

# Design implementation of Behavioural change techniques to improve perceived euhydration

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## ABSTRACT

**Purpose** - This paper describes the execution and result of an exploratory constructive design research study. The study investigates if a design implementation of behavioural change techniques can improve perceived euhydration under young adults. These young adults feel they are insufficiently hydrated on a daily bases.

**Study** – At the beginning of the study a baseline about the current perceived behaviour and perception concerning beverage consumption is established. This is done by completing a questionnaire. The study has two interventions, intervention 1 and intervention 2. During intervention 1 participant manually register the amount and type of beverages they consume on a daily base. They would register this for seven days. During intervention 2 the participants were given a design that uses behavioural change techniques. They would use this design for seven days. These behavioural change techniques aim to improve perceived euhydration. After both interventions, the participants completed a questionnaire. The questions of the questionnaires were identical to each other. All collected data was used to see if the interventions had any influence on the perceived behaviour and perception concerning beverage consumption.

**Findings** - It can be concluded that implementing behavioral change theories in design has a positive influence on perceived euhydration. Using activating behavioral change theories has a greater influence than awareness raising behavioral change theories.

## CCS Concepts

Human-centred computing → Interaction design →  
Interaction design process and methods → User centred design

## Keywords

Euhydration; Design; Qualitative; Feedback; Personalized; Young adult; Behavioural change; Transtheoretical model; Vitality; Habit; Health; Lifestyle

## INTRODUCTION

### 1.1 Vitality

Vitality is the combination of factual and perceived [29] mental and physical well-being. Factual vitality consists of aspects of vitality that are based on data, observations and facts. Perceived vitality consists of aspects of vitality that are influenced by personal feelings, beliefs and opinions. Having a healthy lifestyle contributes to one's vitality [14]. Maintaining a balanced diet [15], executing sufficient exercise [17][19] and taking enough rest [20] are part of following a healthy lifestyle.

When it comes to maintaining a balanced diet there is a lot of information and emphasis on food [15][5]. For instance, one can

calculate what calories and macros need to be eaten according to their lifestyle, goals and preferences [16].

An aspect of maintaining a balanced diet that often does not get a lot of attention is beverage consumption. This is one of the reasons there is not a lot of data available about beverage consumption [25][24][23]. Another reason for lack of conclusive data is that studies use different methods [9]. For clear insight more and structured research on beverage consumption and its influence on health and preventing disease is needed [4].

It is known that being hydrated is important for one's health [27][7]. But how much one should drink is not very clear. There are some set rules that people tend to follow that consist of drinking a set amount of water a day [34]. These set rules do not take into account one's surroundings, lifestyle, goals, experiences or preferences [25].

### 1.2 Euhydration

To be sufficiently hydrated one should be euhydrated [25]. One is euhydrated when the volume of water in the body is that which supports good health and function. This is different for every individual. When the euhydration level decreases with 2% or more, the body will be dehydrated and start showing performance inefficiencies [21]. These inefficiencies are both physical and mental [25].

A way to know a person is dehydrated is that they have the sensation of thirst. Papers seem to not be conclusive on whether drinking according to thirst will keep an individual sufficiently hydrated [24][34]. Both sides do admit that the sensation of thirst gets influenced by environmental factors. They also admit that drinking according to thirst is not sufficient for athletes, military, hot environments, people who are ill, the elderly or infants [4].

Even for healthy individuals, it is reported that they are not sufficiently hydrated [23][12]. Because of the different research methods, the reported percentage of sufficiently or insufficiently hydrated individuals differs. One study found mild and overt hypertonicity were observed in 40% and 20% in community-dwelling adults aged 20 to 90 years [32]. A cause of hypertonicity is dehydration. Another paper reported that roughly 60% of the population is euhydrated in daily life. The other 40% is either dehydrated or hyper hydrated [23]. Another paper states that the prevalence of dehydration in adults has been estimated to be 16–28 % depending on age [9].

Not being euhydrated can result in multiple unwanted consequences. These consequences show themselves as inefficiencies in both the mental [1] and physical [31] capability. It can lead to decrements in physical performance, reduced endurance, increased fatigue, altered thermoregulatory capability, reduced motivation and increased perceived effort. Dehydration

has a negative influence on cognitive function such as concentration, alertness and short-term memory [25]. It also has a negative influence on one's mood [10]. These inefficiencies can have a great impact on the daily lives of individuals.

### 1.3 Hydration

One can be hydrated through consumption of food that contains liquid [13] and beverages [30]. This study will focus on hydration through the consumption of beverages. The type of beverages one consumes has an influence on the health and vitality of that person. Thus it is important to be aware of what type of beverages one consumes and what the influence of this can be.

