Literature overview on maintenance of behaviour change

Task 1.3 of Let's make it easier being green

April 2024, Machiel Reinders & René de Wijk

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Report 2556, Final Version

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Overall project goal

To select, develop and test behavioural change interventions to move consumers towards pro-environmental behaviours.

➢ To develop effective and feasible interventions that are accepted in real-life situations and consistently reduce water usage and food waste in households.

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1-4-2023 to 31-3-2026
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Project structure: overview of workpackages

Aim: To select, develop and test behavioural change interventions to move consumers towards pro-environmental behaviours.

WP1: Overview of current knowledge

Insights from literature and research methodology

WP2: Select or develop measurement methods

WP 3: Water Use Case:

testing interventions in practice

WP 4: Food Waste Case:

testing interventions in practice

WP 5: Project coordination & dissemination:

Project communication and exchange of generic learnings from both cases

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WP1 – Activities & partners

WP1: Overview of current knowledge Insights from literature and research methodology	
Activities	1.1 **Literature and practice scan on promising consumer household water reduction interventions** including scan of existing initiatives, ways to measure water use and other activities from the water utility companies (interviews with 'case owners' from the different companies). 1.2 **Literature scan about latest insights on household interventions to reduce food waste** including mapping of outcome measures to assess effectiveness, acceptance and feasibility.
	1.3 **Review literature on maintenance of behaviour change**: habit formation, reward & reinforcement and scope relevant models and theories for food waste reduction behaviours.
Partners	WR, KWR, Unilever in lead with support of PWN, WML, TGTG
Timing	April 2023 – December 2023

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WP1: Overview of current knowledge.
Insights from literature and research methodology

1.3 Review literature on maintenance of behaviour change

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Introduction – Objective and Reading guide

- The literature scan, presented in Part I of this deliverable, aims to provide an overview of the latest insights on habit formation and long-term behaviour change.
- The scan conducted is meant to scope theories and models relevant to the project, not meant to be a systematic literature review. Stated differently, this deliverable provides a concise overview of what has been found in the literature and is not intended as a detailed reference work on all existing literature.
- In addition to the literature scan, we briefly looked into the operant conditioning literature, which is presented in Part II of this deliverable.
    - NB. This part was added, as literature on operant conditioning (which can be defined as a learning process where voluntary behaviours are modified by association with the addition (or removal) of reward) may provide additional insights into how rewards can be used to modify behaviour.
- Finally, the insights from the literature are applied to respectively the water use case (Part III) and food waste case (Part IV).

Part I: Literature scan

Method - Determine search terms

- Three criteria were used to define the search query to identify studies in the scientific literature:
    1. The study should focus on behaviour change or habit formation;
    2. The study should focus on maintaining the behaviour change on the long-term;
    3. The study design should be an intervention (experiment).
- For each criterion, search terms consisting of several keywords were combined into a query.
- Limited to publications of the last 10 years
- A query was specified in the syntax of Scopus.
- The search was carried out on July 13, 2023.
- The search resulted in **277 articles**

