

# The gendered division of cognitive household labour and mental load in the digital space

## Using web tracking data to estimate cognitive household labour

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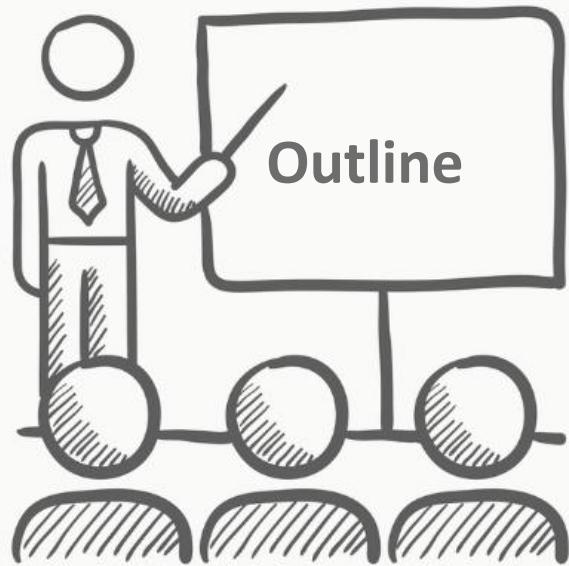
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Workshop II - 'Linking Digital Footprint and Survey Data for Open Research'

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## Background

- Cognitive HH labour
  - The importance
  - The problems



## Our research

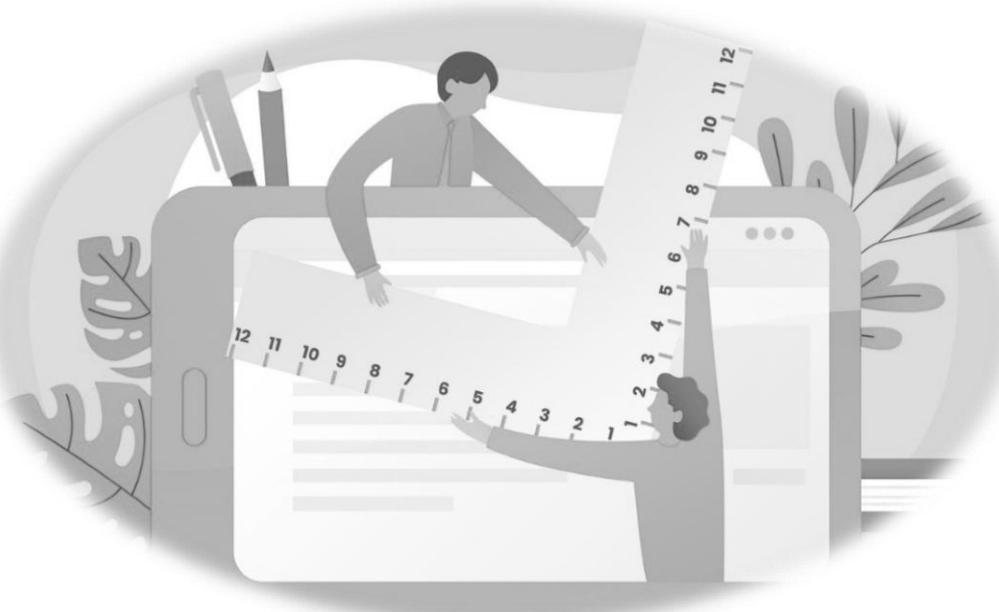
- First steps: Classifying & validating URLs/domains
- Next steps: Improving classifications, estimating gendered division of cognitive HH labour

# Cognitive household labour – the importance



- ❖ Managing and organizing a household, includes:
  - managing the household budget
  - planning family activities
  - anticipating needs
  - delegating assignments
  - identifying and choosing among options
  - monitoring outcomes
- ❖ Important & underappreciated mechanism underlying gender inequality within families and labour market
  - Previous research suggests women do most of it
- ❖ Rarely talked about, acknowledged or outsourced → high burden for women, stress, work-related adverse outcomes ...