For instance, caffeine causes dehydration but the way caffeine is consumed most often brings more liquid into the body than is taken by the caffeine [28]. Beverage can contain valuable nutrients like vitamins in juice and calcium in milk. But many beverages also contain calories which if consumed too much and carelessly have a negative influence on one's health and vitality [8][3].

### 1.4 Influence of design on perceived euhydration

This exploratory constructive design research study focuses on the question if design can have an influence on perceived euhydration. The design made for this study uses behavioural change techniques aimed to improve perceived euhydration. The design is a bottle that gives real-time qualitative feedback about personally set goals about hydration.

The design made for this study uses a set of behavioural change theories and techniques. The behavioural change theories and techniques are aimed to persuade, enable and motivate the adaptation of new behaviour and habits concerning beverage consumption that contribute to euhydration.

Furthermore, the study investigates if what people believe they do, concerning the amount and type of beverages they consume, is in agreement with what they actually do.

### 1.5 Behavioural change theory and techniques

This study uses a range of behavioural change theories and techniques. The behavioural change theory is used to gain insight into the mental state the participants are in when it comes to adopting new behaviour towards beverage consumption. The behavioural change techniques are implemented into a design that aims to improve the perceived euhydration of the user. The following theory and techniques have been implemented in this study.

#### 1.5.1 The Transtheoretical Model

The Transtheoretical Model [26] is a theory that describes the process one goes through when changing their behaviour. The process is a cycle in which one can go back to an earlier stadium at all moments. One will move to the next phase when one finds the gain more important than the effort it will take to go to the next step. The phases of the Transtheoretical Model are (See figure 1):

1. Pre-contemplation: During the pre-contemplation phase one is either not aware of the possibility to change or is not interested to change.
2. Contemplation: During the contemplation phase one is aware of the possibility to change and is thinking whether

they do or do not want to change their behaviour or do not know how to change their behaviour.

3. Determination: During the determination phase one has decided they want to change their behaviour and are actively looking how they could do that.
4. Action: During the action phase one has started to undertake action to change their current behaviour into the desired behaviour.
5. Maintenance: During the maintenance phase one has been able to change their behaviour and now has to take action to keep performing this new desired habit.

To change behaviour one will go through each phase in chronological order. Relapse can occur during any phase of the Transtheoretical Model. When one relapses they go back to a previous phase. One can relapse back one phase but also could relapse back more than one phase.

The Transtheoretical Model is used to gain insight into the mental state the participants are in, when it comes to adopting new behaviour towards beverage consumption, during the study.

#### 1.5.2 Goal setting

By setting goals one sets a point they want to work towards. When one can set their own goals their self-efficacy and motivation to reach the goal will rise [18]. By having goals one knows why they undertake certain actions and get a sense of direction and purpose. If one is willing and able to take the necessary actions to change their behaviour one will be able to reach their goal. Having a goal will also make it possible to reflect upon this goal and when necessary to adjust the goals or the actions aimed to reach the goal. Giving the goal a certain time frame to be completed will help motivate the goal setter to complete it within a certain time.

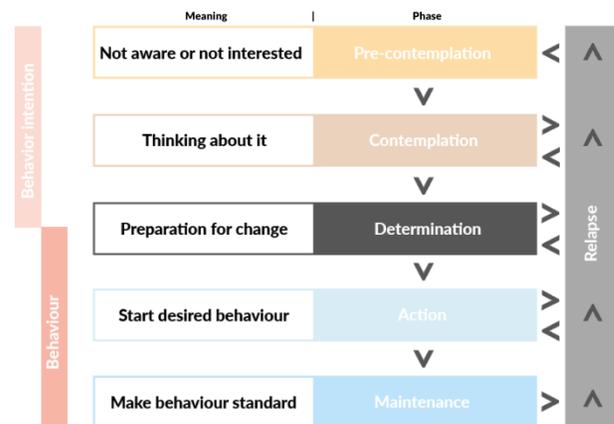


Figure 1. Visual representation of the Transtheoretical Model.

#### 1.5.3 Feedback

Receiving feedback related to one's performance will improve the success rate of accomplishing one's goal. [22]. Feedback will help them determine how well they are doing and what opportunities there are to improve their actions.

#### 1.5.4 Nudging

Giving people certain cues, options or information can direct them in a certain direction. This is called nudging. Making simple or small changes in presentation or available possibilities can make the desired choice the easy, automatic or default choice to go to [33].

### 1.5.5 Facilitation

To adopt a new behaviour one has to be able to access all the necessary resources to reach that goal [2]. This includes the necessary social structure, knowledge, normative beliefs, intrinsic and/or extrinsic motivation and physical resources.