Method - Search query Scopus

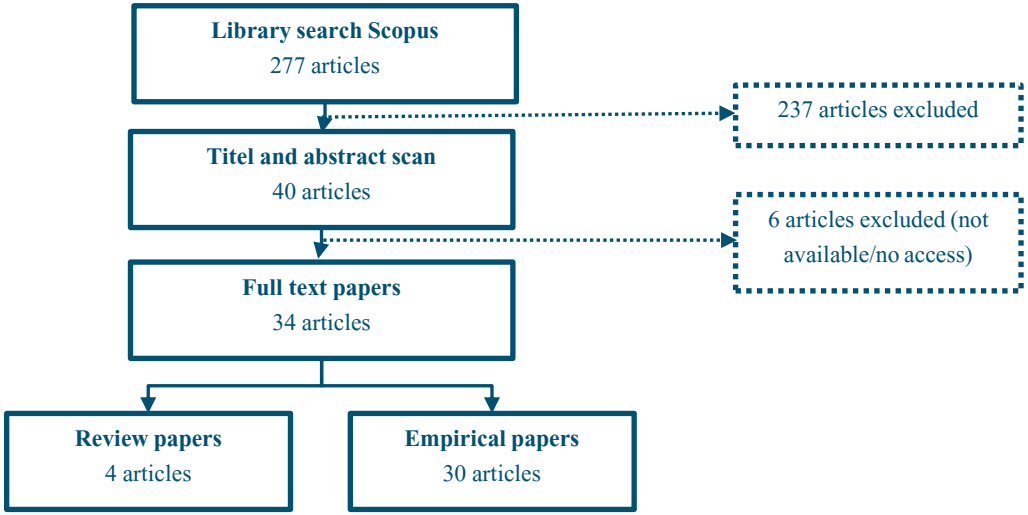
Search query Scopus:

```
SUBJAREA ( psyc )
TITLE-ABS-KEY ( (( behavio* W/3 chang* ) W/3 ( long-term OR lasting OR sustained OR maintain* OR maintenan* ) ))
OR
TITLE-ABS-KEY ((change OR formation OR discontinuity) W/3 habit) AND
TITLE-ABS-KEY ( ( intervention* OR strateg* OR tool* OR technique* OR experiment* ) )
AND
PUBYEAR > 2012
AND
( LIMIT-TO ( SUBJAREA,"SOCI" ) OR LIMIT-TO ( SUBJAREA,"PSYC" ) OR EXCLUDE ( SUBJAREA,"MEDI" ) )
AND
( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"ch" ) OR LIMIT-TO ( DOCTYPE,"re" ) )
AND
( LIMIT-TO ( LANGUAGE,"English" ) OR LIMIT-TO ( LANGUAGE,"Dutch" ) )
```

Result: **277 articles**

Flow chart for the selection of relevant papers

- The flow chart below provides an overview of how the articles were selected:
  - Articles were first screened on title and abstract, based on a list with eligibility criteria for inclusion/exclusion (see next slide).
  - Next, full papers of the relevant (to be included) abstracts were retrieved.



Method – First round article screening

- Screening on title/abstract: this resulted in 40 relevant articles.
- Articles were screened based on the following inclusion/ exclusion criteria:
    - Relevant reviews or conceptual papers
    - Empirical papers which consider long-term behaviour (> 3 months)
    - Human studies, but no clinical studies
    - Target group: general population (no specific target groups like patient groups, elderly, children, etcetera)
    - Excluded: papers with specific target behaviours from unrelated topics that are too far away from water conservation or food waste reduction (e.g., creating new learning habits in preparing for exams)

Method - Retrieving full papers for inclusion

- Retrieving full-text papers of the 40 included articles:
  - 5 articles were not available and for 1 book chapter we did not have access
- This resulted in 34 remaining articles, containing 4 reviews/ conceptual papers and 30 empirical papers
  - We used the 4 reviews (and conceptual papers) as *key papers*, i.e., starting point for describing the results of the literature review (*see slides 15 to 22*)
  - The remaining 30 articles are used to identify the factors for successful long-term behaviour change (*see slides 23 to 26*)
- Next slides describe the results of the literature review, to begin with the 4 *key papers*.

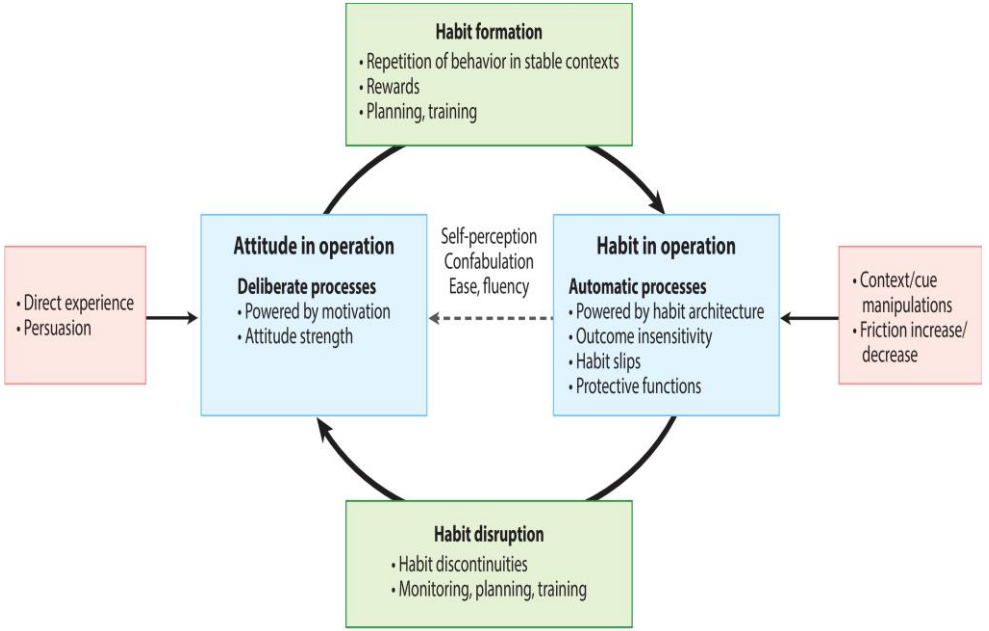
Results - 'Habit formation' is not the only way to accomplish long-term behaviour change

