Why, when and how do people stream videos?

A qualitative study on the sustainability of video streaming behaviour

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Executive summary

- Information and communication technology (ICT) can contribute positively to sustainability by reducing energy consumption and conserving raw materials in other sectors. However, the high energy and resource demands of the ICT sector itself significantly counteracts greenhouse gas emission reductions in other sectors.
- In the light of sustainability and efficiency, this had led to many efforts aimed at reducing this environmental footprint. These are partly offset by an increase in use of ICT services as result of this higher efficiency. A new paradigm of digital sufficiency emerges that focuses on moderating use to be in line with user needs and societal challenges.
- To progress the development of the digital sufficiency paradigm, we focused on video streaming, as this is the most common data-intensive online activity. We investigated the video streaming behaviour of Dutch users with a mixed methods approach. For a period of two weeks, we conducted a study with 18 participants who self-monitored their streaming behaviour via daily surveys. Afterwards, the participating households reflected on their streaming behaviour in semi-structured interviews.
- Findings from the study describe a varied role for video streaming services in our daily lives. Mainly driven by motivations of entertainment, Dutch citizens use streaming services to escape from daily struggles and unwind, often in a solitary setting. The amount of screen time is also driven by easy access to streaming services and a compulsion to stream that is difficult to resist. The agency of users to moderate their streaming behaviour is further weakened by automated and deceptive features as well as a lack of social reinforcement to reduce.
- Based on the findings, we propose a development focus for human-centered, 'social' recommendation algorithms facilitating informed decisions by users. Furthermore, we conclude there is an opportunity for mobilising social structures that reinforce users' ambitions to moderate their behaviour, for example via normative feedback and communal viewing practices.
- Future studies could build upon present findings by identifying user characteristics correlating with certain streaming behaviours, investigating the decision-making process for alternative activities, and analysing the effects of specific video contents, always considering the context of the behaviour.

Contents

1. Introduction

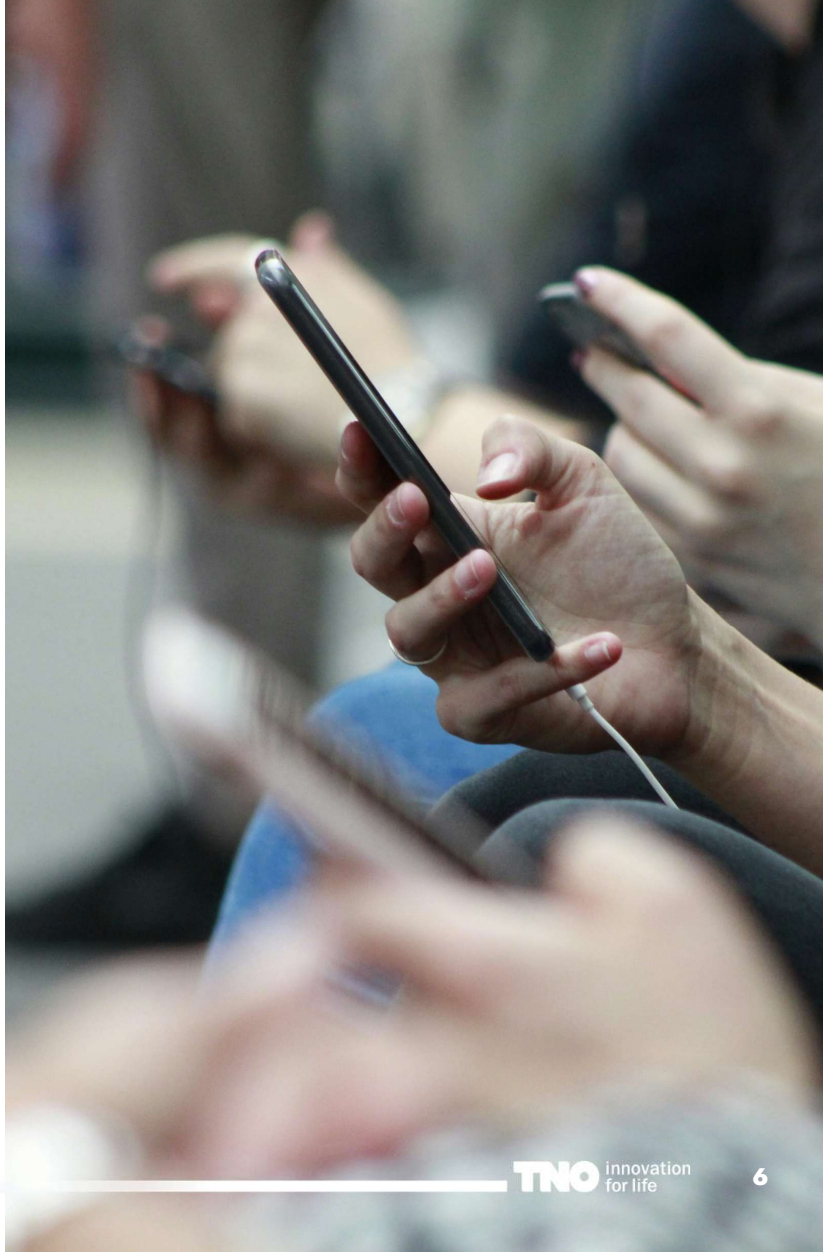
TNO innovation for life

Scope (1)

- Information and communication technology (ICT) can contribute positively to sustainability by reducing energy consumption and conserving raw materials in other sectors.[1,2,3,4,5,6,7]
- However, using ICT also has negative climate and environmental impacts due to the sector's high energy and natural resource demands (e.g., fresh water, land, critical raw materials), e-waste disposal and greenhouse gas (GHG) emissions.[1,5,8,9,10,11,12,14]
- Despite efforts to mitigate the ICT sector's climate and environmental impacts with technological solutions (e.g., hardware and infrastructure efficiency),[13] the total footprint of the ICT sector still contributes roughly 2% to 4% of all global GHG emissions.[10,14,15]
- ICT-related emissions are predicted to increase as gains from efficiency measures are expected to decrease.[1,13] Simultaneously, the sector is expected to reach 21% of global electricity demand by 2030,[16] as the number of devices, global bandwidth and computing infrastructure will expand due to the rise of artificial intelligence (AI)[103] and Internet of Things (IoT), and an increase in video streaming.[10,17,18]

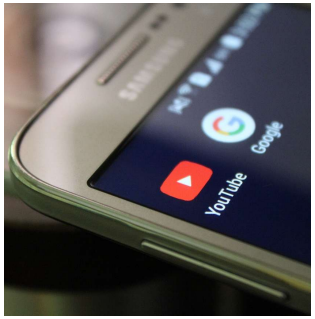
Scope (2)

- Due to declining efficiency gains and an increased adoption of ICT, a shift is needed from the current technological, efficiency-oriented solutions ('cornucopian' paradigm)[19] towards sustainability approaches based on demand reduction via changes in user behaviour (sufficiency paradigm).[13,20,21,22,23,24]
- A suitable focus for research on digital sufficiency is video streaming, as this is the most common data-intensive online activitity.[16,25,26,27] Video streaming accounted for 66% of all internet traffic in 2022,[28] thereby contributing significantly to the aforementioned environmental impacts.[16]
- For users to decide to change their behaviour, they must be facilitated in a way that makes these changes last.[29] This goes hand in hand with the development of effective policies by governing bodies that empower users in this transition.[30,31] Therefore, more knowledge is needed on users' drivers and barriers for interacting sufficiently with ICT devices and services.
- This report describes an in-depth study of video streaming among Dutch citizens. In this study, we aim to capture a detailed picture of the contexts in which audiovisual media are consumed and the underlying motivations of users. We reflect upon these findings by formulating a set of concrete opportunities for reaching sufficiency in video streaming.



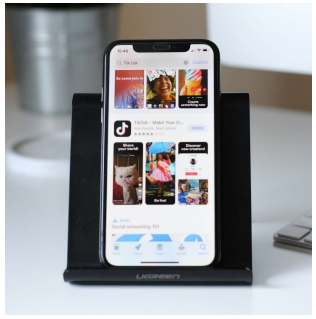
How do we define video streaming?

The streaming of...