### 1.5.6 Consciousness Raising

To change a behaviour one has to be aware of what their current behaviour is and in what ways it could be changed [26]. This can be done for instance by doing self-monitoring of behaviour, feedback, self-re-evaluation and reflection.

## 2. METHODOLOGY

This study consists of two interventions [6], a baseline questionnaire (questionnaire A) and a questionnaire after both interventions (questionnaire B & C). For a visual representation of methodology see figure 2.

The questions given in the questionnaires are formed to collect data to determine the participant's location in the Transtheoretical Model and their perceived behaviour and perception concerning beverage consumption.

Ten participants took part in this study. The participants were a balanced group of both males (n=5) and females (n=5). The study takes place in the daily life of the participants and thus is categorised as a field research study.

### 2.1 Target group

At the beginning of the study, the participants were asked to fill in some basic information to make sure they fit the target group profile. Furthermore, they signed a consent form that allowed the collection and publishing of data. To respect the privacy of the participants any names have been made anonymous.

#### 2.1.1 Young adults

The target group of this study are young adults who live independently from their parents / caretakers and feel they are not sufficiently hydrated. These young adult are between the ages of 18 to 29 years old. During the transiting of living at one's parents/ caretakers to living independently, young adults will have to make decisions about what they value in life, what is important to them and how they implement those things in the way they live [11]. This moment of redefining habits and values could be a good moment to implement a habit of sufficient and healthy beverage consumption.

#### 2.1.2 Position in Transtheoretical model

The target group is in the contemplation or determination phase of the Transtheoretical Model[26]. The Transtheoretical Model (see Figure 1) describes the process one goes through during behavioural change. During the contemplation phase, the person is aware there is the possibility to change and improve their behaviour but they are not prepared, willing or don't know how to take action yet. In the determination phase, a person has decided that they want to change their behaviour and are actively looking how to do so. During this phase, they start preparing to take action.

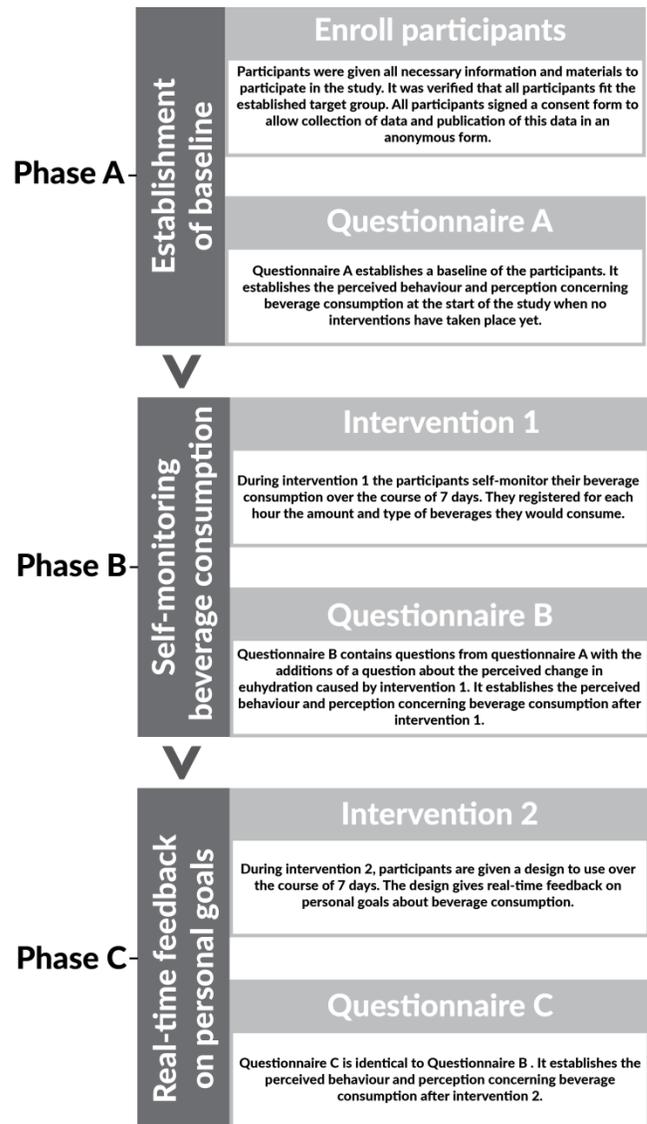


Figure 2. Visual representation of methodology.

### 2.2 Phase A

During phase A the participants were given all necessary information and materials to participate in the study. It was verified that all participants fit the established target group. All participants signed a consent form to allow collection of data and publication of this data in an anonymous form. Furthermore, they complete questionnaire A.

