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“I know it's just pouring it from the tap, but it's not easy”: Motivational processes that underlie water drinking.

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Abstract

Water drinking behaviour is under-researched despite the prevalence and adverse health consequences of underhydration. We conducted a qualitative exploration into the motivational processes underlying water drinking, informed by a grounded cognition perspective on desire and motivated behaviour. We interviewed and analysed data from 60 participants stratified by age, gender, and education level using thematic analysis, to generate three key themes. “Water as situated habits,” suggests that participants form and maintain situated water drinking habits, so that within certain situations they regularly drink water. However, participants who situated their water intake only in one key situation (e.g., work routine), had low and inconsistent intake when they left this situation. Some situations happened so infrequently during the day (e.g., before bed) that participants’ daily water intake was low. Many participants reported drinking water in reaction to thirst cues, but these were easily suppressed or ignored, so that water drinking was inconsistent. Participants who saw drinking water as part of their self-identity had consistent and high water intake across a variety of situations. “Knowledge and attitudes,” suggests that few participants had knowledge or attitudes that promoted water intake (e.g., perceived water as positive or understood the importance of hydration). “Strategies underlying attempts to increase intake” suggests that many participants lacked insight into strategies to increase water intake, although they spontaneously discussed attempts to drink more. This lead to ineffective attempts at behaviour change. Participants’ mentions of dehydration and their responses to a urine colour chart suggested that many participants were possibly underhydrated. Our findings suggest that interventions and practitioners attempting to increase water intake need to increase knowledge about the importance of hydration, and encourage individuals to develop effective situated water drinking habits.
Keywords: habits; water drinking; hydration; behaviour change; qualitative research; thematic analysis; obesity
1. Introduction

Water is essential for all physiological functions (Jéquier & Constant, 2010; Kavouras & Anastasiou, 2010). Therefore, drinking water could be considered one of the most important consumption behaviours. Underhydration, the process of maintaining a state of hydration with consistently low water intake (Kavouras, 2019; Perrier et al., 2013; Perrier, 2017; Perrier et al., 2020), is associated with adverse physical and psychological outcomes. Underhydration has been linked to chronic kidney disease, diabetes, obesity, as well as cardiometabolic disease, and there is evidence that increased water intake could be an effective prevention strategy for reducing these health outcomes (Armstrong & Johnson, 2018; Perrier et al., 2020). Underhydration is also linked to deficits in higher-order cognitive function as well as negative mood states and fatigue (Liska et al., 2019). Gibson & Shirreffs (2013) estimate that 33% of people in the UK maintained their hydration state with low water intake and may therefore be underhydrated. The prevalence and adverse impact of underhydration show a need for research to understand the motivations underlying hydration behaviours and to inform health interventions that increase people’s water intake. The health behaviour literature currently provides an overview of factors that could influence water intake, but lacks insight into the day-to-day motivational processes that underlie water intake. The present article therefore presents an in-depth qualitative analysis of water drinking behaviour and its underlying motivational processes in a UK sample.

1.1 Research on Water Drinking

Most research on drinking behaviour focuses on sugar-sweetened and alcoholic beverages. It is unlikely that these findings will generalise to water, as people perceive and use water differently than these drinks (see Block et al., 2013; Brownbill et al., 2020). Regarding water intake, cross-sectional, survey and qualitative research provide initial insights into demographic trends and psychological variables that impact consumption. Older
age groups have a higher risk of underhydration (Elmadfa & Meyer, 2015; Goodman et al., 2013), and the association of gender with underhydration depends on the country and age group (Elmadfa & Meyer, 2015). Gender also seems to influence how people perceive barriers to water drinking. Wippold and colleagues, (2020), for example, found that lack of knowledge and social influence were prominent barriers to healthy beverages choices mostly for male adults. Lack of availability, on the other hand, is a key barrier to water intake across a variety of demographic groups (Hess et al., 2019; Wippold et al., 2020). Water intake is further associated with perceived water quality, perceptions of taste, and health beliefs about water (Block et al., 2013; Brownbill et al., 2020; Onufrak et al., 2014). Water consumption also correlates with other healthy behaviours in the domains of sleep, eating and exercise (Elmadfa & Meyer, 2015; Vézina-Im & Beaulieu, 2019). Peer influence on water intake is relatively understudied but can negatively impact water intake in adolescents (Vézina-Im & Beaulieu, 2019). These insights give us a broad understanding of factors that could influence water intake. However, there is a limited understanding of what drives the day-to-day motivational process underlying water drinking.

1.2 Water Drinking Interventions

Most interventions focus on increasing water intake to either reduce sugar-sweetened beverage consumption, or as part of a broader health-related habit change. A systematic review of interventions promoting water intake to reduce sugar-sweetened beverage consumption found that only six of 17 studies were effective in increasing water intake (Moghadam et al., 2020). A meta-analysis of similar interventions found that 29 of 40 studies in the domain of sugar-sweetened beverage consumption did not report the impact of the intervention on water intake (Vargas-Garcia et al., 2017), indicating that water is often not considered important within these studies. Interventions that increase water intake to improve hydration levels mainly focus on children, which is unlikely to generalise to other age groups.
In addition, these interventions have limited success, as a large proportion of studies see no statistically significant change in water intake (Franse et al., 2020), or changes that are very small (29 mL, Franse et al., 2020; 67 mL, Vargas-Garcia et al., 2017) and unlikely to have an impact on physical or psychological outcomes.

A possible reason that these interventions are ineffective is that their messaging on water is not prominent for participants (Franse et al., 2020), especially when researchers are treating water intake as a secondary topic in the research. Furthermore, these intervention strategies are primarily informed by findings from other consumption behaviours and top-down knowledge from expert stakeholders (Vercammen et al., 2018), rather than by empirical research on water drinking and the underlying motivational processes. Franken and colleagues, (2018), for example, studied an intervention using peer influence, which assumes social norms are an important driver of water drinking. They based this assumption primarily on research on eating behaviour. Although this assumption may be correct, it remains untested. To develop effective interventions to increase water consumption, the underlying motivational processes need to be established more systematically.

1.3 Current Research Aims and Methodology

The current research was designed to improve the understanding of what motivates and what hinders water drinking behaviour. Because very little seems to be known about this topic at the moment, we opted for a qualitative study as a broad, initial, hypothesis-generating research approach (Holloway & Biley, 2011; Korstjens & Moser, 2017; Tracy, 2010). We anticipated that the findings from this study could later serve as confirmatory hypotheses in quantitative research. We adopted a critical realist perspective, which assumes that knowledge is gained through fallible theories, some of which are closer to reality than others (Danermark et al., 2019). Critical realism allows for the use of existing theories as an initial starting point for research, as these theories allow researchers to undertake a more
meaningful analysis into the mechanisms underlying a phenomenon (Fletcher, 2017).

However, to gain a more accurate representation of reality, the researcher must acknowledge the fallibility of existing theories and use the analysis process to support, expand on or oppose existing theory. This perspective was appropriate for the current research, which aimed to identify the underlying mechanisms of water drinking while, acknowledging the researchers’ prior exposure to current theories in the health behaviour literature and outlining how these theories influenced the research process.

The Grounded Cognition Theory of Desire and Motivated Behaviour (Papies et al., 2017, 2020; Papies & Barsalou, 2015) was the most prominent initial theory used to guide the research process. This theory posits that each consumption behaviour results in a situated conceptualisation stored in memory that incorporates a variety of information streams (e.g. sensory information, contextual features, internal states). When a relevant cue is encountered later (e.g., a location in which a food or drink is often consumed), other elements of the situated conceptualisation are activated in the form of simulations (thoughts of the taste and texture of the food or drink). These simulations can create desire, affect people’s consumption decisions, and also trigger nonconscious behaviour in the form of habits. It is important to note other theories influenced the research process such as the Theory of Planned Behaviour (McEachan et al., 2011) and theories on goal-directed behaviour (e.g., goal priming; Papies, 2016). We used this theoretical framework and the critical realist perspective to address the following research questions:

1. What are the underlying processes that prompt or hinder water drinking behaviour?
   Specifically, which processes affect whether individuals choose water or other drinks, and how much water they drink?

2. How do people perceive their water drinking behaviours?
3. What are the underlying processes of effective and limited attempts at behavioural change?

We note that Research Question 3 was added during the final stages of data analysis. Our inductive research process led to the generation of a theme and a research question that addressed behavioural change, because many participants spontaneously discussed increasing water intake as something they should do or had previously tried to do. This provided rich data on the theme of behavioural change in the domain of hydration.