Volpp & Loewenstein (2020) – This paper argues that besides 'classic habit formation' (i.e., automatically activated behaviours formed through repetition and learned stimulus–response associations) there are also other mechanisms that can lead to persistence of behavior and provides eight alternatives as explaining mechanisms for sustained behaviour change.

1. **Learning**: people find it rewarding to engage in activities they are skilled at
2. **Information acquisition**: getting to know more about a certain behaviour
3. **Status quo bias**: over-weighting the perceived losses of switching back to old routines
4. **'Taste discovery'**: learning about one's own preferences
5. **Technology**: acquiring goods or expertise that reduce the costs and/or increase the benefits of a new behavior
6. **'Commitment contracts'** with oneself
7. **Social norms**: behavior of other people, can affect a focal individual's behavior either through changes in norms or via network effects
8. **Changes in choice environments** that could either work for or against the desired behavior change

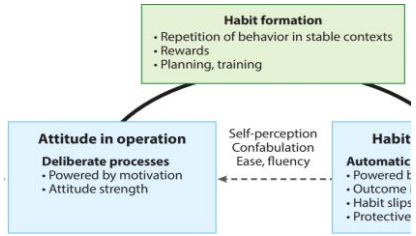
Results - The relationship between attitude and habit

- Verplanken & Orbell (2022) provide an overview of the relationships between attitudes, habits and behaviour change
- Attitudes and attitude change are an important starting point for the formation of habits. The role of attitudes is attenuated when habits are in operation, but as soon habits are disrupted, new opportunities arise for attitudes to create new habits.
- This circular process is shown in the figure (Figure 1 of Verplanken & Orbell, 2022, p. 332).



Results - From attitude to habit

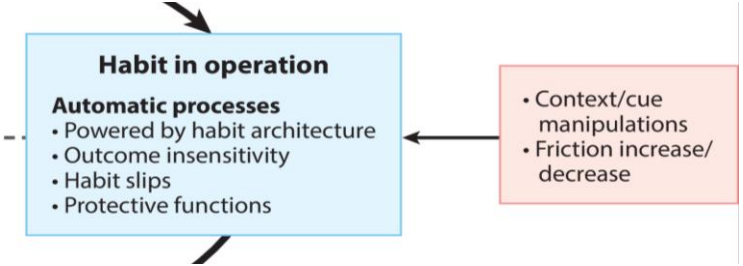
(Verplanken & Orbell, 2022)



- (Strong) attitudes and motivation can be an important starting point for structural behaviour change/ habit formation.
    - Note: Mind the **Attitude-behaviour gap,** i.e., circumstances in which attitudes' influence on new target behaviour is attenuated because existing behaviour is controlled by alternative mechanisms (e.g., existing habits, automatic impulses, environmental cues).
- Frequency/repetition, reward and context stability are positively associated with habit formation, complexity shows a negative association.
    - **Extrinsic rewards** (e.g., financial incentives or social approval): especially effective in initially inciting action (setting dopamine systems in action).
    - **Intrinsic rewards**: tap into the self-concept (personal values) or make behaviour easier.
- Supplement positive attitudes with deliberate self-regulation strategies such as planning to act in specific cue contexts (e.g., implementation intentions: "When encountering cue X, I will do Y").