#### 2.2.1 Questionnaire A

Questionnaire A establishes a baseline of the participants. It establishes the perceived behaviour and perception concerning beverage consumption at the start of the study when no interventions have taken place yet.

### 2.3 Phase B

During phase B the first intervention took place. After the intervention, the participant's completed a questionnaire about their perceived behaviour and perception concerning beverage consumption.

### 2.3.1 Intervention 1

#### Self-monitoring beverage consumption

During intervention 1 the participants self-monitor their beverage consumption over the course of 7 days. They registered for each hour the amount and type of beverages they would consume. At the end of the day, they would give the day a score for mood and euhydration. They could score their mood and euhydration on a scale from 1-Very bad to 7- Very good. They were given a booklet in which they could register the data. The self-monitoring would make the participant aware of their current behaviour towards beverage consumption and collect data about what behaviour the participants execute when it comes to beverage consumption.

### 2.3.2 Questionnaire B

After completing the manual registration of beverage consumption for 7 days the participants completed questionnaire B. Questionnaire B contains questions from questionnaire A with the additions of a question about the perceived change in euhydration caused by intervention 1. It establishes the perceived behaviour and perception concerning beverage consumption after intervention 1.

## 2.4 Phase C

During phase C the second intervention took place. In the second intervention, the participants were given a design that uses a set of behavioural change techniques. These behavioural change techniques are aimed to persuade, enable and motivate the participant to reach a self-set goal about beverage consumption. It will stimulate participants to change their current beverage consumption behaviour towards a more euhydrated lifestyle.

### 2.4.1 Intervention 2

#### Real-time feedback on personal goals

The second intervention consisted of a design which the participants would be using for the course of 7 days. The design uses behavioural change techniques aimed to improve perceived euhydration. The design consists of a bottle (See figure 3) with an accompanying app (See figure 4).

#### 2.4.1.1 The design

The design used during the study is a water bottle. By the use of an app, information could be retrieved from the bottle and send to a database.

##### 2.4.1.1.1 The bottle

At the bottom of the bottle, a unit with electronics is secured by the use of a silicon sleeve. The sleeve acted as a way of connecting the unit to the bottle and protecting the unit from liquids. The electronics unit underneath the bottle contains:

- 4 Digital RGBW LED's as a way of communication.
- ESP32 as microcontroller.
- Rechargeable Li-Po battery as a power source.
- Push button to add 50 ml to the logged amount of drunken liquid.

On the bottle, there are markings that each mark 50 ml. When a participant would reach a new mark they would push the button on the electronics unit. Pushing the button would make the LED's light up twice in bright white and add 50 ml to the logged amount of drunken liquid.

The bottle has the word "water" on it, to nudge the user to drink water.



Figure 3. Design used during the study. The bottle gives feedback to the user about their beverage consumption goals by changing colour trough the use of LED's.

#### 2.4.1.1.2 YOUhydration app

With the YOUhydration app participants could connect their phone to the bottle via Bluetooth. The functions of the app are:

- Connect or disconnect to the bottle.
- View the amount of logged drunken beverage.
- Add or subtract 50 ml to the logged amount of consumed beverages.
- Log an euhydration-score on a scale from 1-Very bad to 7-Very good.
- Log a mood-score on a scale from 1-Very bad to 7-Very good.
- See how much liquid is in the bottle.
- Log that they filled the bottle.
- Set the bottle into day mode: LED's active.
- Set the bottle into night mode: LED's deactivated.

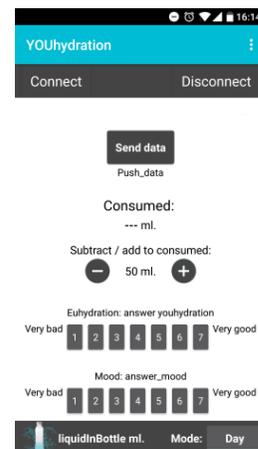


Figure 4. Screen capture of the app used during the study. Users could connect their bottle to the app via a Bluetooth connection.

### 2.4.1.2 Goal setting

Before the participants were given the design they had to set personal goals. They had to set a goal for:

- How much liquid, though the consumption of beverages, they would like to consume each day.
- In what time frequency they would like to consume beverages.
- How many hours they are awake / active each day.

The system would use these goals to calculate how much a participant minimally had to drink each interval to reach the amount of beverages they would like to consume in the hours they are awake each day. This would result in a goal. This interval goal is a goal that can change depending on how close or far a participant would stay to their goal. If the participant would drink more or less than the interval goal, the interval goal would be adjusted. The adjustment would make sure that, if the feedback of the design would be followed, the goal would be reached at the end of the day. The participant would always be free to drink more than the set goal.