2. Method

2.1 Research Design

The current research had a qualitative, comparative case study design, which analyses the patterns of similarities and differences across two or more cases. We defined the cases as individuals within the general population of the south-west of Scotland during December 2019 – February 2020. We used semi-structured interviews, which allowed us to address the topic and theoretical viewpoint of interest, while ensuring enough flexibility to explore new ideas. The research was approved by the University of Glasgow Ethics committee (See ‘Ethics Documents’ in supplementary materials). We used the Open Science Framework to pre-register and document the complete research process, and all supplementary materials describing this in detail and providing additional information for interested readers can be accessed there (https://osf.io/t9cus). The debate on the appropriateness and use of pre-registration in qualitative research is novel (Haven & Grootel, 2019; Kern & Gleditsch, 2017; Pratt et al., 2019). Within the current research, pre-registration was used solely as a transparency tool.

2.2 Participants

To achieve high diversity in participants’ experiences, we recruited a relatively large sample (Braun et al., 2017, 2020; Malterud et al., 2016). Participants had to be living in the
UK, and be 18 years old or above to participate. Sixty members of the general population were interviewed. In order to ensure the data collected reflected a range of backgrounds and to allow for an examination of different life experiences in different groups, a sample frame was generated to guide participant recruitment. The sampling frame was stratified by age (younger: 18-35/ middle: 36-55/ older: 56+ years), gender (female/male) and education level (higher education/ non-higher education), with five participants in each of the 12 sub-groups (See Appendix A for demographic information). We expected that there could be a difference in the underlying motivational processes of water drinking between these groups, because the cross-sectional research previously outlined had shown a difference in water intake across these demographic variables. For an in-depth discussion on the pragmatic and conceptual considerations made regarding sample size, see 'Sample Size Considerations' in the supplementary materials.

Participants were recruited via purposive and snowball sampling from AR’s online and personal social network. Participants were recruited in stages using the demographic sub-groups to ensure equal numbers of participants per group. Participants were told the study involved an approximately 30-minute interview on their daily drinking habits (excluding alcohol), and were compensated with £5.

2.3 Interview Schedule Development

Following Kallio and colleagues, (2016) we consulted two approaches to generate ideas for questions. (1) The Situated Assessment Method (Dutriaux et al., 2020), a quantitative measure used to assess individual differences in habitual behaviours across specific situations. (2) Feature listing, a method used to assess how participants represent different foods and drinks (Papies et al., 2020). Additionally, we held question creation meetings using the research aims, questions and relevant theories. These activities led to a list of potential questions of interest in assessing the underlying processes of water drinking.
motivational processes in water drinking

habits. We created an initial interview schedule from this list and field-tested it on two participants. The schedule was then discussed and refined to an open-ended format (Moser & Korstjens, 2018). The final interview schedule asked participants to describe their day-to-day drinking routine and their perception of water. Then, they were asked to give examples of situations where they drank water, and of situations where water was an option, but they drank something else. Finally, they were asked to describe what advice they would give themselves regarding their water drinking, and to suggest effective strategies that could increase their water intake. For the full interview schedule, see Appendix B.

During iterative data collection and analysis, we interpreted there being a discrepancy between participants self-reported water intake (i.e., average cups per day) and how they had discussed their water intake previously during the interview (i.e., the researchers expected higher self-reported water intake in some cases based on prior discussion). A high number of participants also reported low water intake, but the interview schedule did not allow for hydration levels to be assessed or discussed. In response, we created additional questions using Armstrong et al.'s., (1994) and the Scottish NHS urine colour charts. Although not as sensitive as more invasive methods, the urine colour chart is an appropriate hydration assessment tool (Baron et al., 2015; Perrier et al., 2016). The urine colour charts (See Appendix B) were added at the end of the interview to avoid influencing participants’ responses. The updated interview schedule was used from the 20th participant onwards.

2.4 Procedure

All the interviews were conducted, in person, by AR (female, 23 years old, MSc Student) between December 2019 – February 2020. AR had prior experience facilitating qualitative interviews but did not have a prior relationship with participants, though many participant’s knew people (i.e., friends or family) from AR’s immediate social network.

Before the interview, AR introduced themselves and provided context about the study (i.e.,
the research was part of her Masters course and clearly outlined the research goals), each participant then provided written informed consent and demographic information, and was given payment. The interviewer discussed the meaning and consequences of open science practices (e.g. transcripts are hosted, with identifying information removed, on an open platform and possibly used in future research) during the consent process to ensure participants were adequately informed. The payment was made before the interview to ensure participants knew that withdrawing consent would not affect their compensation. The interviewer reiterated that participants could stop the interview at any point or not answer any questions that made them uncomfortable. Before the interview ended, the interviewer asked participants if there was anything else they would like to discuss. The interviewer then stated the interview was over, stopped recording and debriefed the participants (See supplementary materials ‘Ethics Documents’).

All interviews were audio recorded via Dictaphone. Each interview was conducted in a location chosen by the participants where they felt most comfortable (e.g., their work, school or home) The interviewer took notes to document any areas for future probing questions and reflexive thoughts (See supplementary material ‘Reflexivity’; Langdridge, 2007; Lazard & McAvoy, 2020). The recordings were transcribed verbatim using pseudonyms generated by AR (See ‘Transcripts’ folder in supplementary materials). We redacted information that we thought could identify participants (e.g. names of people and places) to maintain participant confidentiality. However, the participants were made aware during the consent process that complete anonymity may not be possible within the current research. AR and LW transcribed the interviews. The interview length ranged from 12 to 45 minutes ($M = 21$ minutes).

2.5 Analysis
Data was analysed using reflexive thematic analysis (Braun & Clarke, 2006, 2014, 2019; Clarke et al., 2016) with Nvivo (Mac Version 12) qualitative data analysis software. This method is not tied to a methodological framework, so it was compatible with critical realism (Braun & Clarke, 2019; Fletcher, 2017). Reflexive thematic analysis involves six stages: data familiarisation, initial code generation, theme generation, theme review, theme definition and results write-up (Braun & Clarke, 2006, 2013; Clarke et al., 2016). These stages allowed us to move from the empirical level data to the development of an understanding of underlying mechanisms that impact water drinking behaviour by generating patterns across participants, through qualitative coding (Fletcher, 2017). These patterns are known as demi-regularities in critical realism, and we present these as themes in the current research (Fletcher, 2017).

AR and LW followed the stages of reflexive thematic analysis (Braun & Clark, 2006; Clarke et al, 2016) using the Nvivo platform as a data and analysis management tool (Castleberry & Nolen, 2018; Maher et al., 2018; Silver & Lewins, 2014). They collectively analysed the first two transcripts by discussing and annotating each quote with a description of their interpretation of the participant’s meaning. They used the annotations to create an initial list of codes. Although some initial codes were deductive, as they were influenced by the authors exposure to initial theories on habits and health behaviour (e.g. Grounded Cognition Theory of Motivated Behaviour and Desire), the coding process was also inductive (i.e. data driven). For example, the initial code ‘Situated context that promotes’ in the NVivo file (see ‘Analysis’ in supplementary materials) focuses on situatedness, illustrating the influence of grounded cognition. However, initial codes such as ‘Self-identity’ and ‘Perception of self vs other’ focus on concepts not covered by the Grounded Cognition Theory of Motivated Behaviour and Desire, illustrating inductive coding and the fallibility and limitations of the initial theory. After creating the initial code list, AR and LW coded the
rest of the interviews separately, adding codes when they generated new evidence and interpretations. After initial coding, AR and LW then discussed and grouped or collapsed codes based on similar underlying meaning via hierarchical links in NVivo. AR then generated a tentative thematic framework by reviewing the coded data, hierarchical structure and research questions. All authors then discussed and amended the thematic framework to ensure it was the most coherent account of the data collected. See supplementary material ‘Theme Generation Process’ for an in-depth description.

2.5.1 Analysis of Demographic Differences

We conducted an additional, non-preregistered exploratory analysis after the initial analysis to assess whether the underlying mechanisms from the thematic framework illustrated differences across demographic groups (adapted from analysis procedure see Kuckartz, 2014; Urech et al., 2019). AR filtered the supporting quotes for each subtheme by each demographic grouping (i.e. age, gender and education level) using the ‘Master Table of Supporting Quotes’ (see supplementary materials). AR then read and reviewed the quotes within each sub-group to check for differences. No meaningful differences in the underlying mechanisms were noted during this analysis, so this is not discussed further in the Findings section.