Results - Habit architecture

(Verplanken & Orbell, 2022)



- **Context cues**: Effective habit development necessitates the repetition of actions in relation to context cues that naturally and reliably occur with an appropriate frequency: "Piggybacking on existing daily routines"
- **Increase friction** for a less desired course of action by making it seem more difficult or to **reduce friction** for a more desired course of action by making it seem simpler, more readily available, or the default course of action
- Concept of **'self-nudging'**: re-structuring the own environment in a way that is congruent with own goals
    - Reijula & Hertwig (2022): Self-nudging and the citizen choice architect
    - Van Rookhuijzen et al (2023): When nudgees become nudgers: Exploring the use of self-nudging to promote fruit intake

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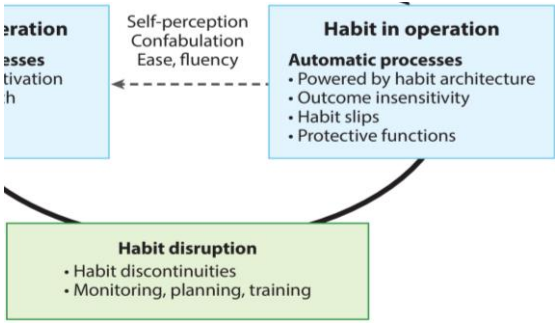
Results - Disruption of bad habits

(Verplanken & Orbell, 2022)

