**Towards a Theory of Water Drinking: The Essential Health Behaviour**

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**Abstract**

Water intake is a vital aspect of health, yet a comprehensive theoretical understanding of this behaviour has been lacking, hindering efforts to increase people’s intake. Recent advances in psychology research methodology stress the importance of theory development for understanding and changing behaviour. Specifically, poor theory development practices are considered partly responsible for current issues, such as the replication crisis and ineffective interventions. Therefore, we aimed to develop a theoretical framework of water drinking behaviour informed by current best practice recommendations on theory development. We reviewed emerging water drinking research to (1) define water drinking behaviour, and (2) identify and establish how various constructs influence water drinking in daily life, which are key activities in the theory development process. Our framework suggests researchers should account for the complexities of water drinking, including the different steps involved, how they vary between people and situations, and the relative time and effort needed for each step. Moreover, it underscores the intricate interplay between internal and external factors influencing water drinking behaviour. External influences include constructs like water security, tap water quality, and toilet facilities, while internal influences include individual attributes like thirst, knowledge, habitualness, and reward. Our framework implies that comprehensive theories of behaviour are essential to comprehend the complex interplay of influences underlying water drinking. Additionally, it suggests that a complex intervention approach, targeting both individual and systemic-level influences, is likely needed to address inadequate water intake. We also discuss research from other consumption behaviour domains, evidencing that aspects of this framework may apply to consumption behaviour more broadly. This paper does not aim to establish a definitive theory of water drinking behaviour but offers a current snapshot of our understanding to inform future research and intervention efforts.

**Introduction**

Recent literature on best practices in psychology research methodology advocates that psychology must better engage with theory development to understand and change behaviour (Barsalou, 2019; Eronen & Bringmann, 2021; Oberauer & Lewandowsky, 2019; Proulx & Morey, 2021; Scheel et al., 2020). Specifically, this literature advocates for developing comprehensive theories that explain how behaviour is performed in real-world settings and what influences its performance. According to Scheel et al., (2020), psychology too often incorrectly prioritises testing predictions over earlier stages of theory development, such as observing and describing behaviour in real-life settings and defining constructs regarding its influences. As a result, mere descriptions of highly controlled experimental effects, unlikely to generalise to real-world settings, are being passed off as theories (Meehl, 1978, 1990; Proulx & Morey, 2021), and the field is facing issues such as the replication crisis (Scheel et al., 2020). To tackle these issues, the psychology research methodology literature suggests that psychology researchers must spend more time developing theories than testing them (Scheel et al., 2020). The current paper aims to review emerging water drinking research to develop an initial theoretical overview of this behaviour regarding which constructs *may* be relevant and should be *considered* when designing theoretical and intervention-focused water drinking research, using best practice recommendations from the wider methodology literature.

We focus on water drinking as this is an important health behaviour essential for survival that impacts physical health and psychological function, as we will describe in more detail below (Kavouras & Anastasiou, 2010; Perrier et al., 2020; Seal et al., 2019). Additionally, water drinking research is well placed to inform theory development work as there is now considerable research describing how water drinking is performed in naturalistic settings, establishing what constructs are relevant for understanding this behaviour, and assessing how these constructs influence this behaviour. These research activities are fundamental to developing well-specified comprehensive theories (Bonetto et al., 2023; Scheel et al., 2020). However, to our knowledge, no recent works have reviewed water drinking research intending to present an initial theoretical overview of how water drinking is performed in real-life settings and what influences its performance. Before further outlining this paper's aims and approach, it is important to establish why water drinking is an important health behaviour and why the domain of water drinking research would benefit from theory development work.

**Water Drinking is an Essential Health Behaviour**

Adequate fluid intake is essential for human health as water sustains all physiological functions (Jéquier & Constant, 2010; Kavouras & Anastasiou, 2010). Inadequate intake can lead to underhydration, which is linked to adverse health outcomes such as chronic kidney disease, diabetes, and urinary tract infections (Armstrong & Johnson, 2018; Perrier et al., 2020; Seal et al., 2019). Despite this, large proportions of industrialised nations' populations do not meet adequate intake guidelines (Drewnowski et al., 2013; Ferreira-Pêgo et al., 2015; Gibson & Shirreffs, 2013). For example, 60% of men and 40% of women did not meet adequate intake guidelines in a survey across 13 countries and three continents (Ferreira-Pêgo et al., 2015). Increased fluid intake could be an effective prevention strategy against the adverse health outcomes linked to underhydration (Perrier et al., 2020).