### 2.4.1.3 Personalization of feedback

The design gives feedback to the user about how close or far they are from their set goals. It communicates this through the use of LEDs that change colour. Each participant could choose their own preferred colours for communication.

The information given by the design:

Colour 1: You are on track.

0% to 40% of the set interval time.

Colour 2: You could drink something if you want to.

41% to 80% of the set interval time.

Colour 3: You should drink something.

81% to 100% of the set interval time

Colour 4: You are off track. You really should drink something.

More than 100% of the set interval time.

The time the design would be a certain colour depends on the set interval (See Figure 5).



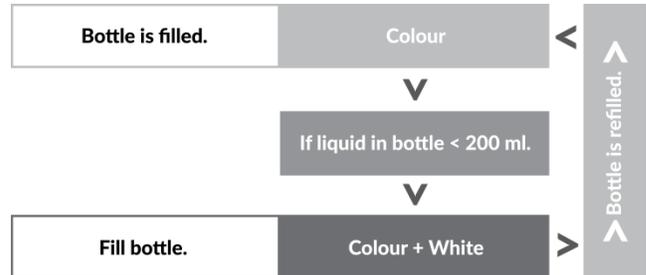
**Figure 5. Visual representation of the colour feedback progression the design gives.**

### 2.4.1.4 Facilitation

The resources needed by the participants are beverages that can be consumed. To encourage the facilitation of resources the design gives feedback on the amount of liquid in the bottle. Since the

resources that are important for euhydration are beverages, the design stimulates the participant to keep their bottle filled.

When there is only 200 millilitres of liquid left in the bottle, the bottle will add white to the feedback colour. In this way, the colour becomes lighter and the light source itself will become brighter. It will remain like this until the design is refilled (See figure 6).



**Figure 6. Visual representation of the refill feedback progression the design gives.**

### 2.4.2 Questionnaire C

After the completion of intervention 2, the participants completed questionnaire C. Questionnaire C is identical to Questionnaire B. Questionnaire C was given to see if intervention 2 had any influence on the perceived behaviour and perception of the participant concerning their beverage consumption.

## 3. RESULTS

### 3.1 Baseline

In questionnaire A, the participants are given questions that determine if they fit into the established target group. All participants are young adults between the age of 18 and 29 and live on their own. The participants are all in the contemplation or determination phase of the Transtheoretical Model.

As can be seen in table 1, three participants never tried to actively change their liquid consumption and seven participants tried to actively change their liquid consumption in the past.

Have you ever tried to actively change your beverage consumption?	
Participant 1	No
Participant 2	Yes
Participant 3	Yes
Participant 4	Yes
Participant 5	Yes
Participant 6	No
Participant 7	No
Participant 8	Yes
Participant 9	Yes
Participant 10	Yes

**Table 1. Answer of each participant to the question “Have you ever tried to actively change your beverage consumption?”**

### 3.2 Beverage consumption perception vs. facts

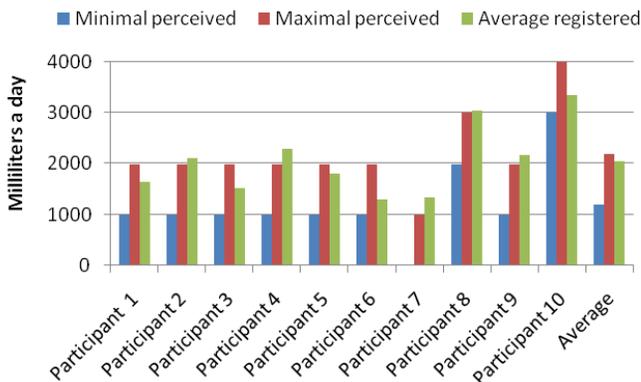
During phase B the participants were asked to manually register the amount and type of beverages they consume in a booklet. In questionnaire B they were asked how much liquid and how many of a certain beverage they think they consumed on average each day during intervention 1. This data shows to what extent the perceived behaviour of the participants corresponds with what the participants actually do.

#### 3.2.1 Amount of beverage consumption

In figure 7 can be seen how the minimal and maximal perceived amount of beverages consumption a day during intervention 1 compares to the average registered amount of beverages consumption a day during intervention 1. It can be seen that five participants on average consumed more beverages than they perceived. The other participant registered to have, on average, consumed between their minimal and maximal amount of perceived beverages consumption a day.

The lowest amount of registered beverages consumption is a daily average of 1292 ml (See participant 6 in figure 7). The highest amount of registered beverages consumption is a daily average of 3342 ml (See participant 10 in figure 7).

On average the participants consume the amount of beverages between the minimal and maximal value they perceive to consume. The average perceived minimal is 1200 ml. The average perceived maximal is 2200 ml.