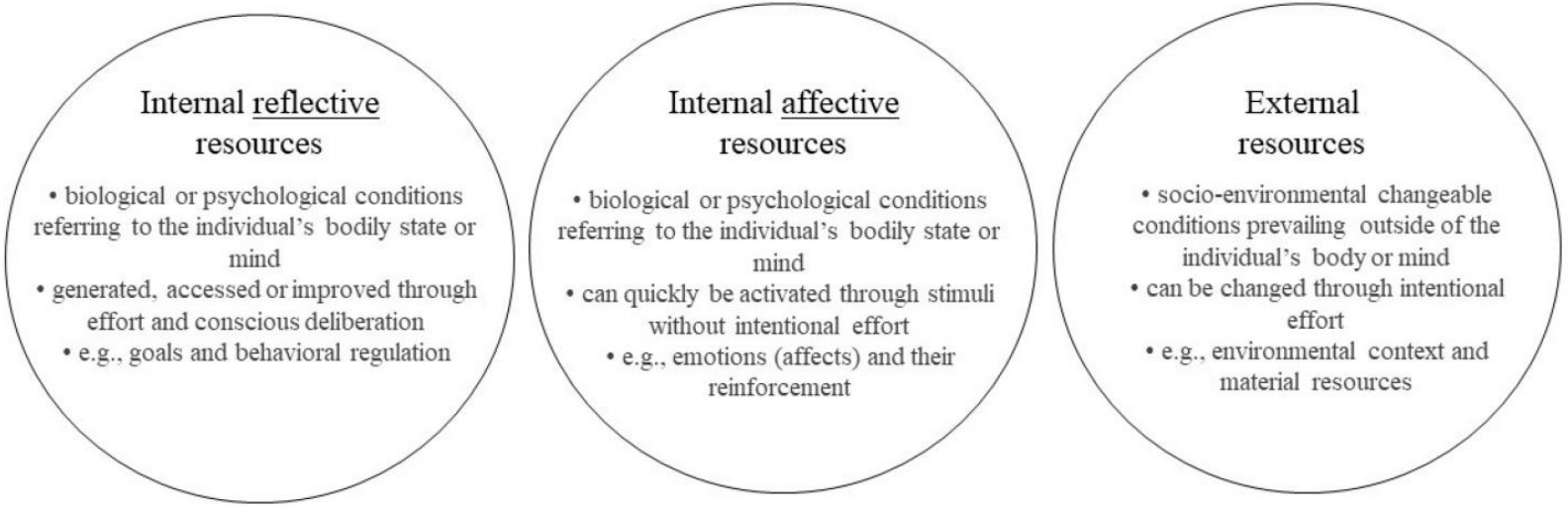


- **Vigilant monitoring**: be alert, monitoring the 'bad' habits and the circumstances of its occurrence (e.g., monitor the cues that trigger a nervous habit such as nail biting), and effortfully try to inhibit its performance
- **Planning to change**: plan a reaction to the cue other than the unwanted habit response, e.g., plan to grab a fruit when starting to feel hungry instead of a candy
- **Replace an undesirable habit with a new desirable habit**: e.g., replace throwing waste paper in the garbage with recycling the paper
- **Context disruption** (e.g., change of job, retirement, marriage) (see also Whitmarsh et al., 2021)
  → may initiate a shift to deliberate processing and a more open mindset, contrary to the tunnel vision mindset that characterizes strong habits

Results - Michaelsen & Esch (2022): Understanding behaviour change

The authors distinguish three critical resource clusters relevant to behavior change:

1) reflective internal processes in the brain (accessed through effort and conscious deliberation)
2) affective internal processes in the brain (automatically activated through stimuli without intention effort)
3) external resources (socio-environmental), such as environmental context and material resources



Results - Michaelsen & Esch (2022): Understanding behaviour change

The three behaviour change resources (internal reflective, internal affective, external) allows constructing three types of behaviour change options:

Facilitating: by means of resources in the environment

- *Adding objects to the physical environment, financial gifts, restructuring physical environment, providing social support*.

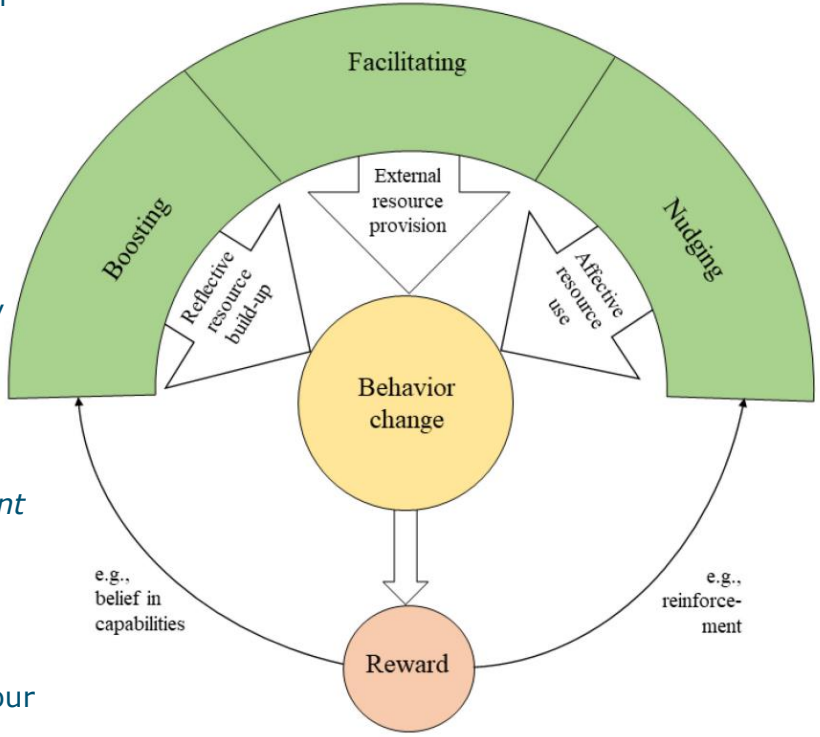
Boosting: developing or strengthening internal cognitive capacity

- *Self-monitoring of behavior, education, and counseling.*

Nudging: using stimuli or triggers in the environment to (unconsciously) stimulate behaviour

- *Specific presentation styles, reminders or reinforcement learning strategies, lotteries, and gamification*

The 3 behaviour change resources lead to the initiation or maintenance of a new behavior, and a reward in form of positive affect is generated. In turn, this reward can then improve behaviour change resources (e.g., as reinforcement of behaviour or belief in capabilities).