... content from video streaming platforms

YouTube, Vimeo, Dailymotion



... content on social media

Instagram, LinkedIn, Pinterest, TikTok, Snapchat, Reddit, X

... content via commercial video-on-demand platforms

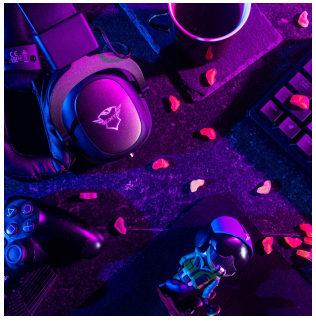
Netflix, Videoland, Amazon Prime Video, Disney+, Apple TV+, HBO Max, Google TV, Viaplay

... TV programs from a website or dedicated app

NPO, NLZIET, interactive TV of own provider

Participating in video calls or conferences

WhatsApp, Telegram, Discord, Zoom, Facetime, Microsoft Teams

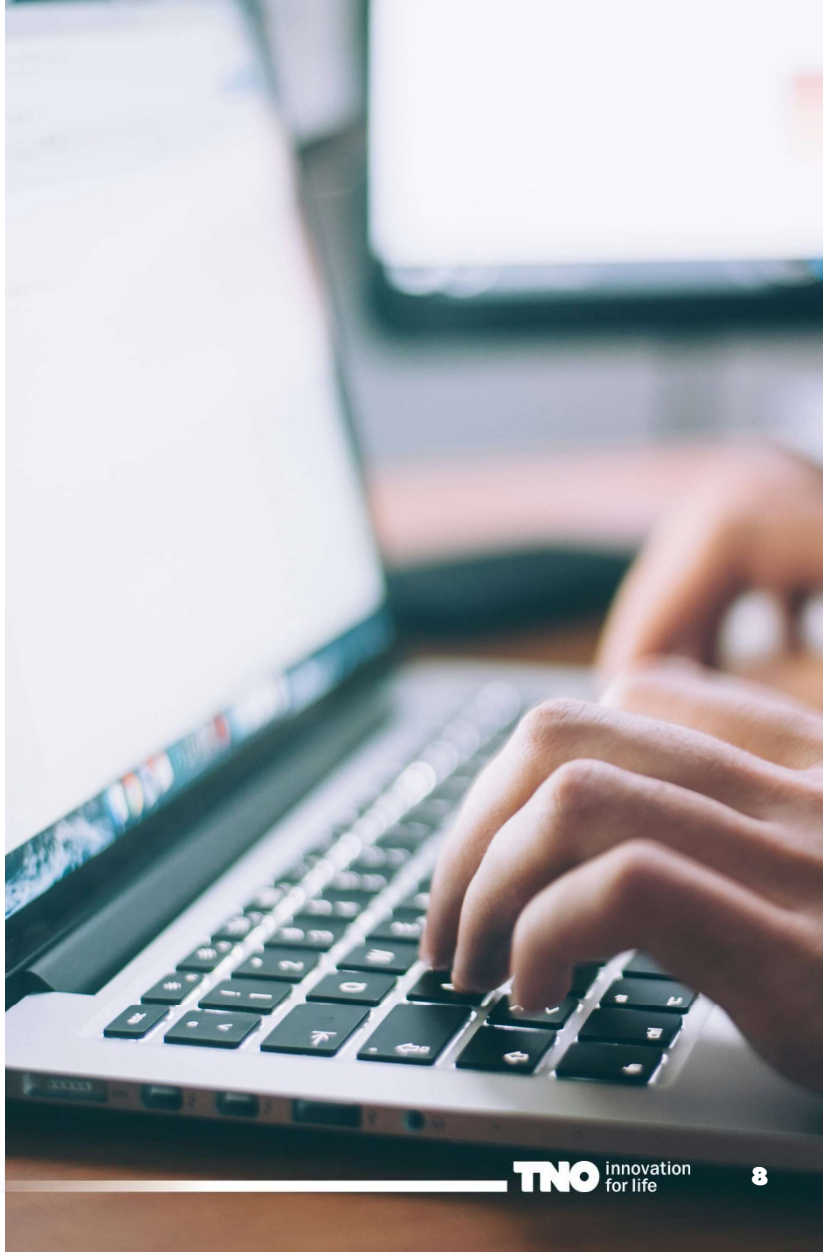


Cloud gaming

PS Now, Xbox Gamepass, NVIDIA GeForce NOW, Steam Remote Play

Background

- To find promising directions for reaching sufficiency in video streaming, we need to understand which forms of video streaming behaviour may be undesirable and how that behaviour comes about.
- While previous research into sustainable streaming has focused on technology-related determinants of video streaming behaviour, such as streaming duration, resolution, end-device choice and subscription type,[16,26] only a few studies thus far have looked at the social and psychological drivers and barriers underlying sufficient video streaming and the context in which this behaviour occurs.
- We reviewed the literature on contemporary television studies, binge watching, smartphone use, gaming and related fields. In examining video streaming behaviour, various studies address the extent of its meaningfulness, thereby distinguishing between hedonia or short-term fulfilment and eudaimonia or long-term fulfilment, and conscious choices versus unconscious processes.
- In the following we will outline several of these factors underlying video streaming. We recognize individual psychological characteristics, including anxiety, available cognitive resources, locus of control, need for cognition and sensation seeking, may also play a role in driving these behaviours.[32,33,34] However, they are outside the scope of the current study.



The meaningfulness of video streaming behaviour

- In understanding sufficiency of video streaming, one possible research direction is to look at the meaningfulness of the behaviour. For instance, watching a tutorial to learn something new can be considered meaningful, whereas not actively watching videos but rather using them as background noise for other activities can be regarded as less meaningful.[16]
- Concerning the meaningfulness of certain behaviour, a distinction can be made between hedonia (short term pleasure) and eudaimonia (long term fulfilment).[35]
  - Hedonic experiences are "pleasurable experiences rooted in human values and evidently pleasurable activities" such as unwinding and relaxing, whereas eudaimonic experiences are "about striving towards and accomplishing personal goals" such as learning something new.[36]
  - Specifically related to technological user experiences, hedonic user experiences concern "momentary pleasures directly derived from technology use", whereas eudaimonic user experiences concern "meaning from need fulfilment".[36] As such, gaming or video sharing platform activities (i.e., passive consumption) were described mainly as hedonic experiences, whereas those activities employed for "learning purposes and/or working towards a personal goal" such as learning a (programming) language (i.e., active communication or consumption) were mainly classified as eudaimonic experiences in a study.[36]
- Despite the subtle differences between hedonic and eudaimonic user experiences, they can take place simultaneously and thus are not mutually exclusive.[37,38,39,40,41] Yet eudaimonia appears to be valued higher by users than hedonia in the long term.[36,37,40]
- Nonetheless, several studies have adopted a user-focused approach in conceptualizing meaningful streaming.[27,36,40,43] The authors stress that users determine themselves what they find meaningful digital interactions and leaving the interpretation of meaning open to the user, rather than solely focusing on the sustainability of these interactions and dictating what should or should not be considered meaningful.[27,36,40,43]

Conscious processes underlying video streaming (1)

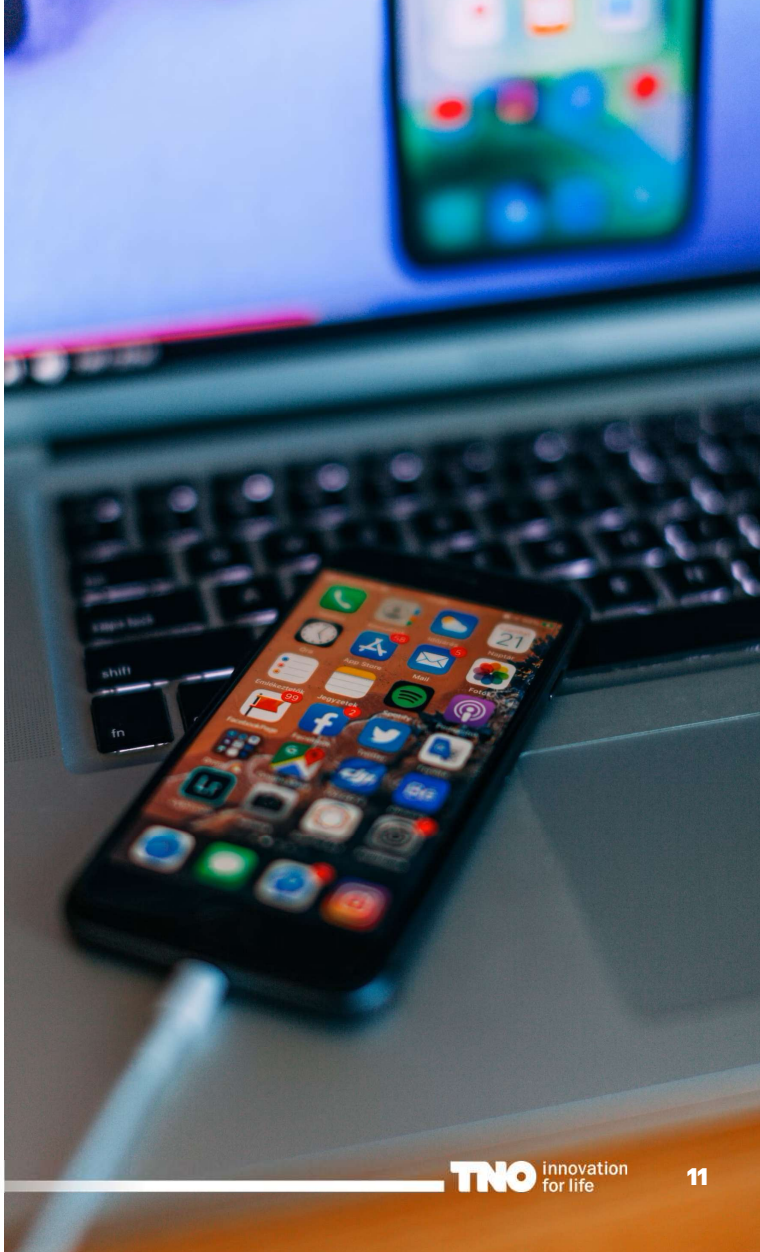
Motivations

- Motivations to engage in video streaming are multifaceted and vary depending on the situation. However, the literature from various research areas consistently cites the following motivations.[44,45,46,47,48,49]
  - One common motivation is the pursuit of entertainment or enjoyment.[45,50,51,52] Individuals often engage in video streaming to satisfy their desire for enjoyment,[44,47] specifically "purposefully watching and seeking certain positive emotional states".[50] Therefore, video streaming can be seen as a means for emotional enhancement.[44,46,50] This emotional enhancement motivation has also been found for other behaviours such as video gaming,[53] sport activities,[54] and gambling.[55,56] Similarly, amusement and entertainment are also found to be reasons for smartphone and social media use.[45,57] The immediate and endless possibilities of social media platforms excite individuals, along with the opportunity to access others' reactions and experiences.[57]
  - Individuals watch videos online to unwind from their daily lives, making relaxation a significant motivation for video streaming.[44,50,58] A closely related but more negatively connoted motivation is escapism, where individuals stream audiovisual media as a way to cope and avoid thinking about their daily problems and stress.[59,44,46,50] Another related common motivation for video streaming is to relieve boredom,[44,45,59] described as a means to pass time or avoid boredom when there is nothing else to do.[46,50,52]
  - A different frequent motivation for video streaming is enrichment, for example, in the form of wanting inspiration or seeking information and learning something new.[44,45,46,48] For example, obtaining information from documentaries and tutorials was a key motivation for watching videos.[49]
- These different motivations appeal to the degree of meaningfulness. Accordingly, it is suggested that certain motivations, such as relaxation, are more hedonic, whereas other motivations, such as enrichment, are more eudaimonic.[39,51]