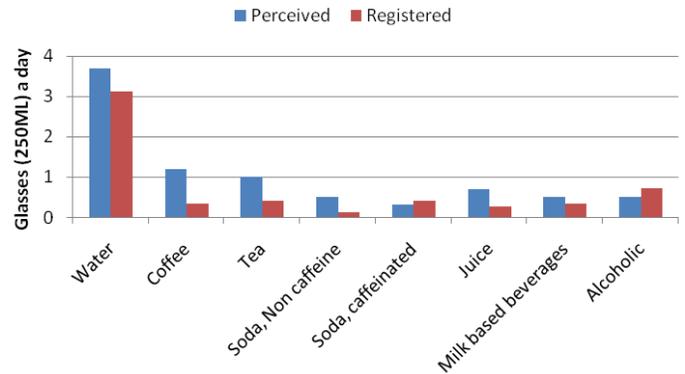


**Figure 7. Minimal and maximal perceived vs. average registered amount of beverages consumption a day during intervention phase B.**

#### 3.2.2 Type of beverage consumption

In figure 8 can be seen how the perceived consumption of different types of beverages a day during intervention 1 compares to the registered type of consumed beverages a day during intervention 1. It shows that the participants on average perceive that they drink more of each type of beverages except for alcohol and caffeinated soda, of which they perceive to drink less on average than they actually do.

Participants perceive to consume 925 ml of water on average each day while they register to have consumed 780 ml as a daily average. For alcoholic beverages, they perceive to consume 125 ml on average each day while they register to have consumed 180 ml as a daily average. When it comes to caffeinated soda they perceive to consume 75 ml on average each day while they register to have consumed 180 ml as a daily average.



**Figure 8. Average perceived vs. registered type of beverages consumed a day during intervention 1.**

### 3.3 Influences of the interventions

#### 3.3.1 Influence on the position in the Transtheoretical Model

For the establishment of the baseline and after intervention 1 and 2 the participants were asked if they would like to actively change the amount of liquid they consume. With the information whether a participant ever tried to actively change their beverage consumption (See table 1) and whether or not they would like to actively change the amount of beverages they consume (See table 2), it can be determined in what stage of the Transtheoretical Model the participants were at the time (See table 3). The participants can be placed in the following phase of the Transtheoretical Model.

**Contemplation phase:** The participant would like to actively change the amount of liquid they consume but never has undertaken any actions to do so.

**Determination phase:** The participant would like to actively change the amount of liquid they consume and has tried to find ways to do so.

**Action phase:** The participant would like to actively change the amount of liquid they consume and wants to actively undertake steps to do so.

**Maintenance phase:** The participant is satisfied with the amount of liquid they consume at the moment and would like to maintain it.

	Would you like to actively change the amount of beverages you consume?*		
	Baseline	After intervention 1	After intervention 2
Participant 1	Yes	Yes	No
Participant 2	Yes	Yes	Yes
Participant 3	Yes	Yes	Yes
Participant 4	Yes	Yes	Yes
Participant 5	Yes	Yes	No
Participant 6	Yes	Yes	No
Participant 7	Yes	Yes	Yes
Participant 8	Yes	Yes	Yes
Participant 9	Yes	Yes	Yes
Participant 10	Yes	Yes	Yes

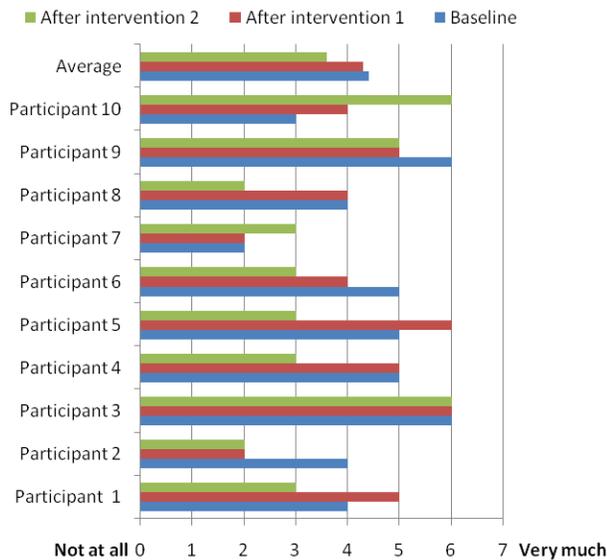
**Table 2. The willingness of the participant to actively change the amount of beverages they consume during the course of the study.**