2.5.2 Analysis of Hydration Status

During the interviews, many participants described dehydration and dehydration-related symptoms as cues for water intake, as well as low water intake, which lead to our interpretation that many participants were possibly underhydrated. To investigate this further, we conducted a second non-preregistered exploratory analysis to gain an insight into participants hydration status (Opperman et al., 2014; Silver & Lewins, 2014). AR ran a word frequency query on the 'Bodily Signals' node that contained quotes relating to internal hydration cues, and then recorded and categorised a list of keywords relating to hydration
status. AR then counted the number of interview files in which each word was used in the context of hydration status. This count indicated the number of participants who mentioned the hydration status-related words (possible \( n = 60 \)). See Appendix C for an overview of the search items used.

To assess underhydration via urine colour, AR reviewed all responses (possible \( n = 41 \)) to the urine colour chart questions. Participants whose average daily urine colour range fell within 4 to 8 on the NHS urine chart (Range 1-8) were labelled as underhydrated (categorised by the NHS as “drink more”).

2.5.3 Trustworthiness of Analysis

During the research process, we established trustworthiness of analysis (Korstjens & Moser, 2018) through critical discussion: Persistent observation of the data through continuous discussion between AR and LW while reviewing each other’s coding and annotations, as well as discussions between all researchers during weekly analysis meetings enhanced credibility and transferability. These discussions promoted reflection on, and the exploration of different interpretations that were possible throughout the analysis process (Smith & McGannon, 2018), resulting in rich descriptions of the participants experiences. For example, the researchers carefully considered the credibility of interpretations supporting their theoretical starting point (e.g., the relevance of situatedness). LW had limited exposure to the Grounded Cognition Theory of Desire and Motivated Behaviour and was therefore well placed to challenge analysis that could have been too heavily influenced by deductive reasoning. These discussions also allowed us to assess our prior assumptions, and how these evolved. Dependability and confirmability were ensured by the transparent description of each step of the analysis. For an in-depth description, see ‘Trustworthiness’ in the supplementary materials.

3. Findings
3.1 Contextualising the Findings with Hydration Status

Of the 60 participants, many frequently outlined drinking water in reaction to dehydration symptoms such as thirst \( (n = 38) \), dry mouths and dry/sore throats \( (n = 38) \), discomfort in the head such as headaches or migraines \( (n = 21) \) as well as tiredness \( (n = 14) \). They also described drinking water in response to dehydration explicitly \( (n = 26) \). Hydration was discussed less frequently \( (n = 16) \) and concerned acknowledging the lack of being hydrated as well as the need to be or the state of being hydrated. The prevalence of dehydration symptoms being mentioned in the interviews may suggest that participants are allowing themselves to become mildly to moderately dehydrated before considering water intake.

Additionally, many participants who saw the urine colour chart \( (n = 41) \) reported an average daily urine colour range that was indicative of underhydration \( (n = 14) \). These participants viewed being in the range of approximately C to E on the initial urine colour chart (6-4 on the NHS urine colour chart) as an acceptable hydration level. However, the NHS outline only 1-3 on the urine colour chart as healthy. Participants’ reactions, when confronted with the advice that accompanies the NHS urine colour chart, varied from reasoning with this difference ("I don't pay attention when it’s bad because then, I don't have to worry about it.” - Seth) to surprise ("That’s madness (points at the chart) I need to drink more.” – Jessica). There was also evidence that participants would let their urine colour fall to severely dehydrated levels before feeling the need to change ("I mean 5 or 4 I wouldn’t really do much about it but obviously 6 or 8 I would.”- Gavin). The findings on dehydration symptoms and urine colour are in line with the researchers’ initial interpretations during data collection and analysis that a sizeable proportion of the sample may have been underhydrated.

3.2 Overview of Themes
We generated three themes from the data. Theme 1 covers the tendency for water drinking to exist as situated habits. Its three sub-themes illustrate (1.1) the variety of ways people situate their habit, (1.2) the consequences of these situations with regards to water intake, and (1.3) decision making within versus outside of these situations. Theme 2 covers the knowledge and attitudes underlying participants water intake. Its two sub-themes illustrate the underlying influences of knowledge and attitudes that (2.1) promote or (2.2) limit water intake. Theme 3 covers the strategies participants use during attempts to increase water intake. Its two subthemes illustrate strategies that lead to an (3.1) effective or (3.2) limited increase in water intake. We additionally discuss how each theme influences water drinking in three individual case studies, which are not included within the main text but can be found under ‘Case Studies’ in supplementary materials.

The following sections use supporting quotes taken from the ‘Master Table of Supporting Quotes’ (see supplementary materials) to illustrate each theme. The quotes presented are edited to showcase the relevant narrative of each quote without changing the meaning of the quote. See 'Original vs Edited Supporting Quotes' in supplementary materials for comparison.

3.3: Theme 1 - Water Drinking as Situated Habits

3.3.1: Subtheme 1.1 - Situations Used to Form Water Drinking Habits

Our interpretation identified situatedness as a key concept for understanding water drinking. Habitual water consumption occurred within the context of different internal and external situations, e.g., during specific times, in specific locations or states, or as part of specific, existing routines. When participants were within these situations during the day, they consistently performed water drinking behaviour. See Table 3 for an overview of the critical situations we identified.

Table 1. Overview and description of critical water drinking situations
<table>
<thead>
<tr>
<th>Situation</th>
<th>Type of Situation</th>
<th>Description of Water Drinking Behaviour within Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiencing thirst</td>
<td>Internal physical state</td>
<td>Water intake triggered by physical sensation (e.g. dry mouth).</td>
</tr>
<tr>
<td>Physical exertion, prompting</td>
<td>Internal physical state</td>
<td>Water intake triggered by physical sensation (e.g. sweating during manual labour).</td>
</tr>
<tr>
<td>awareness of thirst cues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being mentally or physically</td>
<td>Internal mood/physical state</td>
<td>Water drinking driven by boredom or increased awareness of thirst cues during boredom. (e.g. drinking between tasks at work).</td>
</tr>
<tr>
<td>idle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larger routine changes</td>
<td>Internal motivated state</td>
<td>Water drinking motivated by other health behaviour changes. (e.g. changing consumption habits to gain better physique for summer).</td>
</tr>
<tr>
<td>Self-identity</td>
<td>Internal state</td>
<td>Water drinking driven by habits that are seen as part of oneself and valuing this behaviour (i.e., water drinking is an extension of the self).</td>
</tr>
<tr>
<td>Warm climates, prompting</td>
<td>External environment</td>
<td>Aspects of the external situation (e.g. sun) act as a cue or cause a change in internal state. Water drinking driven by external environment/physical sensations (e.g. warm day causes increased awareness of thirst cues).</td>
</tr>
<tr>
<td>awareness of thirst cues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education, work and home</td>
<td>External location</td>
<td>Routines performed within external situations prompt water intake or internal situations (e.g. idleness/thirst) that trigger water intake. (e.g. increased awareness of thirst cues during work routine).</td>
</tr>
<tr>
<td>routines</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Specific time-points during the day (i.e. morning, evening and mealtime routines) | External time-point | Routines during specific time-points associated with internal situations (i.e. thirst) trigger water intake. (e.g. drinking before bed).  
---|---|---

Drinking in reaction to thirst cues was a typical internal situation that prompted water intake. For many, experiencing thirst cues was the main situation that prompted water drinking:

“It’s probably that I think I’m thirsty… I’ll just drink it when I’m thirsty.” – Mike (lines 126 - 129)

“I’m very much reacting just to what my body is telling me like, ‘drink now.’” – Eli (lines 255 – 257)

Some participants who situated their water drinking in reaction to thirst cues evidenced having prominent hydration goals in their daily routines. Participants evidenced these goals through their awareness of thirst signals throughout the day:

“I’m conscious that you need to keep hydrated… I’d say that is a motivation for me to know, to make sure that I do hydrate throughout the day” – Mike (lines 314 – 319)

“It tends to be that I’m drinking more than I need to just based on all like all my reflexes mean that I’m normally pretty good... just knowing that I'm not feeling thirsty, and then just needing to go to the loo all the time.” – Eli (lines 355 – 372)
Reacting to thirst cues also occurred in more specific situations where thirst was salient. Situations involving physical exertion were often synonymous with water intake. The participants Seth and Tod situated their water drinking internally in reaction to thirst, but this was more salient during periods of exertion (i.e. sports and manual work respectively):