Conscious processes underlying video streaming (2)

Social influences and norms

- Several social influences play a role in video streaming behaviour. The choice for video streaming can be driven by a desire for social interaction or connectedness. For instance, social media can help people connect with others and stay in touch[60,61,62] and watching videos with others or talking about content and sharing recommendations can be valuable in pursuing feelings of connectedness and togetherness.[50,63] Research shows that individuals are specifically drawn to streaming certain audiovisual media when the content was recommended by others.[47,50]
- Video streaming behaviour can also be guided by social expectations or social norms, that is what important others (e.g., family and friends) do or think. People can feel pressured to catch up on missed content to engage in conversations and not feel excluded.[64] Also, social norms appear to be a determining factor in subscribing to and retaining video streaming services.[65]
- This pressure is similar in the use of smartphones and social media, where people often feel compelled to respond quickly to meet social expectations and avoid negative consequences.[66] Individuals may see continuous connectedness as a duty.[57] Consequently, individuals are more likely to show excessive smartphone use if their peers are also high-frequency users, leading to a normalisation of the behaviour within the group.[67]



Conscious processes underlying video streaming (3)

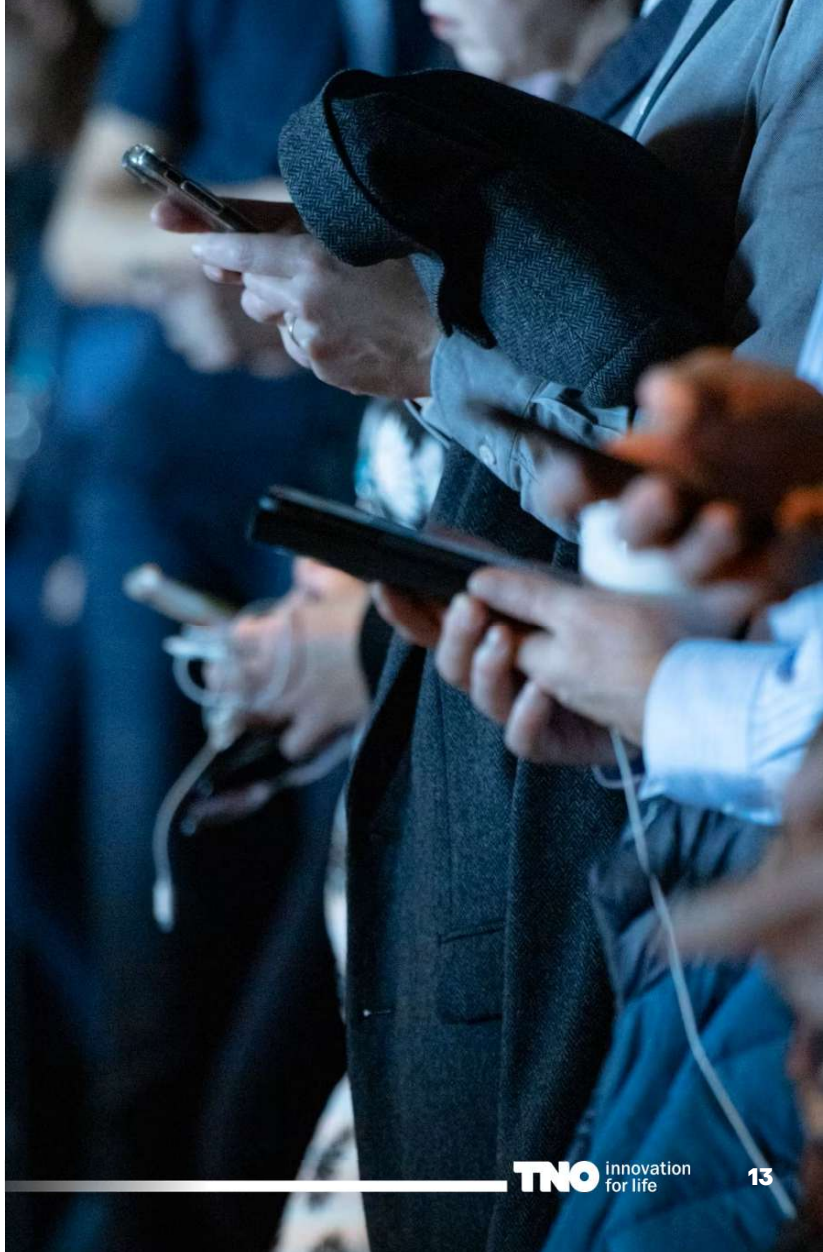
User agency

- Video streaming is also often associated with a sense of autonomy.[63,68] Especially streaming platforms such as YouTube and Netflix allow users to watch what they want, whenever they want, and wherever they are.[69] This is expected to enable unlimited autonomy in selecting and consuming media content.[69] In a psychological context, this increases feelings of self-determination and therefore satisfies the desire for control and efficiency.[47,66]
- However, this notion of user agency is increasingly challenged, as streaming services use features to influence their users' experiences.[63] Agency is gradually constrained by algorithms and dark patterns steering user behaviour.[63,70]
- Dark patterns are described as "design practices or tricks used in websites and apps that make users do things that they did not mean to",[71] and which are often against their own self-interests.[72] Examples of dark patterns are: unlocking new features only when users successfully invite others (forced action)[71,73] and the autoplay function, where a video or audio element plays automatically, without explicit user choice (preselection).[73,74]
- Due to dark patterns, video streaming and social media use are frequently associated with a loss of agency.[74,75] For example, dark patterns like autoplay were found to result in users' loss of autonomy and self-control when watching videos on streaming platforms, and subsequently, negatively impacting their sense of digital well-being.[75]

Unconscious processes underlying video streaming (1)

Habits

- While an active, intentional role of users in deciding to engage in video streaming is often assumed, much behaviour related to ICT devices and services is automatic rather than intentional, with habits driving video streaming.[76,77,78,79]
- Initially, video streaming might be goal-directed, but with repetition in consistent contexts it becomes habituated.[80,81] This automatic behaviour is triggered by situational cues such as specific locations, people and preceding actions.[80,82,83] The automaticity arising from individuals repeatedly engaging with (audiovisual) media in steady conditions is referred to as media habits.[84,85]
- ICT has become an essential part of life globally,[86] leading to certain widespread use patterns: worldwide, people spent an average of 6 hours and 38 minutes daily on ICT devices.[87] Habitual use of ICT devices and services has thus become an everyday behaviour without necessarily pathological (compulsive) implications.[77,88]



Unconscious processes underlying video streaming (2)

Habits

- Frequently discussed in research are checking habits (the brief and repeated inspection of dynamic content quickly accessible on devices),[83,89] leading users to engage in other activities on the device, increasing overall usage. Especially regarding social media use, habits are often formed via a constant state of anticipation created by social media platforms, leading individuals to access social media without a clear purpose, almost as a naturalized state.[57,88]
- A similar pattern is observed in binge watching, which has been called “the new norm in watching favourite shows and movies”.[16,90] Consequently, long usage times and frequencies are no exception anymore.[48,91,92] A habit loop sustaining the behaviour is created through the reward of temporary enjoyment, along with continued investment in the story and enhanced by features such as cliffhangers. Habits have been found to be more predictive of binge watching than intention, suggesting habitual behaviours can overshadow conscious intentions in this context.[90,93]
- Video streaming services and social networking sites often amplify habits and exploit the automaticity of the behaviour[94,95] by increasingly focusing on appealing hedonic motivations with algorithms, infinite scrolling and dark patterns.[63,71,72,75,96] While these features may initially be functional and facilitate ease of use, they habitually encourage compulsive behaviour after a longer period of use.[75]

The present study

- From our literature study we see how video streaming behaviour can be categorized under conscious and unconscious behaviours. Both happen in specific contexts where various factors influence users' (unconscious) decisions.
- Current literature suggests that, in particular, the areas of habit formation[89,93] and features such as algorithms and dark patterns[27,75] offer opportunities to perform less unsustainable video streaming behaviour.
- In the present study we aimed to find promising directions for changing video streaming behaviour by examining forms of video streaming behaviour, and their determinants, which users possibly find undesirable.
- We did so by deepening our understanding of the context in which video streaming behaviour takes place and reflecting on inner thoughts of users when making their decision to engage in these activities.