Drinking water is one of many means of obtaining adequate fluid intake, as food and other drinks also contribute. However, obtaining adequate intake is unlikely solely through eating, as drinking accounts for most daily water intake (Elmadfa & Meyer, 2015). Additionally, water is the optimal drink choice because it is healthier (Perrier, 2017) than other drinks (e.g., sugar-sweetened beverages) associated with adverse health outcomes (e.g., all-cause mortality; Anderson et al., 2020). Therefore, obtaining fluid intake through water drinking, specifically, is important.

**Water Drinking Research Needs Theory Development**

Water drinking intervention research provides a key example of the need for a better theoretical understanding of water drinking behaviour. Specifically, water drinking interventions are typically ineffective (Franse et al., 2020; Vargas‐Garcia et al., 2017) or lead to small increases in intake that are unlikely to address the adverse outcomes associated with underhydration (Rodger et al., 2021). For example, a meta-analysis of water drinking interventions found that intervention groups only drank an average of 67 ml more water than control groups (Vargas‐Garcia et al., 2017). However, larger increases in water intake are needed to regain adequate hydration status and address potentially adverse outcomes (e.g., 1500 ml; Johnson et al., 2020; Pross et al., 2014). Therefore, the potential of increased water intake as a prevention strategy is unlikely to be realised, given the small effects of current intervention efforts.

Water drinking interventions may be ineffective because they are informed by broader research on health and consumption behaviour rather than domain-specific research on water drinking (Rodger et al., 2021). Although water drinking may share similarities with these broader domains (e.g., it is a desire and reward-driven behaviour; Papies et al., 2022), it also has unique features regarding how it is performed and what influences its performance (e.g., the types of reward that motivate it, such as thirst; Rodger et al., 2021). Therefore, applying interventions developed in other domains to increase water intake may not be effective as they do not account for domain-specific water drinking considerations. For example, product descriptions containing language regarding rewarding consumption experiences effectively increase plant-based eating, but this approach does not seem effective for water drinking (Claassen et al., 2022). This was potentially due to people having relatively stable and neutral representations of reward (e.g., taste) related to water drinking, which differs from people's less stable representations of plant-based foods, given their larger variety and novelty (Claassen et al., 2022). This suggests effective interventions from broader health and consumption domains may not generalise to water drinking. Therefore, more research on the underlying influences of water drinking behaviour is needed to inform water drinking interventions.

However, water drinking is a notoriously under-researched behaviour (Rush, 2013), so there has been limited domain-specific research to inform intervention development. Most early water drinking research has focused on demographic trends in water intake (Elmadfa & Meyer, 2015; Ferreira-Pêgo et al., 2015; Gibson & Shirreffs, 2013). Although this research provides insights into potentially at-risk groups needing water-drinking interventions, it is uninformative regarding the underlying influences causing these trends. For example, this research shows older people are less likely to meet adequate intake guidelines than other demographic groups. However, age alone, if at all, is unlikely the underlying cause of this trend. Indeed, this trend can be partially explained by barriers to water drinking that are specific to or particularly prevalent for older people (e.g., urinary incontinence concerns; Bhanu et al., 2020).

In recent years, novel research has emerged on how water drinking is performed and what constructs influence performance in real-life settings, aiming to inform a more comprehensive theoretical understanding of this behaviour. Specifically, we have conducted numerous qualitative and mixed-methods research studies in this domain (Rodger, Barsalou, et al., 2023; Rodger et al., 2021; Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). However, it is important to consistently and meaningfully discuss how current evidence in a research domain relates to relevant constructs and wider theories of behaviour, including emerging research domains (Maatman, 2021; Meehl, 1978, 1990; Oberauer & Lewandowsky, 2019; Proulx & Morey, 2021; Scheel et al., 2020). Therefore, this domain needs theoretical work on the collective implications of emerging water drinking research.