# Cognitive household labour – the (measurement) problems



## *Lack of comprehensive & reliable measures:*

- ❖ Existing empirical evidence limited
  - Based on non-random small samples that are geographically homogenous and US-based
  - Focuses on very specific kinds, like financial decision-making or household management
  
- ❖ Survey measures potentially problematic
  - Difficult for respondents to report reliably, especially small tasks



**Using web tracking data (URLs/domains) to estimate cognitive household labour load and the gendered division of cognitive household labour**

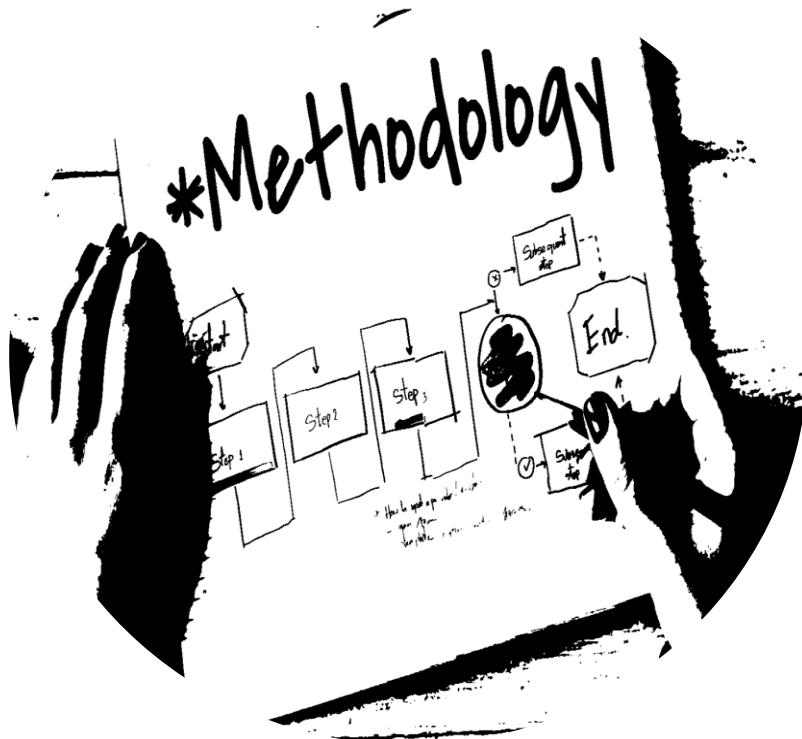
- **Validating measures obtained with equivalent survey measures**
- Predicting related survey measures (stress, family-work conflict etc.)
- Combining survey and digital trace measures to correct for error using latent variable modelling techniques



## GESIS Panel.dbd Digital Behavioral Data Sample

- $N \approx 700$
- *Cross-sectional survey - July 2025*
- *Web tracking data (browser plugin installed on desktop computers and laptops) - June to October 2025*

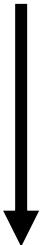
# Deriving measures of cognitive HH labour from web tracking data



- **Step I:** Establishing a typology of websites that includes *relevant* categories
- **Step II:** Classifying URLs/domains in accordance with established typology
- **Step III:** Estimating load of cognitive HH labour
  - frequency and proportion of relevant website type visits
- **Step IV:** Validating the obtained digital measures with equivalent survey measures

Step 1: Establishing a typology of websites

**Using an LLM in combination with existing theories and literature**



Asking chatGPT to come up with a classification that also includes categories relevant for cognitive HH labor, given the definition provided in Haupt and Gelbgiser (2024)<sup>1</sup>

<sup>1</sup> Haupt, A., & Gelbgiser, D. (2024). The gendered division of cognitive household labor, mental load, and family–work conflict in European countries. *European Societies*, 26(3), 828-854.