Research questions

What internal and external factors (e.g., level of awareness and knowledge, motivations, values, contexts, social norms, habits) drive video streaming behaviour?

Are people willing to reduce their video streaming behaviour, and under which circumstances?

2. Methods

Mixed methods data collection

To provide qualitative and in-depth insights into video streaming behaviour, we used a mixed methods data collection approach.

This approach consisted of three parts:

1. Experience sampling: a diary study with daily self-reporting of participants' video streaming behaviour in the 'How Am I' app, developed by TNO. The experience sampling method is regarded reliable for measuring behaviour and experience over time in people's natural context.[97,98]
2. Data monitoring: actual hourly measurements of data traffic through a DD-WRT[1] router. Monitoring of data traffic provides insights into data demand across services, devices and users, following similar research by Widdicks and colleagues.[16]
3. Interviews: a reflection on the experience sampling and router monitoring with participants through semi-structured, in-person interviews in their home. Interviews as a method "provide a space for extended conversations that allow [...] insights into how people think and what they believe".[99]

1. This type of firmware for routers allows for more functionalities, amongst which is the possibility to track and categorize data traffic.

Experience sampling: diary study

- The diary study included daily self-reporting of participants about their own streaming behaviour through the ‘How Am I’ app on their smartphones. The ‘How Am I’ app is an app used for experience sampling measurement, developed by TNO (see Figure 1 for screenshots of the notification and app interface).
- The daily surveys lasted about 5 to 10 minutes per survey and included questions on e.g., whether participants had video streamed during a set period, used service(s) and device(s), the location of the streaming activity, and their reason(s) to stream. Every four days a second set of questions was sent to the participants to be filled in (see also page 19).
- Data collection of the diary study took place during a period of two weeks. Fifteen people participated from 15 July 2024 until 29 July 2024, and due to last minute unavailability, three people participated from 5 August 2024 until 18 August 2024.
- The participants received a notification of the daily survey at different moments of the day according to a set schedule (see Table 1).

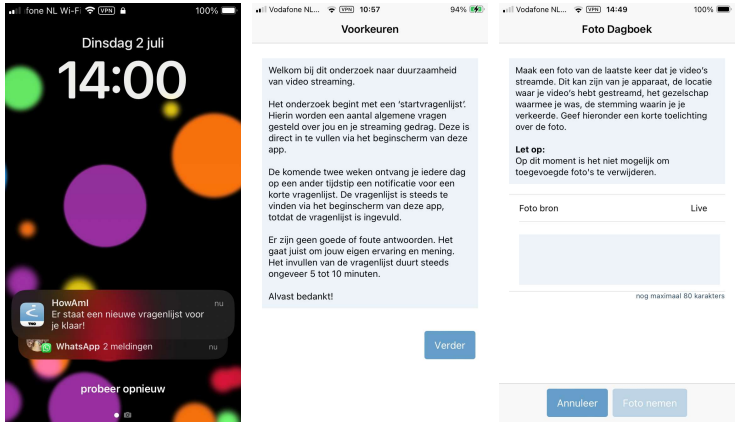


Figure 1. Screenshots of How Am I app.

A day before week 1	Week 1	Week 2
Start survey 0-measurement	Monday 9am (1)	Monday 7pm (2)
	Tuesday 2pm (1)	Tuesday 2pm (1)
	Wednesday 10pm (1)	Wednesday 10pm (1)
	Thursday 7pm (2)	Thursday 9am (1)
	Friday 9am (1)	Friday 7pm (2)
	Saturday 2pm (1)	Saturday 2pm (1)
	Sunday 7pm (1)	Sunday 7pm (1)

Table 1. Schedule of daily surveys with survey number in brackets.

Questions survey How Am I app

Start survey (before experience sampling)

- Reason for participating*
- Video streaming services used**
- Reason(s) for most used video streaming service*
- Estimated daily time spent on video streaming*
- Devices used for video streaming**
- Wish(es) to change streaming behaviour*
- Wish(es) to change video streaming services*

Survey #2 (every four days)

- Photo of streaming context
- Estimated time spent on video streaming during the past four days*

Survey #1 (daily)

- If participant video streamed during morning/afternoon/evening**
- What was and what would have been an alternative activity*
- Video streaming service(s) used**
- Estimated time spent on video streaming*
- Whether streaming was a(n) (un)conscious choice***
- Location of video streaming (e.g., home, on the go)**
- With whom**
- Device(s) used for video streaming**
- Other activity/multitasking during video streaming**
- Reason(s) to video stream**
- Extent of experienced meaningfulness of video streaming***

* Open-ended question, ** Multiple/single choice question, *** Scale/slider question.

Router monitoring

- The data monitoring consisted of actual hourly measurements of data traffic through a DD-WRT[1] router.
- The accompanied software provided automatically generated usage overviews, with insights into data demand across services and devices by the hour (Figure 2).
- Data collection took place during the same period as the diary study.

Figure 2. Screenshot of automatically generated usage overview.

1. This type of firmware for routers allows for more functionalities, amongst which is the possibility to track and categorize data traffic.

Interviews

- During the in-person interviews at their home, we reflected with the participants on the data collected with the router monitoring and the surveys in the ‘How Am I’ app.
- The themes discussed during the interviews were:
  - Introduction: experiences, first estimations of streaming behaviour
  - Streaming behaviour: context factors, motivations/values, habits, social norms, (house) rules, knowledge/awareness
  - Reflection on experience sampling and router data
  - Meaningfulness of streaming
  - Willingness to change/reduce streaming behaviour
- Data collection of the interviews took place between 29 July 2024 and 22 August 2024.
- The interviews were audio recorded. During the interviews, notes were taken. Supported by the audio recordings, the notes were summarized into an interview report after the interview.

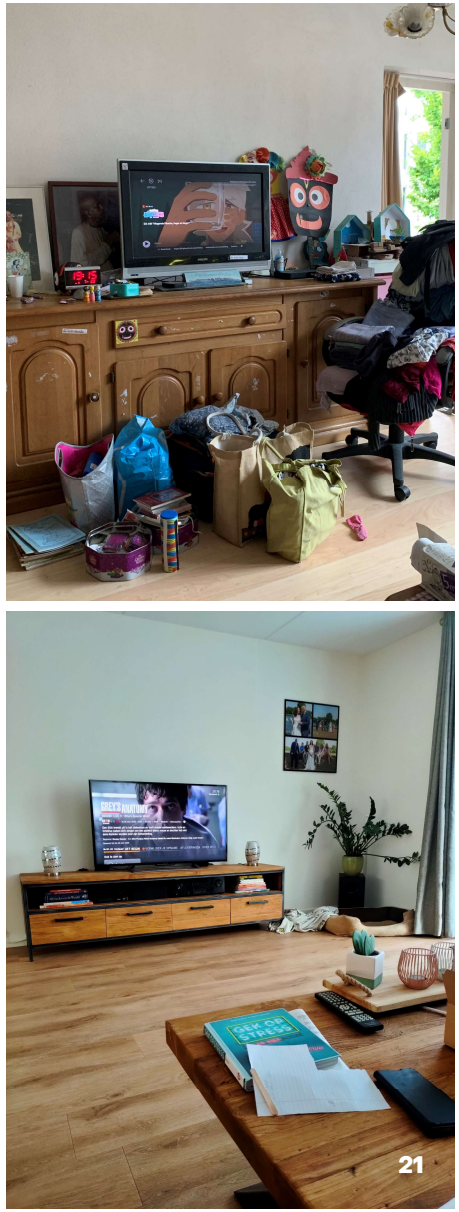


Figure 3. Photos submitted in daily survey #2 on the participants’ streaming context.

Participants (N = 18)

No.	Sex	Age	Family situation	Profession
P1	F	49	Living together with child(ren)	Sports rental employee
P2	M	41	Living together with child(ren)	Project manager
P3	F	35	Married with child(ren)	Management assistant
P4	M	42	Married with child(ren)	Financial controller
P5	F	42	Married with child(ren)	Unknown
P6	F	37	Married with child(ren)	Care worker
P7	F	34	Married with child(ren)	Housewife
P8	F	42	Married with child(ren)	Medication administrator
P9	M	40	Married with child(ren)	Public transport service
P10	F	45	Single with child(ren)	Housewife
P11	M	38	Single	Medical administration
P12	F	56	Single with child(ren)	Goldsmith
P13	F	50	Single with child(ren)	Travel advisor
P14	M	54	Married	Editor
P15	F	50	Married with child(ren)	Administrative employee
P16	F	46	Single	Communication specialist
P17	F	54	Living together	Operational specialist
P18	M	58	Single	Unknown

Table 2. Overview of participants and their characteristics.

- Participants were recruited through a market research agency.
- Participants were selected to reflect a nearly representative sample of the majority of Dutch households.
- Criteria for eligibility were:
  - speaking Dutch
  - somewhat frequently use of streaming services
  - living in region of Rijnmond, Utrecht, Amsterdam, Den Haag and Nijmegen
- Prior to the study, informed consent was asked from all participants, including all household members who would connect to the router but did not participate.
- The study procedure was approved by the ethics committee of TNO.

Data analysis

We processed all collected data in a thematic analysis,[100] carried out in whiteboard software Miro.