**The Current Paper**

In this theoretical paper, we review emerging water drinking research insights to generate an initial theoretical overview of water drinking and discuss its implications. To achieve this, we structure the manuscript into the following sections:

First, we narratively review emerging research on water drinking to (1) define water drinking behaviour (i.e., what steps are involved in drinking water) based on how it occurs in daily life, and (2) identify constructs (e.g., knowledge, reward, etc.) that influence the performance of water drinking and explain how these constructs influence (i.e., hinder and facilitate) this behaviour in daily life. We structure our narrative review around relevant constructs and their role in water drinking, as constructs are the building blocks of theory (Scheel et al., 2020).

Second, we discuss the theoretical implications regarding important discussions in the wider psychology literature, such as the role of reward in regulating habitual behaviour (see De Houwer et al., 2022; Kruglanski & Szumowska, 2020; Wood et al., 2022).

Third, we discuss the applied implications of trying to increase water intake.

Lastly, we outline the strengths and limitations of current water drinking research and potential future directions.

We do not aim to cement a causal explanation of water drinking in developing this initial theoretical overview. Instead, we aim to use the in-depth insights from emerging water drinking research to inform suggestions regarding which constructs and broader theories of behaviour *may* be relevant and should be *considered* when designing theoretical and intervention-focused water drinking research. Our overview is a starting point, which can and *should* be continually improved upon through future research.

***Theoretical Perspectives Informing Our Approach***

Water drinking is an emerging research domain in the earlier stages of theory development, which is best informed by observational, qualitative, and exploratory methods (Scheel et al., 2020). As such, we predominantly review research using these methods to inform the explanations of water drinking in our theoretical overview. Our approach may seem to conflict with dominant positivist-informed perspectives in psychology that advocate confirmatory experimental methods are the sole “gold standard” for informing causal explanations. Therefore, we outline some key theoretical perspectives that informed our approach.

First, there are numerous, long-standing calls within the philosophy of science and methodology literature for psychology to use a more balanced array of diverse research methods to inform theory development (Diener et al., 2022; Grosz et al., 2020; Rohrer, 2018). Although experimental research has strengths (e.g., internal validity), it also has *substantial* weaknesses that other methods do not have (e.g., a lack of external and construct validity; Diener et al., 2022; Vazire et al., 2022). However, these weaknesses are often poorly acknowledged (Diener et al., 2022; Scheel et al., 2020; Wadhwa & Cook, 2019).

Second, positivist perspectives typically advocate that only quantitative experimental methods can inform causal explanations (Willis, 2023). Positivism treats causal influence as an unobservable ‘black box’ focusing solely on establishing regular associations between observable events (Ryba et al., 2022; Willis, 2023). In contrast, our approach aligns with our critical realist perspective, which advocates that quantitative and qualitative methods can and should inform causal explanations (Ryba et al., 2022; Willis, 2023). Critical realism takes a more complex view of causal influence. It assumes all entities (i.e., all objects from abstract social and psychological constructs to concrete physical things) have the capacity for causal influence, which emerges under certain conditions, giving rise to observable events (e.g., behaviour; Willis, 2023). Here, causality is not gleaned solely by assessing associations between observable events but by explaining the causal influences that emerge and give rise to observable events under certain conditions (Ryba et al., 2022; Willis, 2023). Evidence from diverse methods is needed to inform this explanatory work (Ryba et al., 2022).

**Initial Theoretical Overview**

In this section, we review research on water drinking behaviour in real-world settings to establish (1) how this behaviour should be defined and (2) what constructs influence its performance. We then present case studies to further illustrate how this definition and these constructs can be used to understand the water drinking behaviour of real individuals. To inform these sections, we relied predominantly on recent qualitative, observational, and field intervention research, including our prior research and other research identified through database searches and citation chaining. We also used prior reviews of water drinking research, which focused on specific constructs, contexts, or participants. Finally, we used research on water drinking across contexts and participant groups to present a theoretical overview of water drinking that is likely transferable across these facets (Korstjens & Moser, 2018). However, where possible, we outline potential context or participant-specific considerations that should be accounted for when defining water drinking and describing which constructs influence its performance. Appendix A, available through the Open Science Framework (see <https://osf.io/hnyzq/>), provides an overview of the research we used to inform our theoretical overview, including the research aim, method, context, participant group, and key insights from each article.