“I will get very thirsty training because I’m losing a lot of water… from a performance point of view, it's not good to train or play dehydrated. My body personally feels suboptimal if I'm not hydrated so and in fact, typically, that's probably one of the only times when I am quite conscious about drinking” – Seth (lines 291 – 303)

“I think it's just triggered through exertion, like, so if you go to the gym and you're working out, we work out on site every day so you know, people that work out will take a drink, because their body's really telling them it's a subconscious thing for me.” – Tod (lines 286 – 290)

Warmer and dryer climates were also associated with salient thirst cues, where climate includes both weather and indoor atmosphere:

“if it's warmer then I tend to drink more water and that's probably a combination of both knowing that I need to do it. But also maybe feeling dry, which I’m more likely to do if I’m in a hotter climate.” – Joyce (lines 76 – 79)

“working in the hospital it’s very warm, I’ve no windows in my classroom. It's quite a dry atmosphere so maybe that prompts me to drink more water than what I might do when I’m at home or at the weekend.” – Cara (lines 307 – 311)
Internal, mentally and physically idle states were also associated with salient thirst cues. Participants often mentioned drinking water during boredom and natural breaks, during or between tasks, as a form of relief:

“sometimes like boredom or if it's just like having something in my hand or just feeling a bit thirsty, cause my lips get dead dry so I think if I have a drink of water it will like help.” – Catherine (lines 236 – 239)

“the point where I have to stop and there's just some time where otherwise I would just be doing nothing. So, it feels like a very easy, low commitment thing to do.” – Eli (lines 299 – 309)

For some participants’ water drinking was situated more externally, including work, education and home routines. Participant Stuart situated his water drinking within his work routine, where he evidenced awareness of thirst and his hydration goal:

“I really need it during the week because I'm on the move a lot. I'm walking a lot between classrooms. And I do get very dehydrated. The college is quite a dry environment, quite warm and I do get very dehydrated very quickly and then I’ll start getting headaches and things” – Stuart (lines 23 – 30)

Other participants, such as Emily and Jessica, situated their water drinking in education routines. These routines were part of external and internal situations that were conducive to salient thirst cues (i.e. high levels of physical exertion and idle states, respectively):
“it was like a dance course and musical theatre course, you just had it for the day for exercising… your body craves it. So, we would have a big bottle and you would be filling it up by like eleven, twelve o’clock.” – Emily (lines 144 – 153)

“all through Uni... I think it's listening to people. Like you know, that kind of- you’ve got nothing else to do. It's almost like a boredom thing. So, I’ll drink a lot of water then.” – Jessica (lines 237 – 242)

Participants Mary and Tod associated being at home with making water readily accessible to themselves. Specifically, Tod’s home routine allowed him to drink water where other situations did not:

“When I came in from work today… the first thing I did when I came in was have a pint of water… because I probably hadn’t had enough during the day” – Tod (lines 234 – 250)

“I have a bottle with me all the time and if I’m sitting watching the telly or something... I just lift it and drink it.” – Mary (lines 263 – 266)

Water drinking was also situated externally during specific time-points throughout the day, for example during morning, evening, and mealtime routines. Water drinking was often a by-product of mealtime routines. Some participants saw water as a necessity and cleansing in this situation:
“I’ve always just drunk when I’m having a meal. I like to drink to obviously to clear your throat … always like a pint (568 mL measure) with my dinner because one glass isn’t enough” – Lucy (lines 354 – 360)

Water was a part of some participants’ morning routines due to more salient thirst cues, which likely came from a prolonged period without hydration during sleep:

“I just feel thirsty. I also feel like it kind of wakes you up a wee bit when- if you feel a bit groggy.” – Jessica (lines 224 – 226)

Water was a part of some participants’ evening routines. They drank water in preparation for the extended period during sleep that it would be inaccessible or in reaction to dehydration brought on from limited fluid intake during the day:

“I drink a glass of water and then I go through and wash my face and hands and clean my teeth before I go to bed.” – Joyce (lines 180 – 189)

“after I’ve brushed my teeth at night, I guzzle water like an absolute Goblin straight from the tap. And it's really weird because I don't really do that at any other point through the day” – Sarah (lines 85 – 88)

Water drinking habits also piggybacked onto larger routine changes. In these cases, drinking water was a by-product of a more considerable internal and external routine change, rather than a goal itself. These routine changes usually involved strong motivational states.
Participants Seth and Lucian were motivated to increase daily life organisation and obtain a particular body image respectively, which led to increased water intake:

“I'm doing everything or I'm doing almost nothing. So, if I get into like, good routines which typically involves preparing my schedule… I do all the other things I need to do like getting up early and doing exercise and eating properly and stuff like that.” – Seth (lines 507 – 519)

“Like the closer it gets to the summer the more I feel exposed so the more motivated I am to, like engage with healthy behaviours and water is one of them.” – Lucian (lines 510 – 522)

Finally, two participants perceived water drinking as part of their self-identity. These participants spoke about water drinking as though it was an extension of themselves:

“it’s just been part of me for so long, even before it became all the hype.” – Cara (lines 262 – 268)

They drank water consistently across a wide variety of external and internal situations:

“it's just a part of my everyday life is to sip on water throughout the day.” – Cara (lines 244 – 250)

“it's just like anywhere I am I always have water.” – Matilda (lines 266 – 271)
They also viewed water drinking as a positive aspect of their life. The participant Matilda linked water drinking to something people see as “virtuous”, and she internalised this perception because people reaffirmed it:

“there are certain kind of things you consider positively about yourself. Like productivity or being healthy that are kind of seen as virtuous or whatever, which is kind of screwed up… I think it actually became part of my identity because people commented on it so much.” – Matilda (lines 487 – 495)

In sum, participants situated their water drinking habits within a variety of different routines, and such routines were linked to both external and internal situations.

3.3.2: Subtheme 1.2 - The Limited Nature and Breakdown of Situated Water Drinking Habits

Participants’ descriptions of their water drinking suggested that the nature of the situations used to maintain this behaviour is important, as it has consequences on the amount and the consistency of their water intake. Many participants who situated their water drinking in reaction to thirst did not perform this behaviour consistently during the day. We interpreted two possible reasons for this: (1) hydration was not a goal, and (2) there was a lack of awareness of thirst cues. Some participants illustrated that hydration in itself was not a salient goal in their daily routines:

“I don’t tend to think, ‘oh, I should keep myself hydrated,’ because of our climate… I don't feel the necessity to go and drink water.” – Gina (lines 153 – 163)

Additionally, some participants lacked awareness of thirst cues leading to low water intake:
“I typically would not have any sort of conscious effort to drink water. I’d drink if I was thirsty… I’m certainly sure there are days where I wouldn’t drink any water.” – Seth (lines 9 – 12)

“it's not till the end of the day. If like I’ve not peed all day and I'm like, ‘oh my god I've actually not drank anything today,’” – Jessica (lines 156 – 165)

Finally, some participants also evidenced suppression of thirst, and ignored thirst until other dehydration symptoms were salient:

“sometimes I just like, ignore that feeling of being thirsty until I'm like, you know, like lightheaded or something.” – Nelly (lines 424 – 427)

One reason for the lack of awareness and suppression of thirst cues was distraction and forgetfulness. Participants’ external environment impacted their ability to be conscious of and react to thirst cues. For example, hydration goals and awareness of thirst cues diminished during work:

“I suppose it just slips off your radar and you just don't stop.” – Annie (lines 287 – 297)

“when you're busy, you just don't even realise that you're not drinking it but the day just goes away with you.” – Rachel (lines 102 – 108)
The participant John illustrated that the absence of water drinking was not due to a lack of need. The interview gave him the time to reflect and realise that he was thirsty; however, his usual work routine did not allow for this:

“just now I could quite happily go and have something to drink but I think the pace that we work in here... means that you don't always make the time” – John (lines 77 – 83)

When participants directed their focus externally, for example in work settings the prompts for water drinking as a self-care behaviour (i.e. internal need) were not salient:

“I'm focused on other people's needs and what is expected of me. So, if I'm going to work- and therefore, I wouldn't have it at the forefront of my mind.” – Gina (lines 346 – 357)

Water drinking also decreased when the situation was not present. Consequently, outside of work, education or mealtime routines, water intake diminished:

“It's like I forget to drink water. I think as well at uni everyone else has always got a bottle of water, so it's like, just easier to drink water than anything else. And then at home, I can have a cup of tea, which is easier to have a cup of tea at home than it is at uni so I’d just rather have that.” – Jessica (lines 120 – 130)

"it was drummed into you that you have like breakfast, lunch and dinner and because we work right over lunchtime and probably right over dinner time, sometimes... it's not until your body's actually at the point of sheer craving it. ‘shit I haven’t had a drink today, I should have a drink.’” – Emily (lines 401 – 412)
Highly specific situated water drinking such as during evening routines and relying on warmer weather in Scotland occur so infrequently that they lead to low water intake:

“So, I am my own worst enemy. Cause I'm going into people and saying, ‘you're not drinking enough,’ and I’m going the full day and not having a drink till it’s eight o’clock.” – Sarah (lines 503 – 509)

“more in the summer you know, we've got a water machine at work and it's free. I don't really drink it in the wintertime… and I avoid water as well during the winter. I just prefer something hot.” – Ben (lines 99 – 107)

Participants who perceived drinking water as part of their self-identity did not suffer the limitations that are illustrated by participants who use other situations. Situating water consumption within self-identity was associated with consistent water intake across a variety of internal and external situations.