1. Parts of the interview reports were transferred to a Miro board divided into six categories of insights following the interview protocol structure: (1) context factors, (2) motivations/values, (3) habits, (4) social norms, (5) knowledge/awareness, and (6) attitudes towards reducing use (see Figure 4).
2. The team of three researchers conducted several rounds of heuristic clustering of the interview data (for inter-rater reliability).
3. The interview data were supplemented with additional insights from the data of the experience sampling surveys and router usage overviews. Triangulating these three data types increased the validity and detail of the emerging themes.
4. The digital sticky notes including all data sources were sorted into different themes and subthemes based on their interrelationships, capturing shared meanings, also known as affinity diagramming.[101,102]

Figure 4. Screenshot of Miro board for clustering, sorting and analysing data.

3. Results

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Overview of themes and subthemes

The findings from the study have been structured along various themes resulting from the analysis. The themes and subthemes are explained further after this overview. In total, we distinguish four main themes with several subthemes each, which are as follows:

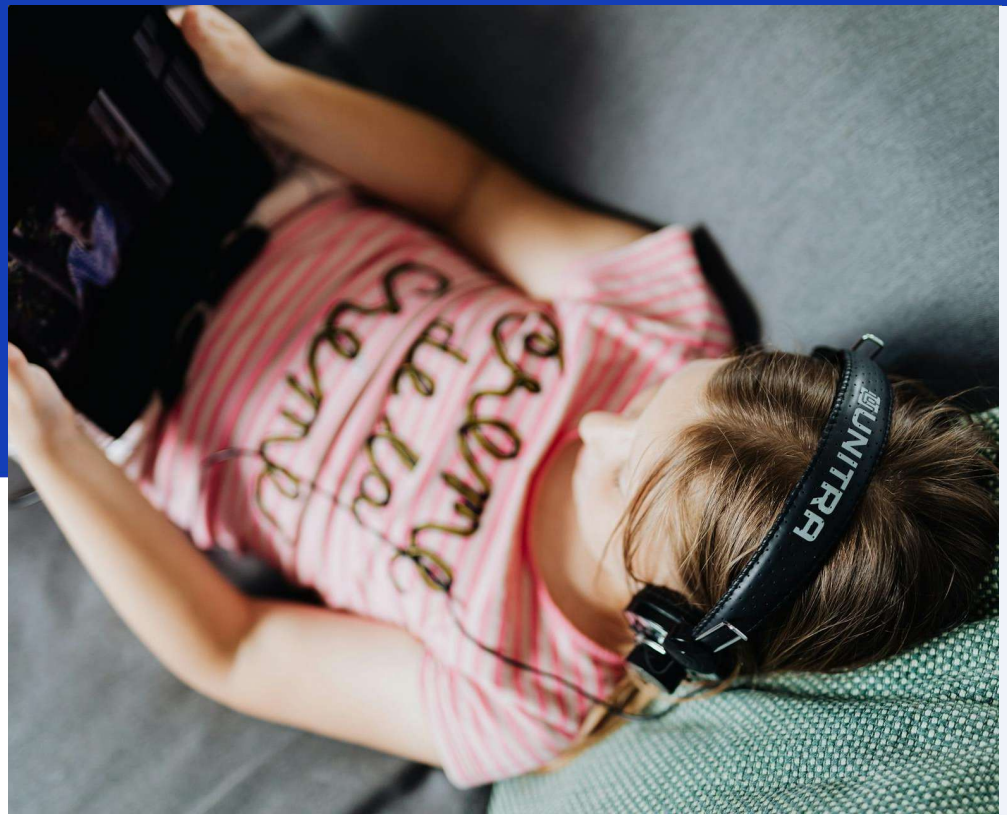
1. **Why we stream**
   a. Streaming for good
   b. A longing for rest
   c. Suppressing our thoughts

2. **External factors**
   a. Always accessible
   b. Distraction and deviation from routines
   c. Control is taken out of our hands

3. **Internal factors**
   a. Streaming at your own convenience
   b. Poor estimation capability for data demand
   c. It is difficult to change
   d. No need for change

4. **The road to streaming less**
   a. Willingness to change
   b. Existing measures
   c. Getting a grip on our behaviour
   d. Social discipline

3.1. Why we stream



Conclusions

- There are various reasons why and contexts where streaming takes place.
- Streaming is oftentimes an easy and efficient way to entertain oneself.
- The desire to take a rest, unwind and escape from daily struggles is most prevalent.

Streaming for good

The main benefits of streaming are considered to be:

- Entertainment and amusement
- To learn something new or be inspired

Streaming in a ‘good’ or responsible way is described as a conscious decision, such as when participants intentionally sit down to watch a programme or movie with a longer duration.

If a conscious decision is made, streaming is viewed as a meaningful activity.

For me, most important [is] entertainment. Just a nice series occasionally. – P3

I often look up things on YouTube too, I learned a lot of things from that. – P4

I don't just zap, I actually watch something I want to see. – P18

When I start streaming, it is really conscious, I sit on the couch in front. Then I really watch a few series that I want to see on Netflix or something on YouTube. – P2

A longing for rest

When streaming, people often make themselves comfortable, settling down at the end of the day.

Streaming often occurs in the bedroom, sometimes with the intention to fall asleep during this activity.

Most of the time, streaming is used as a means to create a moment to unwind and let go of stress.

- It can be a release after a long day at work.
- It can distract the kids.
- It can help ‘escape’ from everyday life.

In the living room, I usually drink my cup of coffee in the morning while reading the news apps or watching series. My sofa is kind of my island. – P16

75% of respondents were recorded streaming in afternoons and evenings.

The living room and bedroom make up about **90%** of all recorded streaming locations.

I think mainly entertainment/relaxation. [...]. And also a nice series to fall asleep to. – P12

Someone has to keep the children busy, if their dad can't and I can't either, we sometimes turn on the TV. – P5

I can really watch aimlessly. It's just like switching everything off, you've had a busy day and want to be reset. – P1

Streaming motivations

	Morning (n = 19)	Early afternoon (n = 34)	Late afternoon (n = 24)	Evening (n = 24)
Finishing a series	26%	21%	25%	29%
Entertainment	53%	29%	54%	54%
Making it easier to fall asleep	11%	6%	0%	0%
Boredom / there was nothing else to do	21%	6%	17%	21%
Relaxation	47%	38%	58%	67%
Postponement of responsibilities	0%	6%	4%	8%
Escape from reality	0%	18%	13%	4%
Looking for inspiration	5%	0%	0%	8%
Learning something	5%	6%	0%	4%
Social interaction via video calling	5%	6%	4%	0%
Group activity	0%	6%	0%	0%
Discussing content with others	0%	0%	0%	0%
Being in charge of what I watch	5%	12%	8%	13%
Out of habit	21%	9%	13%	29%
A notification from one of my streaming services	5%	0%	0%	0%

Table 3. Participants motivations for streaming throughout the day.
Note. This table only shows responses after streaming took place; respondents were allowed to select multiple motivations. The highlighted percentages indicate the most frequently mentioned motivations.

Suppressing our thoughts

- Streaming oftentimes takes place during another activity:
  - During daytime and when performing household chores.
  - When working from home.
  - While browsing online.

- The background noise (or “white noise”) that streaming creates provides stimulation and focus at the same time.

- People tend to purposefully select simple or familiar content so that they don’t (have to) actively engage with it.

Sometimes I am ironing but then I can just put something on, then I am on my own. – P15

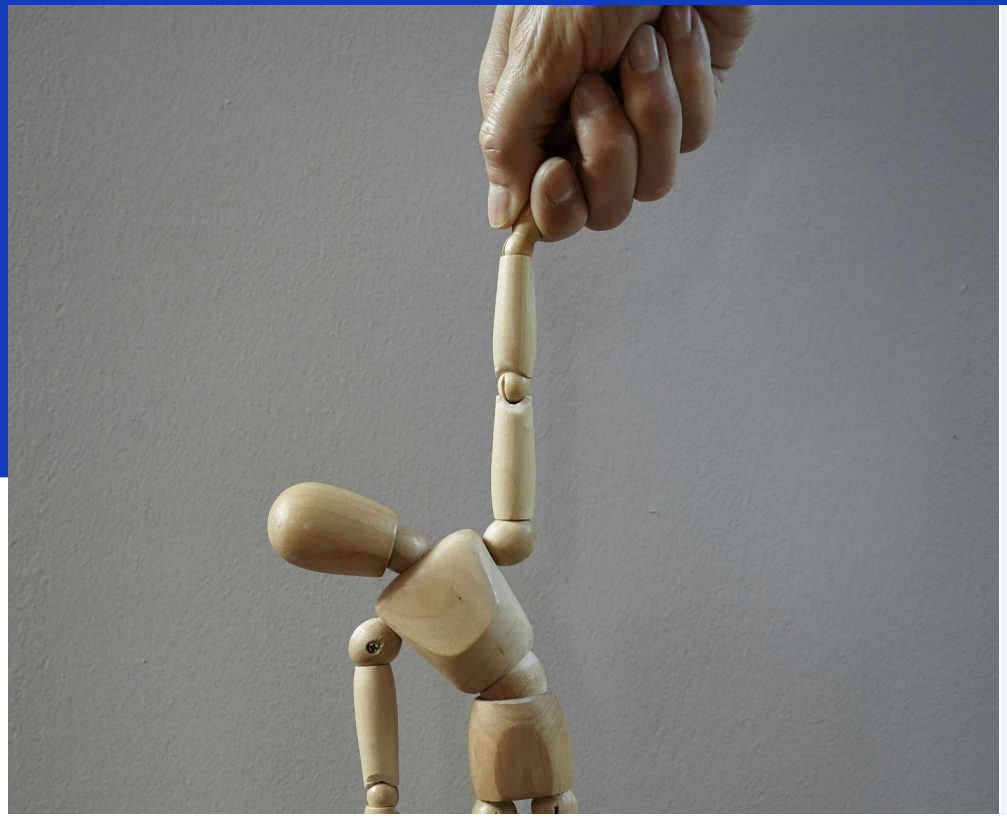
Even during a Teams meeting this morning, then it's so boring and I find myself scrolling again. – P5

~50% of daytime streaming events occur during another activity.