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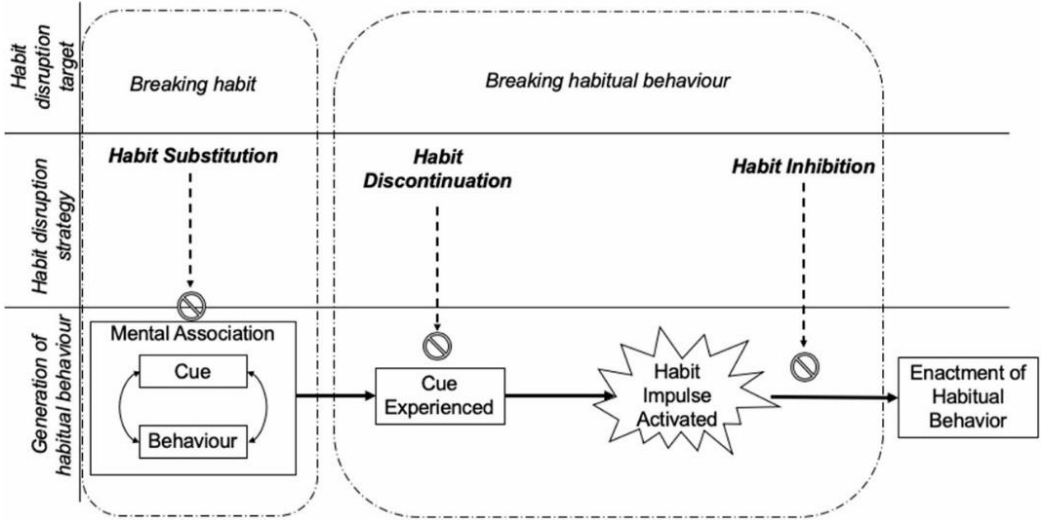
Results - Breaking habits versus breaking habitual behaviour

Gardner et al., 2021 make a distinction between:

1. Intervention strategies focused on breaking habitual behaviour
   - *Frustrating the expression of habit impulses in action (habit inhibition)*
   - *Preventing the activation of habitual responses by modifying exposure to associated contexts (habit discontinuation)*
2. Strategies focused on changing underlying habit associations
   - *Unlearning undesired associations or forming new, competing associations*



Even where habitual behaviour has been discontinued, underlying habit associations can remain, and retain the potential to elicit unwanted behaviour in future, thereby undermining the desired behaviour change over the longer term.

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Results - Factors for successful long-term behavioral change (1)

Next to the insights from key papers, which were described in the previous slides, the articles in the literature review provide insight into which factors play a role in successful long-term behavioural change.

These are summarized on the following slides.

Results - Factors for successful long-term behavioral change (2)

General observations:

- Individual's environmental concerns/ attitudes are not sufficient to trigger a permanent behavioural change.
- There is not one single mechanism to achieve successful long-term behavioral change.
- There are individual differences in the ability to achieve long-term behavioral change (Linnebank et al., 2018).
- Differentiate habit (unconscious: stimulus-respons) from goal-oriented behaviours (conscious, where self-regulation and depletion are involved).

Results - Factors for successful long-term behavioral change (3)

Relevant conditions for sustained behaviour change:

- The target behaviour should be specific, not generic. I.e., focus on simple well-defined behaviours.
- Long-term behavioral change is best achieved in a stable physical context/(cue) environment: *predefine the specific physical environment and time of day* (e.g., Castro et al., 2020; Diefenbacher et al., 2022; Stojanovic et al., 2022)
- Use subtle modifications in cues to facilitate good and hamper bad habits for example by increase/decrease in friction, i.e., redesigning the behavioural environment by imposing effort or waiting time (Verplanken & Orbell, 2022). *For example, making it harder to reach for unhealthy snacks*.

Results - Factors for successful long-term behavioral change (4)

Tips & tricks:

- Link new habit to strong existing habit (e.g, linking flossing with tooth brushing) (Judah et al., 2013).
- Habit formation interventions should be particularly targeting intrinsic reward (pleasurable experience, convenience, intrinsically valued) (e.g., Di Maio et al., 2022; Fessler et al., 2023)
    - *NB. Effects of extrinsic (monetary) rewards disappear when reward stops.*
- If possible, let consumers choose themselves a behaviour for change.
- Use elements of gamification (e.g. competition, feedback) (e.g., Ro et al., 2017).