3.3.3: Subtheme 1.3 - Decision Making Within versus Outside of Situations Where Water Drinking is Habitual

It is useful to explore the nature of decision-making within versus outside of the situations previously outlined to understand the impact situatedness has on water drinking habits. The decision to drink water within situations where water drinking is habitual is automatic and effortless. Participant Eli’s water drinking takes no physical or mental effort:

“it's just kind of there and over and you don't have to think about it. There’s no, like change of state or anything.” – Eli (lines 311 – 316)
For some participants water drinking was so automatic that they could not describe the underlying thought process and instead just acted out the behaviour:

“you know that way when you like pick up your phone. That kind of thing, just like a- I’ll just be like (picks up bottle and takes a sip).” – Matilda (lines 124 – 128)

In situations where water drinking was not habitual, the decision to drink water appeared to be deliberate and effortful. When participants discussed the behaviour or preparing and drinking water, this appeared very simple in itself. However, when thinking of preparing and drinking water in the context of situations where no water drinking habit existed, this was perceived as much more challenging:

“it sounds really stupid like filling up a water bottle in the morning, but when you’re getting up in the morning and getting everybody ready to go out and making three packed lunches, just all those wee things… I know it's just pouring it up from the tap but it's just that it's not easy” – Dana (lines 154 – 167)

“I can be between meetings, I can have a whole day of back to back meetings. I can be out visiting schools. So, in terms of making time to do that (drink water) I would need to consciously do that.” – John (lines 67 - 71)

In other words, participants viewed water drinking as both effortless and effortful, depending on which situation they positioned this behaviour in, and whether water drinking was habitual or not.
3.4: Theme 2 - Knowledge and Attitudes Underlying Water Intake

This theme discusses how concepts such as identity-relevance, value, knowledge and experience of water’s perceived benefits, as well as social and health factors influenced participants’ knowledge and attitudes on whether they should be drinking water or not. These knowledge and attitudes acted as a motivation to drink water for some, but not all participants. Specifically, some participants had knowledge about the health benefits and importance of hydration, as well as positive attitudes towards drinking water, but were still not motivated to do so.

3.4.1 Subtheme 2.1 - Knowledge and Attitudes that Promote Water Intake

Participants who drank adequate amounts of water valued hydration as a goal and perceived water to be positive:

“you’ve got tae keep yourself hydrated.” – Alex (lines 209 – 215)

“if people realised how great drinking water was they would do it to (laughs).” – Matilda (lines 464 – 469)

They also had an experience of or were convinced of the perceived benefits they associated with water. Some participants could give tangible examples of water being beneficial in aspects of daily life (i.e. performance and mood states, respectively):

“to be dehydrated would then have a knock-on effect like with the children. If I wasn't concentrating or if like I had a sore head… would then affect how I was presenting myself towards the children.” – Catherine (lines 577 – 585)
"sometimes even if I'm a bit anxious, I'll have some water... so I think water improves my mood. Okay, but I'm not sure that it actually does. It feels like it at least." – Daniel (lines 96 – 101)

Other participants did not experience such benefits, but believed in water being healthy more generally. The participant Matilda related water drinking to other culturally accepted health behaviours such as yoga, despite not understanding the long-term health consequences of underhydration. Performing this behaviour made Matilda feel good about herself:

“I feel like it's not the end of the world if people don’t drink water like I mean does it have any long-term health kinda issues? Is it a big deal? I don't know” – Matilda (lines 509 – 515)

“it's like that kind of dumb thing where you say you’ve been to the gym or you say you’ve been to yoga or something you're just like, “yeah I’ve been to yoga today,”… And like your skin is better and you feel kind of like a bit flushed out. I always crave like crap food when I’m unhydrated.” – Matilda (lines 475 – 481)

Early education and peer influence also aided in learning the value of hydration and promoted the preference for water:

“I suppose cuz I played sports from a young age even in my day, there was always a big emphasis on hydration in playing sports. So, there's a drive from a very young age.” – Mike (lines 425 – 432)
“my parents are very against like soft drinks and stuff when water is there. So, I have just never known anything different.” – Eli (lines 259 – 273)

In contrast, late-onset health influences prompted increased water intake in the older participants, as they reappraised the value of water for their health:

“I got diagnosed with fibromyalgia about 20 years ago. So, I try to- no that I had a bad diet, but I tried to make it help as much as it could with it.” – Alex (lines 25 – 28)

“I was diagnosed as diabetic, so that made me probably more conscious of what I was drinking and to get it under control and stable.” – Karen (lines 103 – 110)

These influences provided participants with knowledge and positive attitudes surrounding, water as they understood why they should be drinking water and formed an intention to drink water. The majority of participants understood the general need to drink water. However, those who drank water consistently also valued this behaviour and had specific, first-hand experience or knowledge of why they should drink it (i.e. health benefits), as well as positive peer influences or an influential health diagnosis (e.g., diabetes).

3.4.2 Subtheme 2.2 - Knowledge and Attitudes that Limit Water Intake

Participants who drank inadequate amounts of water knew that they should drink more water, but did not know why. Many participants perceived water merely as a non-negative or neutral drink, rather than positive in and of itself. In other words, water was seen as healthy because it did not have the negative consequences of sugar-sweetened beverages:
“Because it's better, it's not got all the like horrible chemical- well it probably does- I don’t actually know but like to me, in my head it's better than cola, diluting juice, anything like that.” – Sarah (lines 442 – 445)

“No, I don’t think water has any benefits to it, it’s no (not) bad for you.” – Nathan (lines 392 – 331)

Additionally, participants had no belief or experience of the perceived benefits of water:

“Eh a lack of motivation or awareness of the negative impact of not doing it.” – Seth (lines 350 – 355)

When they listed benefits, it seemed as though they simply recited information they presumably had been exposed to:

“'you’ve got a headache, oh that’s cause you’ve not drank enough water.' I don't know if that's even a thing. I don't know but apparently people think it's a thing so, therefore it is.” – Paul (lines 425 – 430)

There was also very little influence from the input of peers and health professionals in participants with low water intake. The participant Anna was told by a health professional that she was dehydrated and needed to increase her water intake. However, this had a limited impact as Anna's strategy for change conflicted with medical advice:
These influences provided participants with limited knowledge and negative attitudes towards water as they did not understand why they should be drinking water and therefore were not motivated to drink water.

3.5: Theme 3 - Strategies Underlying Attempts to Increase Water Intake

The research process generated a lot of data on participants’ attempts to change their water drinking behaviour. This is because many participants discussed water drinking as something they should do or had previously tried to do, rather than something they were doing consistently at the time of the interview. Despite having no prior goal to collect this type of data, the researchers felt it was important that the analysis and findings reflected the data on participants’ attempts to change their water intake. Therefore, this theme discusses how participants reactions to barriers, assessment of their current drinking habits, as well as the connection between their knowledge and attitudes on water drinking, impact the effectiveness of strategies they used to increase water intake.