**How Should Water Drinking Be Defined?**

A key component of theory development is defining the behaviour of interest, which has various implications, such as how the behaviour is measured (Scheel et al., 2020). Defining behaviour involves asking the following: what do we mean by water drinking behaviour? Answering this question may seem simple, but as this section will illustrate, current definitions of water drinking do not accurately reflect how this behaviour is performed in real-life settings, potentially impeding empirical research and intervention efforts.

Water drinking is typically defined as a simple behaviour, especially compared to other consumption or health behaviours. This is because other behaviours, such as healthy eating and exercise, have a higher degree of complexity, most simply defined as the number of lower-order behaviours facilitating a higher-order behaviour and the relative time needed to engage in these (Phillips & Mullan, 2022). However, just because water drinking is simpler than other behaviours does not mean it is inherently simple for people to perform.

First, water drinking behaviour is more than solely the motor act of drinking water, encompassing other essential lower-order behaviours that facilitate drinking (Rodger, Vezevicius, et al., 2023). Water drinking is contingent on remembering; most simply defined as the ability to remember to drink or prepare water when these behaviours are feasible and desired (i.e., prospective memory; Cole & Kvavilashvili, 2021; Kvavilashvili & Rummel, 2020). For example, UK-based adults with low water intake struggled to increase their water intake during an intervention follow-up because they did not remember to drink it during the day (Rodger, Vezevicius, et al., 2023). Water drinking is also contingent on preparation: most simply defined as any behaviour that makes water available to drink and, therefore, applies to a diverse range of behaviours. For example, seeking out a water source, filling up a glass or bottle of water, ensuring a glass or bottle of water is within arm’s reach, carrying a water bottle, and buying bottled water (Hess et al., 2019; Kaushik et al., 2007; Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). Water drinking is facilitated or hindered depending on whether or not these behaviours have been performed (Rodger, Vezevicius, et al., 2023). For example, UK-based adults with high water intake were more likely to engage in preparation behaviours, such as carrying a water bottle or ensuring a glass or bottle of water is within arm’s reach, than those with low intake (Rodger, Barsalou, et al., 2023; Rodger & Papies, 2022).

Importantly, preparation behaviours vary across contexts. For example, in contexts with undrinkable tap water, boiling or filtering drinking water is necessary to facilitate water intake, or at least healthy water intake (Duan et al., 2022). Additionally, barriers to preparation behaviours vary across participants. For example, adolescents’ water drinking often depends on whether adults aid adolescents in preparing water or do it for them (Chouraqui, 2023; Franse et al., 2019): Students and parents in rural New Mexico reported that parents’ preparation behaviours (e.g., ensuring bottled water is in the fridge) facilitated water intake (Hess et al., 2019). Schools not providing water at lunch or teachers restricting preparation behaviours (e.g., keeping a bottle of water on the desk) hindered water intake (Hess et al., 2019; Kaushik et al., 2007).

Second, water drinking can be a relatively time-consuming behaviour to engage in. Although one instance of water drinking may span mere seconds, numerous instances across various situations throughout the day are needed to achieve adequate water intake. For example, UK-based adults with high water intake were more likely to have more drinking instances and drink in more situations than those with low intake (Rodger & Papies, 2022). Additionally, depending on their nature, preparation behaviours must be repeated throughout the day (e.g., refilling a bottle). This increases the time needed to facilitate adequate water intake. For example, UK-based adults perceived water drinking, particularly the preparation behaviours involved, as time-consuming in situations where they did not typically drink water (Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022).

Finally, people may typically hold abstract representations that water drinking is a simple behaviour. However, for some people, when they think about performing it within the rich contexts of their daily routines, this behaviour can be complex. Water drinking and preparation behaviours are perceived as subjectively effortful in situations where water drinking is not typically performed (Rodger et al., 2021). This is evidenced by adults with low water intake (Rodger, Barsalou, et al., 2023; Rodger & Papies, 2022) and older people (Bhanu et al., 2020), who reported that effortful preparation behaviours were a key barrier to water intake. It is important to caveat that water drinking can be perceived as simple for some (Rodger et al., 2021), and we will discuss this in more detail in the preceding sections (see Habitualness).