# Step 1: Establishing a typology of websites

## The (very long and detailed...) prompt:

*I need to classify web tracking data that consists of URLs and domains (if the URLs are not available) into approx. 15 broad categories. The classification is needed to approximate the load cognitive household labour. So, the list of categories should also include some that are relevant for cognitive household labour. Could you come up with an exhaustive list of categories including those relevant for cognitive household labour in line with the way the upload article defines cognitive household labour. Specifically, use the following explanation from the article: "Cognitive household labour refers to a host of mental tasks that are distinct from physical or emotional tasks. One of the most clearly articulated definitions of cognitive labour is that offered by Daminger (2019), who draws on in-depth interviews with upper-middle-class couples in the Boston area. She outlines four types of cognitive household task: (1) anticipation, which includes recognizing an upcoming need or problem; (2) identification, which refers to researching and determining the options for meeting the upcoming need; (3) decisions, which include considering and choosing among options; and (4) monitoring, which includes supervising the execution of decisions and ensuring they sufficiently address the need. In parallel work, Robertson et al. (2019) outline six types of cognitive labour: (1) planning and strategizing; (2) monitoring and anticipating needs; (3) meta-parenting; (4) knowing; (5) managerial thinking; and (6) self-regulating. Although some of these dimensions overlap with those outlined by Daminger (2019), they include additional tasks, such as 'constant learning' and 'remembering', as (taxing) kinds of cognitive labour, as well as 'making contingency plans', 'delegating work', and 'reflecting and debating parenting decisions and styles'. Cognitive labour generally takes two forms: it can be directly associated with specific physical, social, and emotional tasks as a cognitive 'over-head'. Consider, for example, the cognitive labour associated with a family trip. The organization of the trip involves anticipating the needs and limitations of all participants, identifying potential destinations and activities to include in the trip, deciding among options, delegating tasks to other family members, and monitoring the results. Often, while all family members engage in the physical and social task of going on the trip, the cognitive task of organizing the trip is carried out by one person. Alternatively, cognitive labour can also be a task of its own. Consider the task of financial decision-making and budget planning, for instance, which involves substantial planning, strategizing, research, and monitoring – all without an actual physical event in view."*

# Step 1: Establishing a typology of websites - classification

## Cognitive Household Labor (Core Categories)

(Mental load: planning, anticipation, decision-making, monitoring)

### 1. Household Planning & Coordination

**Domains:** familienkalender.de · google.com/calendar · todoist.com · trello.com · doodle.com · notion.so

**Activities:** Scheduling family events · Coordinating responsibilities · Remembering deadlines

### 2. Financial Management & Budgeting

**Domains:** sparkasse.de · volksbank.de · commerzbank.de · ing.de · finanzamt.de · elster.de · check24.de · verivox.de

**Activities:** Budget planning · Bills, taxes & insurance · Comparing financial products

### 3. Purchasing Decisions & Comparison

**Domains:** amazon.de · otto.de · idealo.de · geizhals.de · billiger.de · testberichte.de · stiftung-warentest.de

**Activities:** Researching purchases · Price/quality comparison · Decision-making

### 4. Child-Related Cognitive Labor (Meta-parenting)

**Domains:** kita-portal.de · schulportal.de · eltern.de · familienhandbuch.de · kindergesundheit-info.de · jugendamt.de

**Activities:** School/Kita coordination · Child development research · Anticipating children's needs

### 5. Health & Care Management

**Domains:** tk.de · aok.de · barmer.de · doctolib.de · jameda.de · apotheken-umschau.de · gesund.bund.de

**Activities:** Appointment management · Treatment research · Health monitoring

### 6. Food Planning & Household Provisioning

**Domains:** chefkoch.de · eatbetter.de · rewe.de · edeka.de · kaufland.de · bringmeister.de · hellofresh.de

**Activities:** Meal planning · Grocery planning · Anticipating household needs

### 7. Travel & Leisure Planning

**Domains:** bahn.de · booking.com · check24.de/reisen · holidaycheck.de · airbnb.de · familienurlaub-info.de

**Activities:** Trip planning · Destination comparison · Logistics coordination

### 8. Household Administration & Services

**Domains:** stadtwerke.de · immobilien scout24.de · meinestadt.de · myhammer.de · verivox.de/energie · umziehen.de

**Activities:** Utilities management · Repairs & services · Housing administration

# Step 1: Establishing a typology of websites - classification

## Non-Household / Control Categories

*(Used to distinguish cognitive household labor from general web activity)*

### 9. Paid Work & Professional Activities

xing.com · linkedin.com · datev.de · office.com · slack.com · teams.microsoft.com

### 10. Education & Self-Development

vhs.de · coursera.org · udemy.com · open.hpi.de · studyflix.de

### 11. News & Information Consumption

spiegel.de · zeit.de · sueddeutsche.de · tagesschau.de · faz.net

### 12. Social Communication

whatsapp.com · facebook.com · instagram.com · signal.org · telegram.org

### 13. Entertainment & Leisure

netflix.com · ardmediathek.de · zdf.de · spotify.com · youtube.com

### 14. Personal Administration (Individual-Level)

krankenkasse.de (personal sections) · mein-elster.de · paypal.com · klarna.com

### 15. Technical / Infrastructure / Uncategorized

google.com · apple.com · microsoft.com · cloudflare.com · amazonaws.com

## Step II: Classifying URLs/domains in accordance with established typology

- Using a locally hosted LLM (deepseek-R1 on the Surf Research Cloud) to classify a sample of URLs/domains (100 randomly selected panelists; tracking data from July 8 to 15, 2025)
- Prompts:
  - I. Prompt for chatGPT to generate a deepseek prompt (let's skip this for now..)
  - II. Prompt generated by chatGPT used in deepseek

# Step 11: Classifying URLs/domains in accordance with established typology

## Deepseek prompt (Python code):

"""

You are performing a deterministic classification task.

