems as long as the user maintains a non-erroneous sense of agency. Users also do not need to know every detail of how a car works, to have agency as well as a sense of agency, and being able to drive it.

Along the example of search online, it has been shown that there are features that increase, but also decrease the sense of agency. These can be explained with the proposed criteria. Of course, it is still an open question, how a good interface on the internet has to look like, how it should work, and what its affordances have to be like, to fulfil the given criteria and allow for the user to have a sense of agency. But it seems likeable that such systems can be created and that given systems can be optimised to maintain and improve human autonomy and agency with future advances of technology and the internet.

References

- Bergström, J., Knibbe, J., Pohl, H., and Hornbæk, K. (2022). Sense of Agency and User Experience: Is There a Link? *ACM Transactions on Computer-Human Interaction*, 29(4):1–22.
- Dourish, P. (2022). *Stuff of Bits: an essay on the materialities of information*. MIT Press, S.l.
- Engen, V., Pickering, J. B., and Walland, P. (2016). Machine Agency in Human-Machine Networks; Impacts and Trust Implications. In Kurosu, M., editor, *Human-Computer Interaction. Novel User Experiences*, volume 9733, pages 96–106. Springer International Publishing, Cham. Series Title: Lecture Notes in Computer Science.
- Giantari, I. G. A. K., Zain, D., Rahayu, M., and Solimun (2013). The role of perceived behavioral control and trust as mediator of experience on online purchasing intentions relationship a study on youths in denpasar city (Indonesia). *International Journal of Business and Management Innovation*, 2(1):30–38.
- Gillan, D. J. (1997). The Psychologies of Human-Computer Interaction: An Integrative Approach. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 41(1):385–389.
- Harridge-March, S. (2006). Can the building of trust overcome consumer perceived risk online? *Marketing Intelligence & Planning*, 24(7):746–761.
- Jiang, J., Karran, A. J., Coursaris, C. K., Léger, P.-M., and Beringer, J. (2023). A Situation Awareness Perspective on Human-AI Interaction: Tensions and Opportunities. *International Journal of Human-Computer Interaction*, 39(9):1789–1806.
- Limerick, H., Coyle, D., and Moore, J. W. (2014). The experience of agency in human-computer interactions: a review. *Frontiers in Human Neuroscience*, 8.
- Lukoff, K., Lyngs, U., Zade, H., Liao, J. V., Choi, J., Fan, K., Munson, S. A., and Hiniker, A. (2021). How the Design of YouTube Influences User Sense of Agency. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, pages 1–17, Yokohama Japan. ACM.

- Luo, J. and Yu, R. (2017). The Spreading of Alternatives: Is it the Perceived Choice or Actual Choice that Changes our Preference?: Perceived Choice and Actual Choice in our Preference. *Journal of Behavioral Decision Making*, 30(2):484–491.
- Lăzăroiu, G., Neguriță, O., Grecu, I., Grecu, G., and Mitran, P. C. (2020). Consumers’ Decision-Making Process on Social Commerce Platforms: Online Trust, Perceived Risk, and Purchase Intentions. *Frontiers in Psychology*, 11:890.
- Madary, M. (2022). The Illusion of Agency in Human–Computer Interaction. *Neuroethics*, 15(1):16.
- Mathewson, K. W., Parker, A. S. R., Sherstan, C., Edwards, A. L., Sutton, R. S., and Pilarski, P. M. (2022). Communicative capital: a key resource for human–machine shared agency and collaborative capacity. *Neural Computing and Applications*.
- Smith, S. (2003). Humans in the loop: human-computer interaction and security. *IEEE Security & Privacy*, 1(3):75–79.
- Suchman, L. (1998). Human/Machine Reconsidered.
- Wen, W. and Imamizu, H. (2022). The sense of agency in perception, behaviour and human–machine interactions. *Nature Reviews Psychology*, 1(4):211–222.

Competing Interests

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Statement of Authorship

I hereby certify under oath that the paper I am submitting is entirely my own original work except where otherwise indicated. I have not used any auxiliary means other than those listed in the bibliography or identified in the text and any use of the works of any other author, in any form, is properly acknowledged at their point of use with indication of the source.

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