We have shown, regarding complexity, that there are numerous steps an individual must engage in for water intake to occur, which can be relatively time-consuming and subjectively effortful. Complexity is, therefore, a key construct that should be accounted for when defining water drinking behaviour. Specifically, water drinking is best defined as a higher-order behaviour that can be separated into lower-order behaviours: remembering, preparing, *and* drinking (all defined above). Additionally, water drinking’s perceived complexity varies greatly depending on the individual and the situation. Therefore, conceptualising water drinking as a simple behaviour for all individuals to perform in all daily life situations does not align with people's lived experience of this behaviour. Water drinking definitions should also account for these aspects of variation. Figure 1 provides a summary of the key constructs covered in this section.

**Figure 1**

**Defining Water Drinking: Accounting for Complexity**

A diagram of a diagram

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Note: Complexity is most simply defined as the number of lower-order behaviours facilitating a higher-order behaviour and the relative time needed to engage in these (Phillips & Mullan, 2022).

**What Influences Water Drinking’s Performance?**

Another key component of theory development is defining constructs that influence the behaviour of interest and establishing how these constructs influence the behaviour (Scheel et al., 2020). Below, we define 12 constructs relevant to understanding water drinking behaviour and review evidence regarding how these constructs hinder and facilitate this behaviour. We have grouped these constructs into external influences, focusing on aspects of the external environment that influence water drinking behaviour, and internal influences, focusing on aspects of individuals that influence water drinking behaviour. We separately discuss the construct of situatedness and how this relates to water drinking, as it is relevant to external and internal influences.

***External Influences***

**Availability.** The extent to which a context’s infrastructure provides readily available access to drinkable water (i.e., water security) impacts water drinking (Miller et al., 2021). Context can relate to anything from an entire country to a specific building or room, and low water security is associated with lower water intake across various contexts (see Miller et al., 2021; Nounkeu et al., 2022). Conversely, installing appealing water bottle filling stations in recreation centres in low-income communities in Philadelphia increased the number of adolescents drinking water (Patel et al., 2020). Low water security also means more time must be invested in preparation behaviours. For example, in three rural communities in Cameroon with low water security, women spent an average of three hours fetching water approximately every four days (Nounkeu et al., 2022). Low water security could also impact remembering, as UK-based adults reported relying on external cues (e.g., water fountains and bottle refill stations) to aid remembering (Rodger et al., 2021; Rodger, Vezevicius, et al., 2023). Finally, we note that availability is heavily intertwined with policy, which has the power to mandate certain levels of access within various contexts. For example, a California state policy requiring childcare centres to make drinkable water available to adolescents led to increased water offerings (Patel et al., 2020).

On a more individual level, barriers in the immediate external environment can hinder people’s ability to engage in preparation behaviours that increase water’s availability. For example, UK-based adults reported not drinking water in certain situations (e.g., work) because external barriers (e.g., nature of their job) prevent them from engaging in preparation behaviours (e.g., carrying a water bottle) that would have made water readily available (Rodger et al., 2021; Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). Additionally, older people reported not drinking enough due to reduced mobility and external barriers that made preparation difficult (e.g., stairs; Bhanu et al., 2020). In both examples, the external environment does not facilitate the preparation of water, meaning water is not readily available when an instance of drinking is desirable.

**Quality & Safety.** Perceptions of poor tap water quality and safety are typically negatively associated with water intake (Barrett et al., 2017; Geerts et al., 2020; Hess et al., 2019; Onufrak et al., 2014). For example, in Flanders, Belgium, these perceptions led to people not drinking tap water, despite having a drinkable water supply (Geerts et al., 2020). Therefore, actual tap water quality and safety is a necessary but insufficient condition for (tap) water intake (Geerts et al., 2020). These perceptions also affect people's preparation behaviours (e.g., buying bottled water versus filling a bottle from the tap). However, they do not necessarily lead to inadequate water intake if bottled water is drunk instead. Indeed, research evidences that these perceptions lead to increased bottled water intake (Geerts et al., 2020; Onufrak et al., 2014).