Part II: Insights from literature on operant conditioning

Operant conditioning – Reinforcement and punishment

Originating from the work by Thorndike (1898, 1911) and Skinner (1938), operant conditioning can be defined as a learning process where voluntary behaviours are modified by association with the addition (or removal) of reward.

Reinforcement and punishment are the core tools through which operant behaviour is modified, and they can be defined by their (positive or negative) effect on behaviour:

- **Positive Reinforcement**—Positive reinforcement is adding a pleasant consequence that leads to repeating the behaviour (e.g. food as reward for specific behaviour).
- **Negative Reinforcement**—Negative reinforcement is taking away unpleasant consequences, which leads to repeating the behaviour (e.g. reduced headache after aspirin).
- **Positive Punishment**—Positive punishment or correction is adding an unpleasant consequence that leads to avoiding the repetition of the behaviour (e.g. electroshock fence for animals).
- **Negative Punishment**—Negative punishment or correction is taking away a pleasant consequence, which leads to avoiding the repetition of the behaviour (e.g. giving someone no food as consequence of unwanted behaviour).

Four types of operant conditioning techniques

- Many basic emotions that occur in humans can be deduced from this schema of four types of reinforcement/punishment (Rolls, 2000).
- For example, positive reinforcers are associated with happiness, negative reinforcers with relief. Positive punishments with fear, and negative punishments with frustration and anger.
    - In turn, these specific emotions can be related to action tendencies of consumers
- In operant conditioning, stimulus-response associations are typically linked to immediate reward – or punishment, and with accompanying emotions. I.e., the urge to go shopping is fuelled by the immediate euphoria when something is purchased.

Conditioning principles already used – without naming them...

- Behaviorism (of which operant conditioning is part of) is, at its core, an interest in how the environment encourages, enables, sustains, and extinguishes behaviour, without emphasis on intervening mental processes.
- Behavioral economics – and nudging- share similar goals. Rules such as easier access to healthy foods, can be viewed as a way to facilitate stimulus-response relationships.
- HENCE: We already use principles from operant conditioning when we modify the environment to facilitate certain wanted (water and/or food waste-related) behaviours.

Operant conditioning i.r.t. water and food waste-related behaviours (1)

Below, some examples are given how operant conditioning can be applied to water and food waste-related behaviours:

- Positive reinforcement: offering a positive stimulus
  - Example: credits or gifts when a certain reduction in food waste or water use is achieved.
- Negative reinforcement: the removal of a negative stimulus
  - Example: a lower water bill when water is saved.
- Positive punishment: offering or administering a negative stimulus
  - Example: shower stops producing warm water after a certain duration of showering
- Negative punishment: the absence or cessation of the positive stimulus
  - Example: no dessert if the plate is not empty

Operant conditioning i.r.t. water and food waste-related behaviours (2)

What is typically missing in many pro-environmental behaviours (such as household water use and food waste) is the immediate reinforcement/ punishment.

For example, the fact that water reduction is followed weeks later by a reduced water bill is a very loose relationship that probably does not lead to strong stimulus-response associations.

- *Hence, the act of food disposal or water use itself (with no immediate reinforcement/ punishment) is not associated with immediate, strong emotions.*

Interventions could look at closing this gap by associating 'desirable' behaviours with more immediate rewards, which links closely to the finding in the previous Part I that interventions to achieve long-term behavioural change should be particularly targeting intrinsic reward (pleasurable experience, convenience, intrinsically valued) and may use elements of gamification.

The next Part III will provide some specific recommendations for both the water case and the food waste case.

Part III: Conclusions

Apply insights to water conservation and food waste reduction

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Conclusions and recommendations water case

(based on literature review Task 1.1)

To apply the insights of this literature review to water conservation, this slide first recalls the main conclusions and recommendations of the literature review on promising consumer household water reduction interventions (Task 1.1):

- Only providing information is not effective in stimulating water conservation.
- Social influence (social norms and social identity) and providing feedback are effective in stimulating water conservation, at least in the short term.
    - To internalize social norms and create longer-lasting effects, repetition of the norm may be important.
    - The literature study demonstrates that a combination of feedback and social norms indeed appears to be especially effective: social comparative feedback.
- Recent pilots in the Netherlands show promising results on the effect of prompts on toilet flushing behaviour and showering behaviour.
- For any intervention, the frequency of exposure to and engagement with an intervention is of importance to affect water use.