Doing several things at once gives more peace, a kind of distraction, it’s always very busy in my head. – P6

Then I mostly watch Videoland, the easy series where I don't really have to pay attention. Then it's more about the long run of what's happening. It's not that exciting, I shouldn’t be distracted. – P11

3.2. External factors



Conclusions

- Video streaming is always accessible and an easy way to pass spare time.
- Many streaming activities happen on an automatic or a routine basis.
- People feel that their control is taken out of their hands and that they must keep up with societal developments.

Always accessible (1)

There is a huge choice in services and content.

- YouTube, Facebook and WhatsApp are the most popular services, but many different types of services are used throughout the day.
- Sometimes there is so much choice in content that people switch easily between content.
- Accounts can be shared easily, and the costs are so low that it does not matter much how many services participants have.
- Participants that have access to ≥ 3 services (see Table 5).

Social media	13/18
Commercial video on demand platform	9/18
Video calls and conferences	9/18
TV programs from a website or dedicated app	2/18

Table 4. Share of participants with access to more than three streaming services.

We have Netflix, added HBO also recently, Videoland, Disney, the whole bunch. – P6

And I added Netflix. I now have 4 or so. I had Videoland for a long time, and then Disney+ for a few months, and I took NPO Plus for a certain series and then now Netflix. – P17

72% of respondents indicate that they have more than 3 social media platforms.

Well, there is also a lot I haven't seen yet. It's more of a luxury problem that I don't finish some series. – P11

What I also do a lot with my daughter is zapping through series. – P1

I also share them with others. Netflix from the very start, then there was a good offer for Videoland, Prime too, which I had more for deliveries. Sky Showtime too, but I don't use that much. Through family I do get a lot of accounts. – P11

Video streaming throughout the day

Table 5. Overview of video streaming services used throughout the day.
Note. The highlighted percentages indicate the most frequently used services.

	Overall (n = 101)	Morning (n = 19)	Early afternoon (n = 34)	Late afternoon (n = 24)	Evening (n = 24)
YouTube	94%	42%	79%	58%	63%
Vimeo	11%	0%	0%	0%	0%
Facebook	78%	58%	68%	68%	68%
Instagram	78%	58%	53%	37%	47%
LinkedIn	50%	21%	32%	11%	21%
Pinterest	44%	0%	11%	5%	0%
TikTok	33%	0%	0%	5%	0%
Snapchat	22%	0%	0%	0%	0%
Reddit	11%	0%	5%	0%	5%
X	72%	42%	63%	74%	68%
Netflix	72%	32%	53%	63%	53%
Videoland	67%	5%	32%	32%	32%
Amazon Prime Video	44%	0%	0%	0%	0%
Disney+	50%	5%	5%	16%	21%
HBO Max	22%	0%	0%	5%	0%
Viaplay	17%	0%	0%	0%	0%
NPO	67%	32%	58%	53%	47%
NLZIET	11%	0%	11%	11%	5%
Interactive TV	56%	32%	68%	32%	42%
Whatsapp	94%	58%	84%	63%	79%
Telegram	22%	11%	16%	5%	11%
Discord	6%	0%	0%	0%	5%
Zoom	44%	11%	21%	11%	26%
Facetime	44%	21%	26%	16%	11%
Microsoft Teams	50%	26%	42%	16%	26%
PS Now	6%	0%	0%	0%	0%
Xbox Gamepass	6%	5%	0%	0%	5%
Other	Sky Showtime; Pokémon GO; Nintendo Switch	Games apps on phone	9GAG; Rumble; NPO Plus	Ziggo GO; NPO Start	NPO Start

Always accessible (2)

Video streaming is possible all day at any time, making it an easy way to pass time at various moments during the day.

Smartphones are the most used, because they can be used anywhere and anytime.

In general, more (spare) time means more opportunity to stream. Factors related to more (spare) time that seem to indicate an increased use of streaming services are:

- Being alone/single.
- Being unemployed.
- Being sick at home.

Upstairs I really sit for work, downstairs on the couch is more about relaxing. But you can really do it [video streaming] anywhere, sometimes even on the toilet I am still on that thing. Basically, it doesn't matter much where you sit anymore. – P4

78% of respondents indicate that they video stream on their smartphones.

If you're waiting for a while or on the bus, you're back on your phone anyway. – P15

I think maybe, because I'm 47 now and most of my friends do have families, so they just have a different way of spending free time. So, they might have less time in the evening to turn on a series early in the evening. – P16

I think we do use streaming services more than around me. I think that's also because I'm at home myself and most of my friends and nieces all work during the day so they basically can't use this while I can use it. – P10

I'm sitting at home a lot right now due to a strain on my back, so I don't do much other than stream and crochet. – P6

Distraction and deviation from routines

Influenced by lifestyles, personal circumstances and the time of year, streaming behaviour varies greatly.

- People tend to stream less when the weather is good.
- Whereas some people tend to stream less during holidays, other people tend to stream more during holidays.
- On weekends, when people stay at home without any plans, they tend to stream more.

Good weather and holidays so then a lot of going out and doing chores, then less streaming. – P6

On vacation we had no TV and that was really a change, I didn't really miss it either. – P5

One day it is very extreme, because then it is 7, 8 hours, but in the holidays, we are away a lot and then streaming is a lot less. – P10

During the week mainly in the morning and in the evening. And on weekends, I might be more inclined to check my Instagram even during the day as well. And sometimes I also do it when I'm eating a sandwich for lunch or something. – P16

Control is taken out of our hands

People indicate that they often act on autopilot. They are not consciously tracking time (and content). This type of automatic behaviour is more prone to being ‘meaningless’.

- Content is addictive through cliffhangers and ongoing reels.
- Pop-ups are a constant reminder of messages.
- The unlimited data/Wi-Fi access obscures usage.

Participants feel that they must keep up with the societal change.

- Video streaming is often part of someone's job.

I just don't remember which series I watched. So completely useless really, because you can't even remember what you've seen. Then I think ‘gosh, what a shame’, then I don't even remember what I saw. – P12

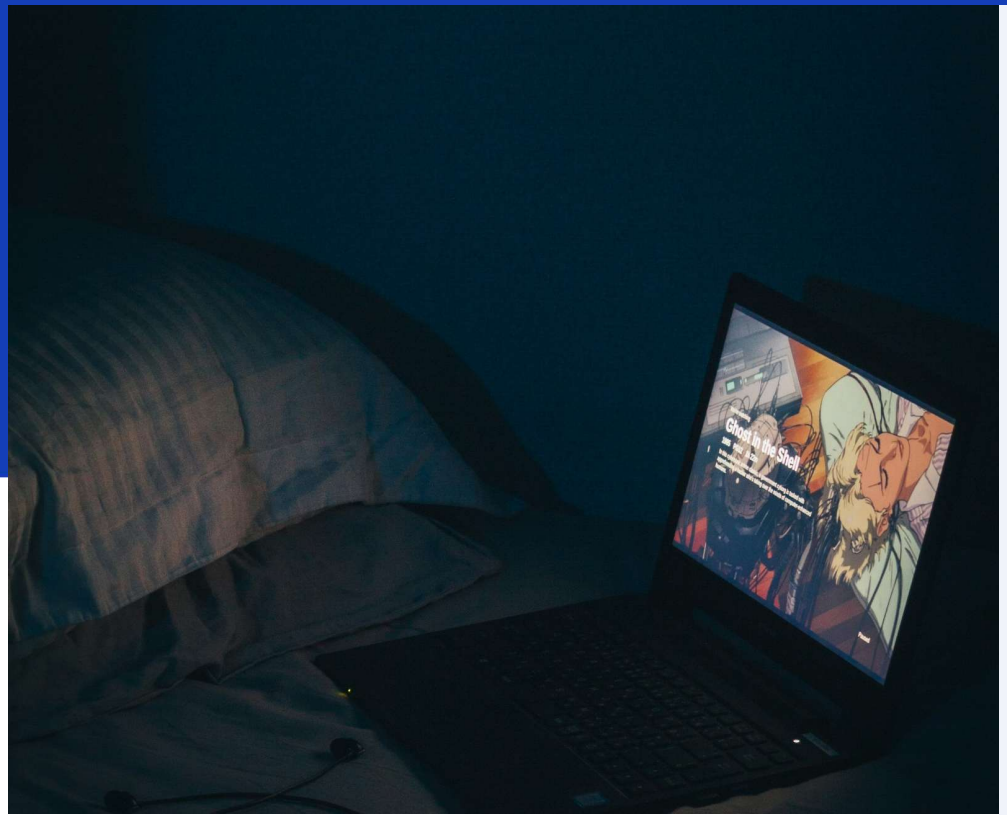
Once you start, you get paralyzed. [...] You are also constantly reminded of posts with all those plings and bleeps and then you start looking anyway. – P1

I have absolutely no idea how much that is. We don't take it into account either. Our subscription is just unlimited. – P7

Soon they will get a laptop for school then maybe they will watch on that. – P5

I work remotely from home a lot so if you include video calling, I'm at 5/6 a day that I'm on one of those screens. – P4

3.3. Internal factors



Conclusions

- People take their freedom in when and how often they video stream, often by themselves.
- People are not good in estimating the data demand for their streaming activities and the amount of time they spend streaming videos.
- Some people struggle with changing their streaming behaviour, some actively resist change.