Substituting tap with bottled water creates an interesting tension for researchers to consider: This substitution may be desirable from a health perspective if adequate intake is the goal, especially in contexts where tap water is undrinkable and preparation behaviours to make it drinkable are a barrier to healthy intake. However, this substitution is not desirable from an environmental perspective if adequate *and* sustainable intake is the goal, especially where tap water is drinkable. This is due to the adverse environmental impacts of bottled water manufacturing, transport, and single-use plastic (Geerts et al., 2020). Additionally, this substitution may not be affordable for certain individuals or groups.

**Affordability.** Free access to drinkable water facilitated water intake across various demographic groups and contexts (Block et al., 2013; Geerts et al., 2020; Hess et al., 2019; Werner et al., 2022). For example, UK-based adults’ baseline water affordability ratings were positively associated with water intake over a three-day follow-up (Rodger, Barsalou, et al., 2023). However, when water is perceived as a free resource, people typically have negative attitudes towards paying for bottled water. For example, US-based college students reported a low tolerance for paying for water, unlike other drinks (Block et al., 2013). Additionally, US-based adults across various demographic groups perceived the high cost of bottled water as a key barrier to water drinking (Wippold et al., 2020).

**Toilet Facilities.** Access to sanitary toilet facilities facilitates water drinking, but lack of access to toilet facilities and access to unsanitary toilet facilities hinders water drinking (Michels et al., 2019; Rodger et al., 2021; Rodger, Vezevicius, et al., 2023; Venugopal et al., 2023). For example, female police officers in South India reported being unable to drink water when thirsty due to a lack of access to sanitary, private, or conveniently located toilets when working offsite (Venugopal et al., 2023). UK-based adults with low water intake reported increased trips to the toilet as a barrier to increasing their water intake (Rodger, Vezevicius, et al., 2023). Older people practised highly restrictive fluid intake due to fear of urinary incontinence and lack of access to public toilets (Bhanu et al., 2020). Finally, adolescent’s hydration was better in schools with policies that gave them regular access to well-maintained toilets (Michels et al., 2019).

**Availability of other drinks.** This can hinder water drinking, as adults and adolescents often report not drinking water because other preferred drinks are available (Álvarez-Sánchez et al., 2022; Hess et al., 2019; Rodger & Papies, 2022). For example, UK-based adults with low water intake reported that the availability of other preferred drinks hindered their attempts to start drinking water in new situations (Rodger, Vezevicius, et al., 2023). Additionally, construction workers in Mexico partially attributed their high consumption of SSBs over water to the widespread availability of these drinks in most situations (Álvarez-Sánchez et al., 2022).

**Weather & Indoor Climate.** Warm weather or indoor climates facilitate, but cold weather and indoor climates hinder water drinking. For example, construction workers in Mexico, who prefer and typically drink sugar-sweetened beverages, reported increasing their water intake in very warm weather (Álvarez-Sánchez et al., 2022). UK-based adults reported preferring warm drinks such as tea during winter but drinking water on warmer summer days (Rodger et al., 2021). Finally, adolescents typically report drinking more in warm than cold weather (Barrett et al., 2017; Hess et al., 2019).

Figure 2 provides an overview of the key considerations regarding each external influence construct and its potential negative impact on water drinking. We highlight each construct's negative impact on water drinking as a key aim of this paper is to inform intervention efforts that mitigate barriers to water drinking behaviour to increase water intake. Additionally, focusing on one type of impact (i.e., negative versus positive) allowed for a more detailed summary of impacts in the figure. However, we note that there is also evidence of positive impacts for most constructs. For example, regarding availability, an effective policy and infrastructure leading to readily available drinkable tap water facilitates people’s ability to remember, prepare, drink water. We also note that for all these constructs, both an objective and subjective framing likely should be considered. For example, imagine a researcher is assessing availability within an office, and there is a bottle refill station on one floor of the building. They may view water as readily available in this context (objective framing). However, a worker one floor above the refill station may perceive this as far away and too much effort to use (subjective framing).