Would you like to actively change the amount of liquid you consume?			
	Baseline	After intervention 1	After intervention 2
Participant 1	Contemplation	Determination	Maintenance
Participant 2	Determination	Determination	Action
Participant 3	Determination	Determination	Action
Participant 4	Determination	Determination	Action
Participant 5	Determination	Determination	Maintenance
Participant 6	Contemplation	Determination	Maintenance
Participant 7	Contemplation	Determination	Action
Participant 8	Determination	Determination	Action
Participant 9	Determination	Determination	Action
Participant 10	Determination	Determination	Action

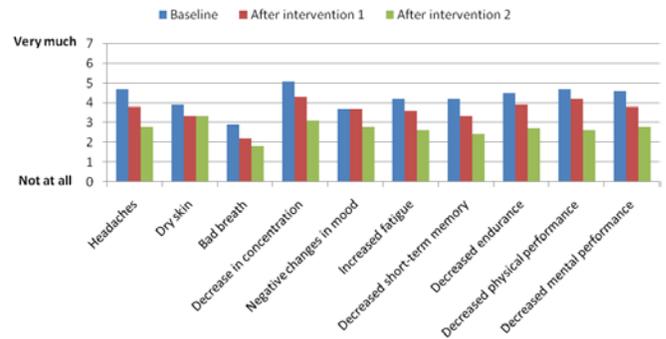
**Table 3. Position of the participants in the Transtheoretical model during the course of the study.**

### 3.3.2 Influence of insufficient hydration on daily life

In figure 9 can be seen how much insufficient hydration influences the daily life of the participants. On average the severity of discomfort caused by insufficient hydration decreases over the course of the study. The same trend can be seen for experienced symptoms as a result of insufficient hydration (See figure 10).



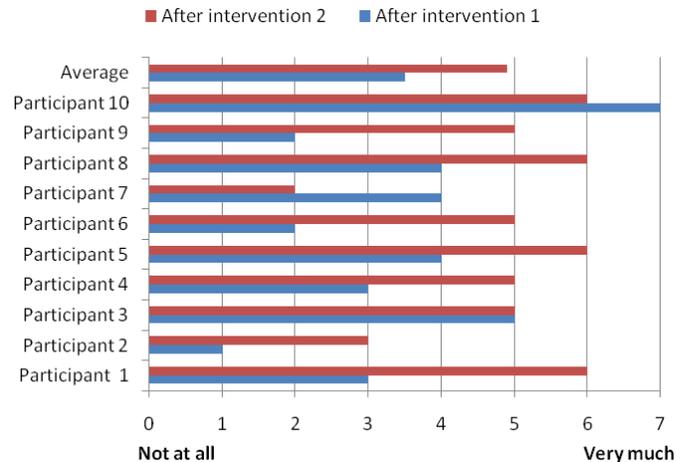
**Figure 9. The severity of discomfort, caused by insufficient hydration, on the daily life of the participants during the study on a scale from 1-Not at all to 7- Very much.**



**Figure 10. Result of the average severity of experienced symptoms caused by insufficient hydration during the study on a scale from 1 - Not at all to 7 - Very much.**

### 3.3.2.1 Influence of Interventions

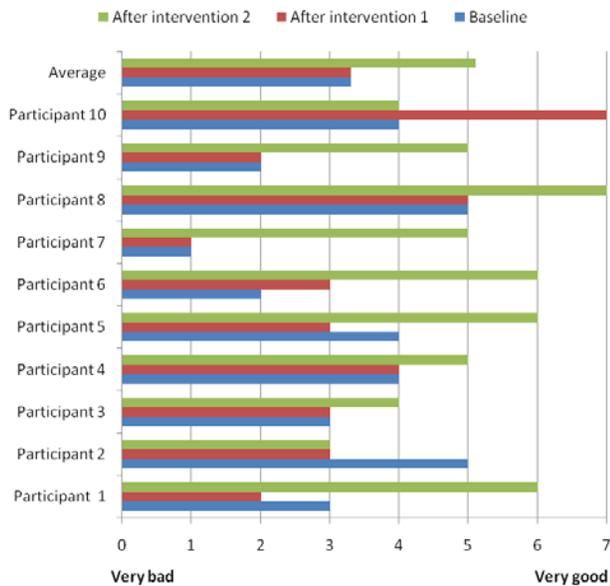
In figure 11 the perceived change in euhydration after intervention 1 and 2 (on a scale from 1-Not at all to 7- Very much) can be seen. Both interventions resulted in improving the perceived euhydration. The participants felt that the second intervention had a greater influence on the perceived euhydration than intervention 1.