Streaming at your own convenience

People stream videos mostly on their own, except in the (late) afternoon. Then, they sometimes watch together with their family.

- Streaming alone is often described as taking time for oneself.
- People stream videos whenever it is convenient through on-demand services.
- Grown-ups typically have no agreements on screen time.

In the morning, **84%** of respondents video stream on their own, in the evening that is **71%** and at noon **56%**.

My sister, for instance, has a family with children, so she is constantly on the screen, and my mother, who lives alone at the Veluwe, watches a lot of TV and then selects streaming services. She also has much more time to do that - even during the day. – P14

And watching later on demand, is that streaming too? Yes, we actually do that all the time, because then you can bypass commercials, so just add 4 hours per week. – P17

Poor estimation capability for data demand

There is a lack of awareness and understanding of video streaming habits, whether it is about screen time or data usage.

- Regarding data usage, this may derive from a general lack of knowledge about data (e.g., number of gigabytes used) and its impact.
- In many cases, participants are surprised when confronted with their screen time or data consumption. Insights into usage can help to increase awareness.

People tend to greatly underestimate the time spent on video streaming.

- When making an estimation, people try to add up different activities or episodes.

Knowledge about the potential impact of streaming (e.g., on health, on the environment) varies greatly.

Because I don't understand what they are, those GBs [...]. It doesn't give me any insight into my data usage at all. – P12

Oh oh, that's a lot more. No idea how that's so much more this week. Really can't say. – P15

I do think it's good to see it [amount of streaming] for once, it creates some awareness. – P11

11 participants failed to estimate their daily streaming time at the start of the study by at least one hour, only 4 of which *overestimated* this figure.

I am well aware of impact of data centres. It was in the news, and I work in construction myself. – P2

I am still a newbie in that area, is that harmful too? – P13

It is difficult to change

Many struggle to change their streaming behaviour, as some even claim to be addicted.

- Self-regulation is difficult, especially without any help.
- It is difficult to separate meaningful from meaningless.
- People bypass the self-imposed rules easily as they also need to be flexible. For example, the rules are different on weekends.
- Sometimes the alternative (obligation or leisure activity) is not very appealing.

For some people, without any serious consequences there will not be much change.

- Consequences can be present in the context of work, in upbringing or in social circles (e.g., not getting work done, dissatisfied partners or children).

I am working on it though, and I notice how difficult it is. It really is a kind of addiction; my brain wants to stream videos. – P2

You actually have to very consciously flip the switch. Well, it just doesn't work for me or something. It's very hard for me to push through, honestly. – P7

So that was my inner conflict: when is it actually meaningless or meaningful? – P8

During the week, the children are not allowed to watch that much, on weekends a bit more. Then they are also allowed in the morning, or we sometimes do a movie afternoon. – P5

No clue what else I would do with the time. – P11

I set a screen time once in a while. But yes, you just click those away again. – P7

The stupid thing is, during work I can put them away right away, but privately I do watch it and video stream for a while. – P1

No need for change

Despite earlier concerns, a lot of participants see no need in changing their streaming behaviour or video streaming service(s).

- People tend to question the need to cut back.
- People are unimpressed when confronted with router data.
- People think that others do worse than themselves.
- It seems that rules do not apply anymore as soon as children grow older.

Desired changes in video streaming services:

Nothing	9/18
More offerings	3/18
Less advertising	2/18
Speed	1/18
Less steering	1/18
New streaming service added	1/18
Integration into one platform/subscription	1/18

Table 6. Share of participants with desires for changes in streaming services.

When I look at myself, is that problematic? – P14

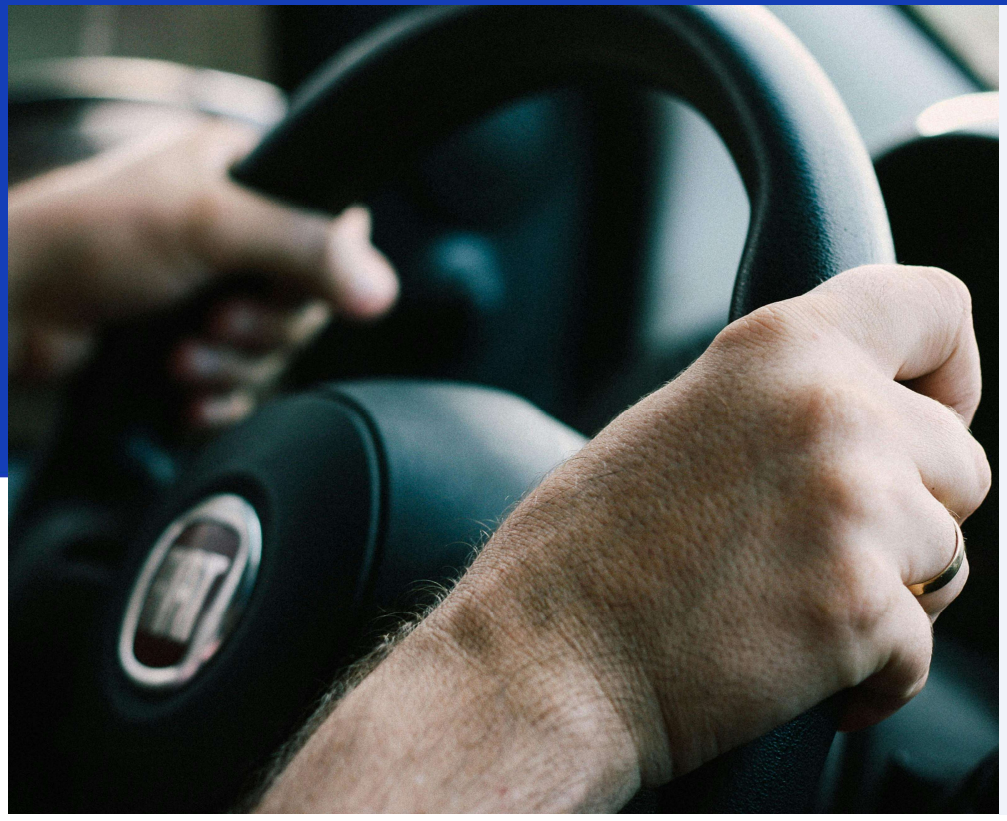
50% of the participants do not want to change the streaming service itself.

There is no need to watch less TV, I enjoy it. – P5

You also hear of many people streaming films. We very rarely do that. We really hardly ever do that. I think that does make a lot of difference to others. People also generally watch a lot of films. They then also have things like Pathé at home, that they can watch films at home. All of us don't really do that either. I think we are modest together. – P8

We did have some stricter control when they were younger through an app where we could control what they could watch. Now we don't do that anymore. – P6

3.4. The road to streaming less



Conclusions

- People care about the impact of their streaming habits and mention various social benefits of streaming less.
- To reduce streaming, new use patterns and more awareness allow participants to get a better grip on their behaviour.
- Besides changes on a product or service level, social structures can be effective in reinforcing changes in behaviour.

Willingness to change

Despite its function as entertainment and moments to relax, video streaming is also regarded as a waste of time by some.

- Especially for streaming late at night or without a purpose.
- Respondents named various alternatives (e.g., reading books, going outside for a walk, do something creative).
- Some action is already being taken by the participants (e.g., by cancelling subscriptions).

Although sustainability is not mentioned, people consider wellbeing, social contact and cost savings as motivators for reduction.

I don't find streaming the most ideal way to spend my time. – P2

I would rather be doing other things, playing sports or going outside with this nice weather. Doing fun things, going into nature, meeting up with friends. – P9

13 respondents indicate that they would be open to reduce streaming in some way.

Recently looked at my statements, I said 'gee did you know Netflix is 19 euros a month!' – P5

It's also better for your eyes, we've seen it with our son. He has glasses due to a lot of screen time. That's what the eye doctor said. – P6

Existing measures (already taken)

Feedback on use

"I also tend to get notifications from my phone myself, I know I need to cut down. I am working on that though."

Screen time

"Screen time for children, but also rules for ourselves, maximum 2 hours a day."

Deleting apps and subscriptions

"In moments of realisation, I then actually want to delete it. I will definitely do that."

Device-free areas

"My phone was always on my bedside table and now I ordered an alarm clock. Now I don't have to put my phone close by anymore."

Dumbphones

"Yes wonderful, when my son is 16 later, he will get a Nokia 3310. Unknowingly, those social media have a great effect on society."

Physical media

"Wanting to be less involved with online, we subscribed to two newspapers."

No cable

"We don't have to watch anything live anymore. We do have a lot of flexibility in that and more control over when you watch."

Gamification

"He really has been offline for 30 days. We did a challenge to see if you have mastered your phone."

Getting a grip on our behaviour

To make a change to current routines, participants state that a deeply embedded rhythm must be broken, such as through significant life events (e.g., moving or changing jobs).

The rhythm needs to be replaced with simple yet rigid new structures:

- Having fixed timeslots for using.
- Never streaming in certain contexts.
- Making alternative activities more attractive.