**Figure 2**

**External Influences of Water Drinking: Key Constructs**

**A diagram of water quality

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***Internal Influences***

**Thirst.** Thirst facilitates water drinking, which is unsurprising given that the adaptive function of thirst sensations creates the desire to consume water to restore the body’s hydration state (Stevenson et al., 2015). Specifically, thirst sensations are a common cue for water drinking, and not experiencing them is a common reason for not drinking water across various contexts and participants (Barrett et al., 2017; Bhanu et al., 2020; Block et al., 2013; Hess et al., 2019; Rodger et al., 2021; Rodger & Papies, 2022; Werner et al., 2022). For example, UK-based adults reported relying on thirst sensations, such as having a dry mouth, to prompt water drinking throughout the day (Rodger et al., 2021). Additionally, UK-based adults' ratings of the extent to which thirst motivated water drinking across ten daily situations predicted future water intake in these situations (Rodger, Barsalou, et al., 2023).

However, relying solely on thirst sensations is unlikely an effective way of obtaining adequate water intake because perceptions of thirst sensations are highly variable and unreliable (Adams et al., 2022; Rosinger et al., 2022; Stevenson et al., 2015). For example, UK-based adults also reported suppressing, ignoring, and not perceiving thirst sensations throughout the day, especially when they felt hydration was not a key priority compared to other goals (e.g., completing their work; Rodger et al., 2021). Additionally, older people may suffer from blunted thirst sensations in later life (Miller et al., 2021). Finally, other influences, such as the external environment, can impact thirst sensations’ capability to facilitate water drinking. For example, we evidenced earlier that female police officers in South India did not act on thirst sensations due to a lack of appropriate toilet facilities (Venugopal et al., 2023). This illustrates that thirst sensations *can* facilitate water drinking, but they are unlikely a sufficient influence.

**Knowledge.** Research across various contexts and participant groups (e.g., adults, adolescents, athletes, older people) highlights that many people lack hydration knowledge (Bhanu et al., 2020; Brownbill et al., 2020; Rodger et al., 2021; Song et al., 2022; Veilleux et al., 2020). Hydration knowledge relates to people’s understanding of, for example, the need for water intake, adequate intake guidelines, and the health benefits of drinking water (see Veilleux et al., 2020). The lack of hydration knowledge indicates the need for education. However, education-based water drinking interventions are typically ineffective (Franse et al., 2020; Vargas‐Garcia et al., 2017), indicating that acquiring hydration knowledge is insufficient to facilitate water drinking. Indeed, in a recent intervention study, hydration education motivated UK-based adults with low water intake, providing a reason to drink water and the potential rewards they may experience (Rodger, Vezevicius, et al., 2023). However, participants did not always drink water during the follow-up, as they struggled with barriers (e.g., effortful preparation) or did not experience the anticipated rewards. Therefore, knowing the importance and benefits of hydration is potentially necessary but insufficient for facilitating water intake in cases where hydration knowledge is lacking.

**Habitualness.**Water drinking appears habitual to some degree (Veilleux et al., 2020), as it is typically performed consistently in similar situations with a high degree of automaticity (Rodger et al., 2021; Rodger & Papies, 2022). Regarding drinking, some UK-based adults struggled to describe the thought process underlying their water drinking as this behaviour was highly automatic (Rodger et al., 2021). However, these adults also reported drinking water inconsistently, relying on conscious thought and subjective effort outside of habitual situations (i.e., situations were they consistently drank water with little consious thought and subjective effort; Rodger et al., 2021). Similar patterns were evidenced for remembering and preparing. For example, UK-based adults with high water intake reported remembering and performing preparation behaviours with a high degree of automaticity (Rodger et al., 2021; Rodger & Papies, 2022). Specifically, they reported engaging in preparation with little conscious thought and subjective effort. Conversely, those adults with low water intake reported that preparing and drinking water was a deliberate action that took time, effort, and conscious thought (Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022).

Highly habitual water drinking is not necessarily conducive to high daily water intake. For example, an individual may only have highly habitual water drinking behaviour in situations that occur infrequently throughout the day (e.g., upon waking up Rodger et al., 2021). However, people with high daily water intake typically have highly habitual water drinking behaviour across various situations (Rodger et al., 2021; Rodger & Papies, 2022), suggesting that having habitual water drinking in numerous situations is necessary for high water intake. For example, UK-based adults with high water intake reported preparing and drinking water with higher levels of automaticity than those with low intake across ten daily situations (Rodger, Barsalou, et al., 2023).