Recommendations water case

The insights from the current literature review on maintenance of behaviour change can be applied together with the conclusions of Task 1.1 (see previous slide) to develop simple interventions to save water use:

- Focus on specific (simple) behaviours in stable physical context, which is often the case when it comes to water use
- Think about possibilities to link desired new behaviour to strong existing water use habits (e.g, flushing the toilet).
- Determine specific interventions for different target groups of water users.
- Based on the literature insights obtained in Task 1.1, interventions should contain elements from social norms and feedback.
- Engagement is key: if possible, let individuals choose their own intervention and make it intrinsically rewarding.

Conclusions and recommendations food waste case

(based on literature review Task 1.2)

To apply the insights of this literature review to the food waste case, this slide first recalls the main conclusions and recommendations of the literature review on insights on household interventions to reduce food waste (Task 1.2):

- Evidence for effective interventions to reduce food waste is still very limited
- Use a combination of intervention techniques (motivation + ability) to achieve desired behaviour.
- No evidence (yet) that consumers will retain the desired behaviour
    - Engagement seems to be key
    - Self-monitoring (feedback) may be effective, but how long do people continue to monitor themselves?

Recommendations food waste case

The insights from the current literature review on the maintenance of behaviour change can be applied together with the conclusions of Task 1.2 (see previous slide) to develop simple interventions focusing on reducing food waste:

- Focus on specific (simple) behaviours in stable physical context
    - Complicating factor is that food waste behaviour is complex: throwing something away is the result of many previous behaviours, all of which are quite complex in themselves (food planning, storage, preparation, consumption)
    - Furthermore, use-up day + flexible recipes (with leftovers) are not stable enough (in terms of product context and sufficient frequency) to lead to habit formation
- Determine specific interventions for different sub-groups of 'wasters'.
- Based on the literature insights obtained in T1.2, interventions should contain elements from engagement and self-monitoring.
    - However, interventions for young people could also contain gaming elements
- If possible, let individuals choose their own intervention.

See Appendix I for examples

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Appendices

Appendix I: Examples of relatively simple food waste interventions aimed at a specific phase

NB. These examples are from a working document from the European REFRESH 2015-2019 project (WP1 on Consumer Behaviour)

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Stage	Problem behaviour	Underlying problem	Possible intervention
Planning	Purchases of unnecessary products	Inadequate inventory of supplies	Tools to facilitate and monitor of supplies
Provisioning	Impulse buying	Purchases not planned	Make shopping list
Provisioning	Impulse buying	Attractive products/product placements	Less attractive products/product placement (e.g. tobacco)
Provisioning	Purchase of too large portions of foods due to large portion sizes	More food is stored than consumed in a certain time.	Smaller portion sizes, better storage, effective labeling
Provisioning	Purchase of too large portions of foods due to discounting	More food is stored than consumed in a certain time.	Better storage, effective labeling
Provisioning	Purchase of too many foods	More food is stored than consumed in a certain time.	Smaller shopping carts
Storing	Chilled foods are stored for shorter periods	Chilled foods warm up during transport (reducing shelf life)	Use cooling bags at POP
Storing	Best-before products past the expiry date are discarded immediately	Incorrect interpretation of expiration date information	Improved explanation of existing labels, new labels
Storing	Stored unlabelled foods are discarded too soon	Incorrect judgement of freshness, edibility	Learn to use own senses of smell, vision, taste.
Preparation	Ingredients are only partially used	Lack of alternative recipes	Alternative recipes based on specific ingredients
Preparation	Too much food is prepared	Social norms, insufficient knowledge of portion sizes	Information about proper portion sizes
Preparation	Foods prepared poorly or not tasty	Lack of interest, knowlegde, adequate tools	Smart cooking tools/appliances
Consuming	Too little food is consumed, leftovers are wasted	Portion size too large, plates too large, inadequate storage	Information on portion size & storage
Disposal	Too much food is disposed	Amount of disposed food is poorly monitored & visible	Smaller waste bins, less frequent waste collection, increase cost of waste collection