3.5.1: Subtheme 3.1 - Strategies that Underlie Effective Attempts to Increase Water Intake

Participants who successfully increased their water intake implemented effective behavioural change strategies. Although barriers were present, the participants had tools to deal with them. For example, when distraction and forgetfulness caused a decrease in water intake, the participant Gillian rectified this via goal setting:

“just been busy... It goes out my head and look at my bottle and think, ‘oh god I’ve not even drank anything today,’… I need to keep drinking, to drink more get this bottle finished before I leave.” – Gillian (lines 383 – 394)
Participant Brett staged his increased water intake to deal with the limited time frame he perceived to have for water drinking:

“I tend to have a drink of water and finish it… Whereas I know if I have a bottle of water and drink it in small sips it is more beneficial. I'm not quite at that stage.” – Brett (lines 129 – 135)

Participant Catherine bought a bottle with visual prompts for how much she had drunk to allow her to assess her intake accurately:

“I was just drinking… I don't think I knew how much litres was in my bottle, whereas this one actually tells me how much was on it. So I've got like a visual like everyday like, ‘I filled that up twice, so that's a litre and a half.’” – Catherine (lines 560 – 565)

For participants Karen and Alex, their retirement removed the barriers they used to face within their work routines. They had more time to focus on their internal needs and perform the self-care behaviour of water drinking:

“I've got more freedom to go and get it when I want it rather than think, “I must go and get a drink.” So, I would definitely say I drink a considerably more. When I was working, I would think about it more than actually physically did it.” – Karen (lines 343 – 355)

“I've got more time on my hands tae (to) do… what I’m wanting to do.” – Alex (lines 255 – 261)
Participants also realised the limitation of only drinking water consistently in one situation and situated the increase in water intake across multiple situations:

“I just thought, ‘I don't actually drink an awful lot of water out with when I'm doing an exercise.’ So, I started to think I need to drink some more water and I just got into it.” – Brett (lines 87 – 96)

These participants understood how to increase their water intake effectively in the context of their existing situated water drinking habits and other behavioural routines throughout the day. It is also important to note that these participants generally had knowledge and attitudes that promoted water intake to begin with.

### Subtheme 3.2 - Strategies that Underlie Limited Attempts to Increase Water Intake

Even when participants intended to increase their water intake, sometimes they lacked the tools and knowledge on how to do this effectively. Barriers were salient and stopped the increase in water intake before an attempt at change was made. When participant John tried to think of how he could drink more water, he quickly started describing the barriers that he faced:

“I think it would be possible to do… the water bottle with the times and so on, that's not really feasible for me because I could be in meetings, I could be in other places so I then would be guzzling water at various points to try and make it up.” – John (lines 380 – 385)

Additionally, for some participants, the tool used to combat barriers was ineffective. Participant Tod tried to use reminders as a tool for change, but the barrier of distraction was too prominent for this to work:
“it's just 1000 miles an hour… So, I need somebody giving me a wee reminder… and then I’ve actually been that busy that I haven't gotten any.” – Tod (lines 485 – 501)

Participants also evidenced passive reactions to noticing that their daily water intake was low. When they realised barriers such as distraction and forgetfulness had inhibited water intake, they did nothing to rectify this:

“Just you sit and you forget. You think to yourself- you go to bed and think, 'oh I should of drunk more.'” – Fran (lines 326 – 328)

The barrier of taste and perceiving other options as more rewarding also made changing to water difficult:

“They’re (sugar-sweetened beverages) more appealing… if it's a cold drink, it's back to if it’s a fizzy drink it’s got taste to it so you know it tends to- I don’t know it’s almost an energising feel about it, in a way.” – Harry (lines 331 – 343)

“Other things feel like more of a treat. Like water’s free and water’s always available so you probably just get used to it being there.” – Tim (lines 295 – 300)

Participants also perceived drinking water as going against the social norm in specific environments, such as work-related meetings where tea and coffee were available:
“hot drink it’s cause it’s cosy in the mornings, it’s cosy at nights. It's a social thing for meetings or when I’m out at schools.” – Ted (lines 294 – 301)

Participants lacked insight into behavioural change strategies. When participants were asked to think of strategies, they could use to increase their water intake, they turned to humour or could not articulate what strategy they would use:

“Eh mix it in my vodka (laughs)… it probably won’t change because that’s just the way I’ve always kinda of been. I cannae see it changing.” – Sean (lines 411 – 418)

“I think should drink more water and probably be mindful of that. So, probably I don't know whether- quite if I would set myself- you know I don't know whether I read somewhere or saw somewhere that you actually should drink- I can't remember if it's as much as- eight pints seems an awful lot.” – Gina (lines 383 – 391)

Increasing water intake was possible; however, the nature of this change was limited. For example, participant Mary had previously made an effort to change to water and now drinks it at home but still only drinks coffee at work:

“I've never really about bringing that in with me, probably if I did dae (do) it I would do it all the time. But because I've never done it, I just don't bother.” – Mary (lines 407 – 410)

After health practitioner input, the participant Anna now drinks a 500ml bottle of flavoured water at work but does not drink water in any other situation:
“I’ve got a bottle of water sitting on my desk the now. Flavoured bottled water. Yeah that’s sitting on the desk just now.” – Anna (lines 127 – 130)

Understanding ineffective strategies to increase water intake involves two considerations: (1) participants had knowledge and attitudes that limited water intake and (2) they did not know how to make changes to their water intake effectively. This can be seen in the disconnect between participant's knowledge, attitudes, intentions and behaviours:

“it's stupid… so my advice to myself would be you know the benefits of drinking more water, so why aren’t you doing it.” – Dana (lines 455 – 457)

“It’s classic- it’s do as I say, not as I do… because although you may be well aware, but the motivation for you to do it yourself is often not there.” – Aaron (lines 452 – 458)

The participant Annie, as a health practitioner, advises people to drink water and does not heed the advice herself:

“I know the theory that the healthy option- I should drink more water and as the clearest and the best drink to quench your thirst and purity etc, etc but it is just getting the mindset.” – Annie (lines 211 – 218)

In sum, participants did not understand how to increase their water intake effectively in the context of the daily situations they were in. This seemed to limit the successful execution of behavioural change. Additionally, these participants had knowledge and attitudes that limited water intake.
4. Discussion

4.1. Summary

Through in-dept interviews and thematic analysis, this research identified key motivational processes that prompt and hinder water drinking, and that drive strategies used to increase water intake. Our analysis identified three main themes, namely that habitual water drinking exists in the context of different internal and external situations, the knowledge and attitudes that promote or limit water intake, and the difference in effective and limited strategies used to increase water intake.

Participants formed and maintained their water drinking habits within specific situations (e.g., specific times, locations, internal states or routines). Within these situations, participants reported regularly drinking water. However, the nature of the situations participants used to maintain this behaviour impacted the amount and consistency of their water intake. Participants who used only one key situation (e.g. drinking during their work routine or during physical exertion), had low and inconsistent intake when they were not in this situation. Some situations happened so infrequently during the day (e.g. drinking before bed or during warm days) that participants’ daily water intake was low. Many participants situated water drinking in response to thirst cues, but these, were easily suppressed or went unnoticed, leading to unreliable water drinking habits. Thirst cues were suppressed or ignored due to external demands (e.g. work) leading to internal states (e.g. distraction) that hindered water intake. Participants who saw water drinking as part of their self-identity had high and consistent water intake across a variety of internal and external situations.

Unexpectedly, few participants perceived drinking water as a goal. Many participants were also not aware of the importance of maintaining adequate levels of hydration, the benefits of drinking water, and the reasons for both. This limited water intake and highlights important considerations for understanding the strategies used to increase water intake.
Effective strategies at increasing water intake seemed to be supported by adequate knowledge and positive attitudes towards water (e.g. understanding or believing that why water is important), as well as understanding how to implement change regarding situated habits. Participants who described effective strategies viewed water positively and had experience of, or belief in water’s benefits. They were also able to identify barriers to water intake and put changes in place to overcome these. Conversely, ineffective strategies seemed to be coupled with limited knowledge negative attitudes towards water (e.g. a lack of understanding or belief that water drinking is important). Participants who described ineffective strategies viewed water neutrally and had no experience of, or belief in water’s benefits. Additionally, ineffective attempts to increase intake were often discussed in the context of passive reactions to prominent perceived barriers (e.g. distraction), and in the context of participants’ failures to implement habit change effectively. In other words, participants struggled to situate their new water drinking habits (Gardner & Lally, 2018).

Overall, our findings suggest that habits are crucial in water intake, and may be the key determinant of whether participants consume sufficient water or not. Both when participants described their typical water intake throughout the day, when they described their knowledge and attitudes towards water and when they described attempts to increase their water intake, the integration of water consumption into frequently occurring situations was the most important factor influencing whether participants regularly consumed water or not. In line with dual-process models (Hofmann et al., 2008), water drinking was an effortless activity when it was habitual (i.e. nonconscious pathway), but laborious and less frequent when it was not (i.e. conscious pathway).