At the end of this prompt is a Python dictionary object representing a single web-browsing record.

TASK:

1. Read the value of "domain\_url".
2. If "domain\_url" is missing or empty, use the value of "host" instead.
3. Classify the URL/domain into EXACTLY ONE of the classes listed below.
4. Return the ORIGINAL dictionary object, unchanged EXCEPT for the addition of ONE new key:
  - key name: "class"
  - value: the class you selected (string, must match exactly).

IMPORTANT OUTPUT RULES:

- Return ONLY a valid Python dictionary.
- Do NOT add, remove, rename, or reorder any existing keys.
- Do NOT include explanations, comments, or extra text.
- The value of "class" MUST be one of the allowed class labels listed below.

ALLOWED CLASSES (with German example domains):

1. "Household Planning & Coordination"

Examples: familienkalender.de, google.com/calendar, todoist.com, trello.com, doodle.com

[...]

15. "Technical / Infrastructure / Uncategorized"

Examples: google.com, apple.com, microsoft.com, cloudflare.com, amazonaws.com

CLASSIFICATION GUIDELINES:

- Classify based on the PRIMARY purpose of the domain.
- If multiple classes seem plausible, choose the ONE that best reflects cognitive planning, coordination, or monitoring at the household level.
- If the domain is purely technical, generic, or cannot be meaningfully assigned, use "Technical / Infrastructure / Uncategorized".

Here is the dictionary object to classify:

{d}

"""



# Step II: Classifying URLs/domains in accordance with established typology

## The deepseek classification:

- <1% (n = 203) of web visits not classified due to invalid output format (not a valid dictionary object)
- The model made up three categories (in addition to the 15 pre-defined ones)
  - Financial (1 web visit)
  - Search Engine (1 web visit)
  - Shopping (1 web visit)
- <1% (n = 280) had an invalid panelist ID (the model hallucinated the ID during the classification)
- All these web visits were dropped from the analysis
- Total number of web visits classified = 32996

# Step III: Estimating load of cognitive HH labour

- Frequencies and proportions of visits in one week for (ir)relevant categories:

Website category	Mean number of visits in one week	Proportion of visits in one week
Relevant to cognitive HH labour (cat. 1 to 8)	61	18%
Irrelevant to cognitive HH labour (cat. 9 to 15)	269	82%

# Step III: Estimating load of cognitive HH labour

- Breakdown of frequencies and portions by (i) gender:

Website category	Mean number of visits in one week		Proportion of visits in one week	
	Men	Women	Men	Women
Relevant to cognitive HH labour (cat. 1 to 8)	69	41	15%	26%
Irrelevant to cognitive HH labour (cat. 9 to 15)	329	129	85%	74%

# Step III: Estimating load of cognitive HH labour

- Breakdown of frequencies and portions by (ii) households with children:

Website category	Mean number of visits in one week		Proportion of visits in one week	
	No children	Has children	No children	Has children
Relevant to cognitive HH labour (cat. 1 to 8)	39	77	15.5%	20%
Irrelevant to cognitive HH labour (cat. 9 to 15)	258	278	84.5%	80%

## Step VI: validating the obtained digital measures with equivalent survey measures

- Correlating obtained frequencies and proportions with survey measures:
  - Not possible with current sub-sample of 100 panelists ...



## *Results & findings*

-  Very preliminary!
-  Some evidence that the classification \*might\* be working
-  Further validation requires a larger sub-sample



## *Next steps*

- Run current analysis on a larger sub-sample of the data (more panelists and longer time period)
- Try different LLMs, different prompts → Different categorizations and classifications
- Manually validate classifications
- Calculate (aggregate) measures of gendered division of cognitive HH labour and compare the survey and digital measures
- Use HMMs to combine survey and digital measures while assuming both have errors and obtain error-corrected measures of cognitive HH labour
- ....
- Obtain WhatsApp data (conversations between partners) and use it to estimate gendered division of cognitive HH labour within HHs

 Data provided by GESIS

 Illustrations taken from freepik.com and 123rf.com

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you!*

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