**Figure 11. Perceived change in euhydration after intervention 1 and 2 on a scale from 1-Not at all to 7- Very much**

### 3.3.2.2 Influence on euhydration

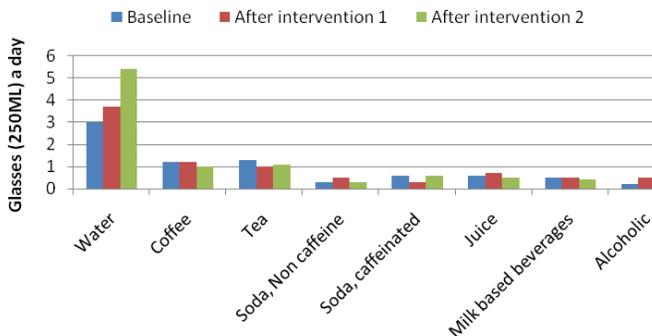
In figure 12 the perceived euhydration of participants during the study can be seen. On average the perceived euhydration during the baseline and after intervention 1 were the same. Intervention 2 caused the average perceived euhydration to improve with the number 1,6 on a scale from 1-Not at all to 7- Very much. Resulting in an average euhydration score of 5,1 after intervention 2.



**Figure 12. Perceived euhydration during the study on a scale from 1-Very bad to 7- Very good.**

### 3.3.2.3 Influences on beverage consumption

Figure 13 shows the average perceived beverage type consumption by the participants. It shows that over the course of the study participants on average perceive to have increased the amount of water they drink. The consumption of other types of beverages stayed relatively the same over the course of the study.



**Figure 13. Average perceived beverage type consumption by the participants.**

## 4. CONCLUSION

This exploratory constructive design research study uses a design implementation of behavioural change techniques to see if these can have an influence on perceived euhydration. The results showed that participants experience both intervention 1 and intervention 2 to have an influence on their perceived euhydration.

Intervention 1 made the participant aware of their current behaviour towards beverage consumption. This awareness placed them in the determination phase of the Transtheoretical Model. On average the experienced symptoms caused by insufficient hydration after intervention 1 decreased in comparison to the baseline (See figure 10). The type of beverages the participants consumed during intervention 1 stayed roughly the same as the baseline except for the amount of water consumption which

increased with 175 ml a day during intervention 1(See figure 13). The perceived euhydration of the participants on average stayed the same as the perceived euhydration of the baseline which is 3,3 on a scale of 1-Very bad to 7- Very good (See figure 12).

During intervention 2 the participant actively pursued to improve their beverage consumption through the use of a design that implements behavioural change theories. This had as result that all participants reached the action phase of the Transtheoretical Model and some even reached the maintenance phase (See table 3). On average the experienced symptoms caused by insufficient hydration after intervention 2 decreased in comparison to the baseline and intervention 1(See figure 10). Compared to intervention 1 the type of beverages the participants consumed stayed roughly the same except for the amount of water they consumed, which increased with 425 ml a day (See figure 13). The perceived euhydration of the participants on average improved with the number 1,6 on a scale from 1-Not at all to 7-Very much. Resulting in an average euhydration score of 5,1 after intervention 2.

It can be concluded that implementing behavioral change techniques aimed to improve hydration in design has a positive influence on perceived euhydration. Using activating behavioral change theories has a greater influence than awareness raising behavioral change theories.

## 5. DISCUSSION

This explorative study has made clear that a Design implementation of Behavioural change techniques to improve perceived euhydration has some interesting influences. It is able to influence the position of the participants in the Transtheoretical Model when it comes to beverage consumption behaviour. It has made the participants more aware of their current behaviour regarding the amount and type of beverage they consume. And nudged them into following more healthy behaviour regarding the amount and type of beverage they consume. This behaviour contributes to a healthy lifestyle and ultimately to their health and vitality.

This study has its limitations. To establish a full constructive design research study about design implementation of Behavioural change theories for the improvement of perceived euhydration a couple of things can be done:

- It would be good to gather a larger group of participants so that average numbers become more reliable and outliers have a smaller impact on the results.
- It would be good to establish a control group. This control group would participate in phase A and B but would not receive the design during phase C. This could clarify what data resulted due to intervention 1 and what data resulted due to intervention 2.
- It would also be good to find a way to register the activity and stress level of the participants to see if this could have an influence on the collected data about euhydration. This could gain new insight and make the collected data more reliable.

For future research it could be interesting to investigate the following things:

- It could be interesting to investigate if participants would be free to choose to keep using the given design, how long participants would keep using the given design.
- It could be interesting to investigate how long the influence of intervention 2 last after the participant

chooses not to use the design any longer. It also could be seen, if after participant chooses to no longer use the design, if there would be a time the participant would choose to start using it again, and what triggers this reuse of the design. This could gain insight into the influence of the design and the needs of the user.

## 6. ACKNOWLEDGMENTS

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