Our analysis also provides tentative evidence that a large proportion of participants were underhydrated. Specifically, participants frequently discussed experiencing mild to moderate dehydration symptoms and had a urine colour range that the NHS classified as
needing to “drink more”. This evidence is in line with findings from quantitative research, which showed that a large proportion of people in the UK have low water intake (Gibson & Shirreffs, 2013). Given the negative health implications of underhydration (Armstrong & Johnson, 2018), this finding underlines again the need to study hydration and water drinking behaviours in order to inform attempts at health behaviour change.

4.1 Theoretical Considerations and Implications

4.1.1 Situatedness of water drinking habits

The ways that participants situated their water drinking habits (i.e. situatedness) is a crucial concept in understanding this behaviour. Situatedness is also crucial in understanding other consumption habits such as food, sugar-sweetened beverages and alcohol habits (Papies, 2020), and in the habits literature more generally. Gardner (2015) argues that habits can be conceptualised “as a process by which a stimulus automatically generates an impulse towards action, based on learned stimulus-response associations.” The current findings illustrate that the critical stimuli in this understanding of habits can involve a wide variety of cues and context features, which shape the activation and performance of learned responses. In other words, it is not sufficient to understand water drinking habits as the behavioural response to perceiving an associated situated stimulus, such as a water dispenser. Other contextual factors, for example internal cues (e.g., thirst), concurrent goals (e.g., socializing, impression management, self-care), and cognitive states (e.g., idleness, distraction), can serve as contextual modulators of the stimulus-response association, or can themselves serve as cues to trigger water consumption.

This understanding of habits is consistent with the Grounded Cognition Theory of Desire and Motivated Behaviour (Papies et al., 2017, 2020; Papies & Barsalou, 2015). This theory suggests that habitual behaviour can result from comprehensive memory structures called “situated conceptualisations” that have been formed during previous appetitive
behaviours, and which can include information about sensory experiences, as well as time, physical and social context, internal states (Papies & Barsalou, 2015). This theory illustrates possible reasons why current water drinking habits lead to a low desire for and intake of water. Our research suggests that many participants’ situated conceptualisations of drinking water (i.e. their cognitive representations of drinking water stored in memory) involve reacting to dehydration cues during specific situations such as physical exertion. However, the salience of dehydration cues is typically not high, which limits frequency of activation of this situated conceptualisation. Research suggests that more salient and accessible cues facilitate habit formation (Gardner & Lally, 2018). In our research, water drinking cues frequently did not seem to meet this requirement.

Participants associated water drinking with limited short-term and long-term rewards, as they did not value the taste or perceived quality of water very much, and did not have deep knowledge of the health benefits of drinking water. Perceived short-term rewards, especially from taste and pleasure, were much more salient for other drinks. Research in the context of the grounded cognition theory of desire suggests that spontaneous simulations, or re-experiences, of the rewarding aspects of previous consumption episodes can lead to desire and motivated behaviour (Papies Barsalou, & Rusz, 2020), and that these are more salient for sugar-sweetened beverages than for water (Papies, Claassen, Rusz, & Best, 2021). This can explain why cues of other drinks, for example sugar-sweetened beverages, are more likely to trigger consumption than water cues. The expectation and experience of reward are important for the intention to perform a behaviour (Wood & Neal, 2016), and for the maintenance of habitual behaviours (Gardner & Lally, 2018). Expectation and experience of reward were typically not evident in water drinking behaviours.

4.1.2 Automaticity of water drinking habits
Gardner and colleagues (2016) have suggested that health-related habitual behaviour can be broken down into (1) habitually initiated behaviour that takes conscious effort to perform and (2) habitually performed behaviour that takes either conscious or automatic pathways to initiate. They also suggested that this distinction may not be necessary for drinking water, which they characterise as a simple health behaviour (Gardner, 2015; Gardner et al., 2016). However, our research suggests that when participants thought of drinking water in a new situations, this behaviour was challenging to perform. This suggests that the distinction between habitually initiated and habitually performed behaviour may also be appropriate for the seemingly simple habit of water drinking, as we will explain below.

Illustrating habitually initiated behaviour, some participants habitually reacted to thirst, but needed to make a conscious effort to obtain water. At times, then, barriers such as distraction and perceived effort prevented them from drinking water. Illustrating consciously initiated but habitually performed behaviour, on the other hand, some participants made a conscious effort to ensure water was readily available to themselves (i.e. filling up a bottle). Then, once it was available, they drank from it automatically. However, when participants did not make the initial conscious effort, regular water drinking did not occur. Finally, habitual behaviour that was both habitually initiated and habitually performed was evidenced by participants who perceived drinking water as part of their self-identity. For these participants, water drinking was done effortlessly across situations. This more fine-grained analysis of the role of habits in the different behavioural components of water drinking illustrates that conscious and unconscious pathways can co-exist within one habitual behaviour, and it can increase our understanding of why water drinking habits sometimes fail. It can also help identify the most effective points of intervention for a given individual, namely that aspect of behaviour that has not been habitualised yet.
Previous research has also linked highly automatic, goal-related habits to self-identity, which is the mental depiction a person holds about who they are (Verplanken & Sui, 2019).

In line with this, we found that participants who saw water drinking habits as part of their self-identity seemed to have the most consistent and adequate water intake. This is also consistent with recent findings showing an association between self-identity and healthy eating habits. The inclusion of a health-conscious self-identity within the Theory of Planned Behaviour added predictive value concerning fruit and vegetable consumption intentions (Canova et al., 2020; Jung & Bice, 2019) and behaviour (Carfora et al., 2016; McCarthy et al., 2017). Smit et al., (2018) also showed that intrinsic motivation, which may reflect a motivation tied to one’s self-identity, was the strongest predictor of water consumption in adolescents. Interventions that try to generate valued hydration goals and habitual water drinking could develop water drinking habits as part of people’s self-identity. However, the findings on self-identity in the literature so far are limited, and in the current study, identity theory was only considered in-depth at the analysis stage. Future research could address these mechanisms more directly.

### 4.1.4 Water Drinking and Behavioural Change Theory

In the context of the Transtheoretical Model of Behavioural Change (Prochaska et al., 2008), our finding suggest that the majority of participants can be placed within the precontemplation or contemplation phase of the behaviour change trajectory. Many participants lacked the knowledge and experience of the health impact of underhydration, did not hold hydration as a goal, and had little or no intention to change their water drinking behaviour. Participants who showed evidence of being in the contemplation phase brought up the situated barriers (e.g. distraction) to water intake as more salient than the perceived rewards from drinking water, which were seen as limited.
Participants also lacked insight into what strategies to use to form water drinking habits effectively. They were often unsuccessful during the action and maintenance phases. They spoke about their water drinking in terms of something they had tried and failed to change previously. The strategies used to prompt and maintain change were not effective in the daily-life situations participants experienced. These findings suggest that interventions are needed to create knowledge and goals surrounding hydration, as well as giving people situated tools for how to change. For many people, this also means resisting the temptation of sugar-sweetened beverages, which are strongly associated with taste and pleasure (Papies, et al., 2020), and replacing them with water, which most participants here did not describe as positive or rewarding. As a result, behaviour change in the domain of water drinking needs interventions that can change the cognitive structures underlying health behaviours, such as knowledge, associations, or impulses, as well as interventions that can provide cues for the desired behaviour at critical decision points, to incorporate water consumption into various situations during the day and ultimately create situated water drinking habits (i.e., both training and cueing interventions; Papies, 2017).

4.2 Applied Implications

The current research has implications which could be of interest to a variety of readers with applied interests, from developers of large-scale health interventions to individual health practitioners. Our findings suggest that interventions need to educate people on the benefits and consequences associated with hydration and water intake, given the lack of knowledge and hydration goals evidenced. More research is needed to understand effective forms of educational messaging, as many participants in this study did not feel motivated to act on their current, rather general knowledge surrounding water intake and hydration. Interventions also need to develop strategies to combat the existing social norms that lead to
the consumption of other drinks as described in this study (e.g. coffee/tea in the workplace, preference for sugar-sweetened beverages due to taste), at least within the Scottish context.