To give direction to this process, a better understanding of the behaviour in general is key.

- Participants feel there is a need for feedback with concrete figures such as time used.

Covid also played a role for us, then watching really exploded. – P2

We got a new TV cabinet and that is also a moment to reorganise everything. – P5

I have a regular series I watch on Wednesdays, that's when it comes out. I watch those consciously and it feels less bad too. – P2

The only rule we have is no phones at the table during dinner. – P12

I prefer to have it in terms of hours. I can do something with that. Then I can also see it from 'when are your peak hours, the most hours when you watch'. [...] With data like that, it would be better to come up with a plan for yourself to change your streaming usage should I want to. – P12

Social discipline (1)

Streaming is linked to a lot of social aspects and participants are susceptible to the influence of peers, for better and for worse.

The viewing habits of others in the household, family and friends are weighed when deciding when and what to watch.

- People tend to watch what others enjoy too.
- People sometimes watch so they can talk about it.

Social pressure from peers or society could be effective in reducing streaming but can be frustrating too.

- Nobody wants to be the ‘police officer’.
- It helps when it is done in a playful manner.
- It is difficult to follow your own rules.

We also talk about when we will watch what, including the children. Then we can agree on times to watch together at someone's house. And also to continue watching at the same pace so that the children can talk to each other about it when they go to play together. – P9

We stream with the same services but what we adjust to each other. I watch a bit of everything, he has a bit less concentration for things. – P13

Maybe also due to peer pressure, all our friend group is offline then. – P15

Oh, you consume more! – P4

In the end, you manage it yourself and then you are stricter to the children than to yourself. You make your own rule and that's tricky, do you really stand by it or do you do it for someone else? Who punishes me if I break the rule? – P15

Social discipline (2)

The upbringing of children is an important motivation for parents to reduce screen time:

- Parents try not to stream in their vicinity.
- Setting rules for children makes parents more aware.
- Parents want to set an example.

Parents learn from each other but also criticize those they disagree with their own point of view.

Streaming habits can carry over between generations but in general younger generations are perceived to stream in more problematic ways.

Sometimes when my daughter comes in, I quickly pretend I am doing something else, so she doesn't see that I am on my phone. You want to set a good example, having a child does create more awareness. – P1

I know it's a kind of addiction; it creeps into a corner. I'm working on it, especially for the kids. So, they don't have to sit in front of the TV. – P9

With that son of my friend, you can clearly see a difference in parenting, with the mother he gets much more screen time. – P13

Don't think much of it, but I do worry about the youth growing up with it now. That it is going to cause bad eyes, crooked backs and that they are going to suffer from that. – P13

4. Implications

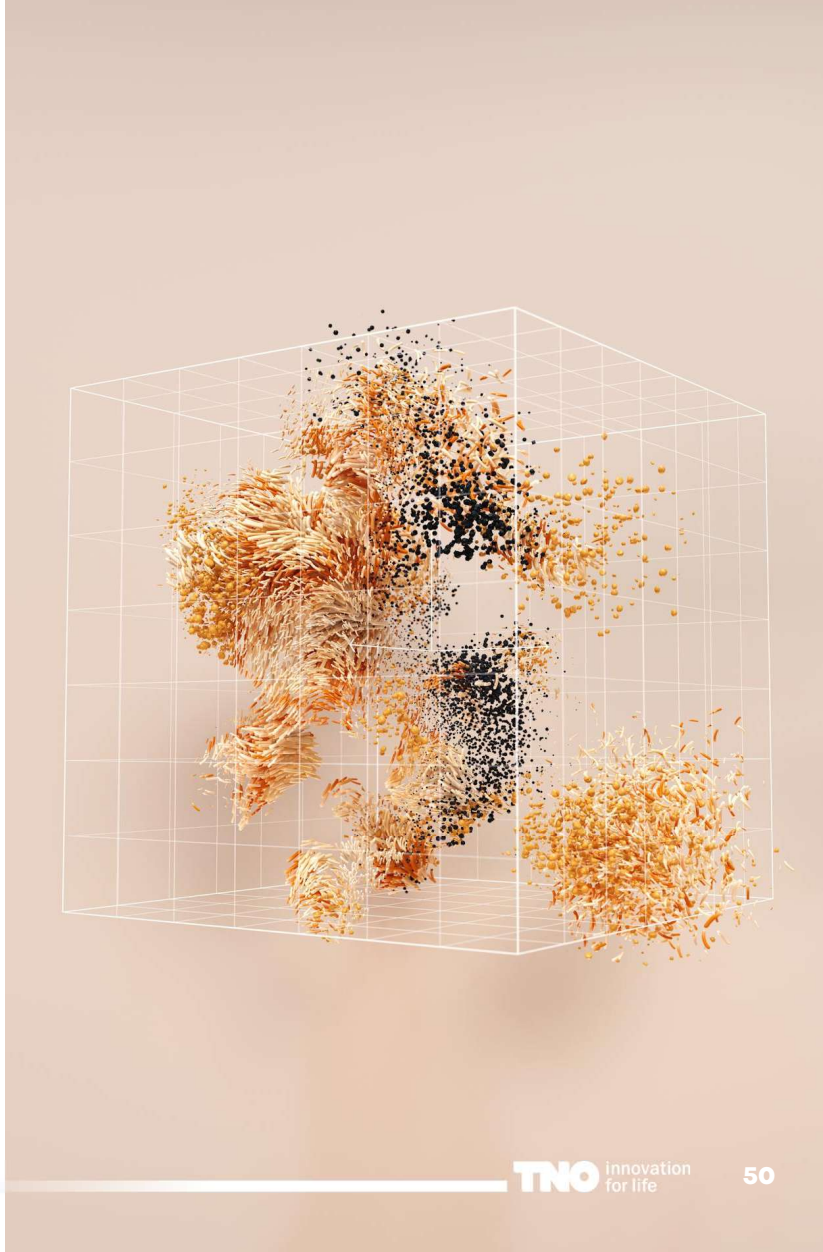
Discussion

- The present study aimed to
  - identify possibly undesirable forms of video streaming behaviour and its determinants.
  - provide a perspective to concretize the digital sufficiency paradigm into new research and development areas, empowering consumers to align their video streaming behaviour with personal ambitions and societal values.
- The findings show how video streaming behaviour is currently driven by motivations of entertainment, autonomy and social norms. This behaviour negatively influence social relationships and well-being and provide only limited autonomy in practice through the unconscious nature of automated (dark) patterns.
- Intentions to reduce streaming and to limit its negative impacts are alternated with dismissal. Behavioural change is proving extremely difficult to sustain, partly due to a lack of normative feedback and support from peers.
- In the following, we address two key solution directions for further research aimed at enabling sufficient video streaming.

Implications (1)

ICT for sufficiency

- Applying behavioural insights into the design of digital services provides perspective for ‘bright patterns’ (design practices prioritizing user goals and well-being, making users do things that they meant to do) as opposed to dark patterns.
- On top of providing moments of reflection and obstructions in use, bright patterns should be introduced at small life events, such as the purchase of new devices or the (de)installation of software.
- Instead of fewer suggestions, users need better predictions for suitable content based on their motivations that help users navigate vast amounts of available content.
- Such ‘social’ recommendation algorithms should promote eudaimonic experiences such as enrichment and social relationships, while acknowledging the need for hedonic experiences like relaxation and enjoyment.
- Resulting suggestions should consider sustainable alternatives for devices and settings (e.g., switching off visual components to save energy) while still matching streaming intentions.



Implications (2)

Mobilising social control

- Another angle for moderating streaming behaviour is found in the introduction of normative feedback or cues in social contexts.
- Right now, many streaming behaviours are performed individually and therefore in a ‘social vacuum’ with little tangible feedback and few immediate consequences.
- Therefore, social contexts can install prospects of guilt by continuing without a ‘viewing buddy’ or a sense of fear for scrutiny by peers if viewing excessively.
- Households and schools are primary examples of social circles in which social control could be established (as is the case with the recent ban of smartphones in many Dutch schools). To avoid tensions, this should be done with respect for ones’ privacy and by encouraging positive interactions.
- Services could further encourage social control by enabling watch parties or allowing algorithms to combine user preferences into suggestions for shared viewing.

Limitations of this research

- Router monitoring did not capture all activities as the router is limited to in-house streaming and respondents failed to connect all their devices, especially Chromecasts proved an issue.
- Daily surveys were not evenly distributed across different moments of the day, resulting in a seemingly high amount of activity in the afternoons whereas evenings were most popular for video streaming.
- The study ran during summertime, leading to different results then were it to be executed during other seasons.
- The sample is limited in number and diversity, mainly excluding younger generations (< 30 years) and including a larger portion of women (66%) as opposed to men.
- Due to time and budget constraints, the current study limits its scope to viewing platforms and contexts, not investigating the content of the videos viewed or games played.

Outlook: emerging focus areas for follow-up research

- Future research could explore:
  - larger, quantitative studies aimed at identifying personality traits and demographic factors that influence streaming behaviour by including more representative samples of the population.
  - The effect of information provision and creating awareness on unsustainable streaming behaviours and their adverse effects could be investigated.
  - The decision-making process for streaming alternatives (how do people choose and what are their considerations?) and their sustainability impact.
  - The content of video material is another promising avenue for research that aims to better understand the needs of users across various contexts.
- We propose that these research efforts are part of a larger focus on the development of more social and personalized algorithms and communal viewing practices using less screens.

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