Although there has been a significant push within Scotland in the past few decades towards healthy eating (Policy Context - ScotPHO, 2019), hydration is not one of the primary public health policy considerations. The annual Scottish Health Survey, commissioned by the Scottish government, addresses numerous drink consumption behaviours (i.e. alcohol and sugar-sweetened beverages) but collects no information on water consumption (Scottish Government, 2018). The addition of water drinking behaviour and hydration measures to this survey could give invaluable insights into hydration status. If hydration was a primary policy consideration, this could lead to more public health messaging educating the general public on the importance of hydration and water intake, as well as challenge existing social norms for other drinks by normalising water intake. As a result, for example, workplace caterers could feel encouraged to always provide water alongside tea and coffee, and to provide water dispensers in offices, schools, and public buildings. Similarly, local authorities could be encouraged to work harder to make water available across indoor and outdoor spaces in public life, in order to facilitate situated habit development by providing easy access to consumption and bottle refilling opportunities. Increasing the visibility and accessibility of water in these ways could facilitate habit development as well as supportive social norms, which could then further encourage people to form healthy water habits.

Our findings also suggest that health practitioners may need to outline better why hydration is important and help people develop strategies that would be effective within their daily life and routine behaviours. A survey of dieticians in the UK illustrated that only 50% of the participating dieticians were aware of the adequate water intake guidelines, and 24% did not mention hydration during a practical session (Douglas et al., 2015). However, based on our finding, simply telling people to drink more does not seem to be effective to increase
their intake. Rather, health practitioners would first need to educate people on the benefits of increased water intake and the consequences of underhydration. Health practitioners also need to help people identify situations where they are not drinking water, possible barriers to water drinking in these situations, and potential strategies to overcome these barriers. For example, someone who is struggling to drink more water at work because they are busy and get distracted could try and counter this by making sure they have a water bottle readily available to them on their desk, or that they carry water with them during their workday.

Our findings also align with previous research (Millard-Stafford et al., 2012) showing that relying on thirst cues may not be sufficient to ensure adequate hydration. As an example, a recent news article (Fleming, 2020) cites an academic and a health professional endorsing the view that if people drink when they are thirsty, they will maintain adequate hydration levels. However, our research suggests that this advice is not likely to be useful due to the lack of awareness and suppression of thirst cues evidenced in all age groups throughout their daily lives. More research on water drinking habits and hydration is needed to challenge and improve the current understanding of health practitioners, researchers and the public.

4.3 Strengths and Limitations

A strength of this research is the use of a large sample within our qualitative approach, which was justified given the lack of understanding on water drinking habits (Braun et al., 2020; Malterud et al., 2016). This sampling approach allowed for a broad array of experiences and underlying mechanisms to be documented and analysed. Consequently, the trustworthiness of the research findings is strong, as they represent a thorough investigation into the generalised mechanisms that underlie a variety of lived experience of water drinking behaviour. The mechanisms we have outlined in our research are also consistent across the demographic groups. Finally, the qualitative approach allowed for
laypersons’ experiences to challenge the assumptions that we as researchers held on water drinking behaviours from our reading of the literature so far.

However, the transferability of our research findings is likely limited to cultural and environmental contexts that are similar to Scotland. The large sample and limited time frame of this research also produced superficial findings (e.g. self-identity) that need to be addressed in depth in further research. Additionally, we could not explore and report all potentially interesting and novel findings of the data within the current discussion. The use of semi-structured interviews may have stifled exploration into components of water drinking behaviour that we had not considered. We also acknowledge that the theoretical lenses (i.e. critical realism and the Grounded Cognition Theory of Desire and Motivated Behaviour) used in this research are not the only plausible theoretical lenses for addressing the current topic. Using a purely inductive approach, or a similar approach influenced by a different theoretical model, could lead to a different, but still valuable interpretation of the data we have presented. Finally, the lack of meaningful differences between the demographic sub-groups does not illustrate that no differences existed. Instead, the lack of differences is more likely a reflection of limitations in the research approach. We were focused on a broad overview of underlying mechanisms rather than an in-depth demographic comparison (Braun et al., 2020; Malterud et al., 2016). Further research should explore how the underlying mechanisms of water drinking habits differ across demographic groups.

4.4 Future Research

Given the likely prevalence of underhydration and its adverse health effects, we argue that water drinking needs to be researched more. Biological approaches dominate current hydration research, and our research shows a need to incorporate research on psychological and motivational mechanisms. For example, future research could test the hypotheses generated here that situated habits are a key predictor of water intake, that drinking in
response to thirst cues only is associated with underhydration, and that habits which cut
across many situations will be associated with healthier water intake than more restricted
water habits. Future research could further address the experience of subjective thirst and
how this relates to biomarkers of hydration and cues water drinking behaviour. More research
from different theoretical perspectives and methodological approaches is also needed to
assess water drinking habit formation, maintenance and behavioural change. Doing this will
allow for the current findings to be challenged or corroborated through the triangulation of
evidence. Findings from the current study can also be used to update items in quantitative
measures that assess what predicts water drinking habits in more large-scale quantitative
studies. A better understanding of water drinking can inform the development of health
interventions to effectively increase water drinking and fully leverage its health benefits.

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Declaration of Interest
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Hydration for Health Scientific Conference and the European Federation of the Associations
of Dietitians 2019 Conference, and registration fees to attend the 2020 European and
International Congress on Obesity.

References


http://www.pearsoned.co.uk/Bookshop/detail.asp?item=100000000090830


Appendix A

Table A1

Younger participant age group (18-35 years) demographic information

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Table A2

*Middle participant age group (36-55 years) demographic information*

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*Older participant age group (56+ years) demographic information*

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Appendix B

Interview questions were formatted to prompt open-ended responses. Open-ended questions are used to facilitate the researchers’ understanding of the phenomenon as experienced by the respondent (Moser & Korstjens, 2018). These questions prompt responses that allow the researcher to generate meaning, interpretations and new ideas more than closed questions (Moser & Korstjens, 2018). Throughout the interview procedure the researcher used variations of the following statement to try a reduce participants generating perceived desirable responses:

“Throughout this interview it is important to note there is no right/wrong way to answer the questions. We want to know what you think and your truth. It won’t serve me to tell me what you think I want to hear.”

The prompts listed were suggestions that were used at the researcher’s discretion based on the information already provided by participant answers.

Warm-up questions

1. Can you walk me through a typical day and tell me what you drink during this? I don’t mean alcohol.

   The following questions should be addressed throughout the answer but will be prompted if not: what kind of drinks, how much, where/when you are drinking these drinks?

2. Can I get you to think about tap water and tell me how you would describe this right now?

   Prompt: Say whatever comes to mind

2.1 Can I get you to think about bottled water and tell me how you would describe this right now?

   Prompt: Say whatever comes to mind

2.3 When do you drink bottled still/sparkling water?
Prompt: when (i.e. what situations) and why in regard to any preferences?

**Main questions**

3. “Could you give an example of a situation/setting where you drank water?”
   
   Prompt: Why do you drink water then? Can you give me another example (try to cover a variety of situations)?

   Prompt: What do you think motivates you to drink water during the day?

   Prompt: Could you describe your water consumption throughout the different seasons?

4. Can you think of a situation/setting where water was an option, but you drank something else?

   Prompt: Why do you not drink water? What do you think hinders you from drinking water during the day?

   Prompt: If they have not brought up peeing/bathroom use: Some people say that it can be annoying having to pee after drinking water in certain situations. How is this for you?

5. “If you could give yourself advice about drinking water, what would it sound like?”

   Prompt: How many glasses of water do you drink on a typical day? How do you feel about that? Do you regularly drink any hot drinks (i.e. tea with/without milk and sugar)? Are you aware of guidelines around how much water you should drink each day?

   Note: If they mention any health consequences prompt, why they do they hold this belief, why they think they should drink more?

6. What do you think would be an effective way of getting you to drink more water day-to-day?

**Urine colour chart questions:**
7. So I’m going to show you a urine colour chart and if you could indicate what number on the scale your urine falls within on a typical day?

Figure A1

Urine colour chart

![Urine Colour Chart]

Note. Armstrong et al’s., (1994) 8-shade urine colour chart with an added letter scale

8. Do you think there is any link between the colour of urine and your hydration levels?

The interviewer then presented the NHS Scotland’s Urine Colour Chart.

Figure A2

NHS Scotland Urine Colour Chart

![NHS Scotland Urine Colour Chart]
Note. Urine colour chart with NHS Scotland’s advice (Hydration | NHS Inform, n.d.)
## Appendix C

*Overview of words used during the text search query*

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<td>Dryness</td>
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<td>Hydration OR hydrated OR hydrates OR rehydrate</td>
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<td>Body</td>
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<td>The references for this were not consistently representative of urine as a marker of hydration. Search count not included.</td>
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An alternative method was used.

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(1 removed as reference wasn’t relevant)