**Reward.** Reward is a desired outcome of consumption behaviour that motivates performance (Shiota et al., 2021). Water drinking behaviour is typically performed when it is associated with rewarding outcomes and not when it is associated with unrewarding outcomes (Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). For example, UK-based adults with highly habitual water drinking behaviour reported drinking water because they find it rewarding (Rodger & Papies, 2022). Additionally, US-based adolescents reported drinking water because it was refreshing and energising (Barrett et al., 2017). Conversely, water drinking is not typically performed when associated with no or unrewarding outcomes. For example, adults and adolescents reported not drinking water because they associate it with outcomes such as experiencing a disliked taste (Hess et al., 2019; Rodger et al., 2021; Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022), spending money (Wippold et al., 2020), and an increased need to urinate (Bhanu et al., 2020; Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). The latter two unrewarding outcomes highlight that reward perceptions are interrelated to external influence constructs such as availability and toilet facilities.

The reward associated with water drinking ranges from shorter-term rewards (e.g., taste) to longer-term rewards (e.g., improved health), and both predict future water intake (Rodger, Barsalou, et al., 2023). Water’s ability to quench thirst is the most common and salient reward (Barrett et al., 2017; Block et al., 2013; Rodger et al., 2021; Rodger & Papies, 2022). However, as previously discussed, thirst’s ability to motivate water drinking may be unreliable. Indeed, UK-based adults with highly habitual water drinking across various situations did not rely solely on thirst to initiate drinking and associated water drinking with multiple rewards (Rodger & Papies, 2022). The diverse rewards associated with water include liking the taste (Bhanu et al., 2020; Geerts et al., 2020; Rodger & Papies, 2022; Wippold et al., 2020), experiencing tangible well-being benefits (e.g., improved mood and energy levels), and preventing adverse dehydration outcomes (e.g., fatigue) (Barrett et al., 2017; Block et al., 2013; Lilo & West, 2022; Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). For example, after exposure to a healthy hydration campaign, high school students' water drinking seemed partly motivated by reward experiences (e.g., weight loss, increased energy levels, and reduced dehydration symptoms; Lilo & West, 2022). However, awareness of these potential rewards is not always sufficient to influence water drinking (Douglas et al., 2015). Instead, water intake is associated with experiencing or believing in certain actual or perceived rewards (Block et al., 2013; Etale et al., 2018; Rodger & Papies, 2022; Vézina-Im & Beaulieu, 2019).

Finally, the reward associated with water drinking varies across situations, such that people associate water drinking with reward in some situations but not others (Rodger, Vezevicius, et al., 2023; Rodger & Papies, 2022). For example, UK-based adults’ ratings on whether a range of rewarding outcomes motivated water drinking was extremely varied across ten daily situations (Rodger, Barsalou, et al., 2023). Therefore, reward seems to motivate the repeated performance of water drinking in certain situations (Rodger, Vezevicius, et al., 2023). This could explain why people have highly habitual water drinking in certain situations but not in others.

**Self-Relevance.** The research on reward suggests that people perform water drinking in situations when it supports the pursuit of self-relevant outcomes. Research on self-identity and social norms also illustrates the influence of self-relevance, as water drinking outcomes that align with one’s identity or with social norms motivate water drinking.

Strong health consciousness is associated with finding water drinking highly rewarding and habitual (Rodger & Papies, 2022). For example, UK-based adults’ ratings of health consciousness positively predicted future water intake (Rodger, Barsalou, et al., 2023). However, these associations are weaker when people prioritise other aspects of self-identity, which are not aligned with water drinking. For example, a student who drank water habitually when studying, did not during Ramadan, when their salient religious identity motivated fasting (Rodger & Papies, 2022). Therefore, the influence of self-identity seems to vary depending on what aspects of self-identity are salient in each situation (Oyserman, 2015).

Water drinking also appears associated with social norms. For example, UK-based adults reported perceiving water drinking as rewarding because it had a social signalling function (e.g., signalling that they are healthy; Rodger & Papies, 2022). Additionally, using peer influence to increase adolescent water intake (Smit et al., 2016) was the most effective intervention strategy in a recent meta-analysis (Franse et al., 2020). Conversely, construction workers in Mexico continued to drink sugar-sweetened beverages (SSBs) over water due to social norms, despite increased taxes on SSBs and knowing the health risks (Álvarez-Sánchez et al., 2022).

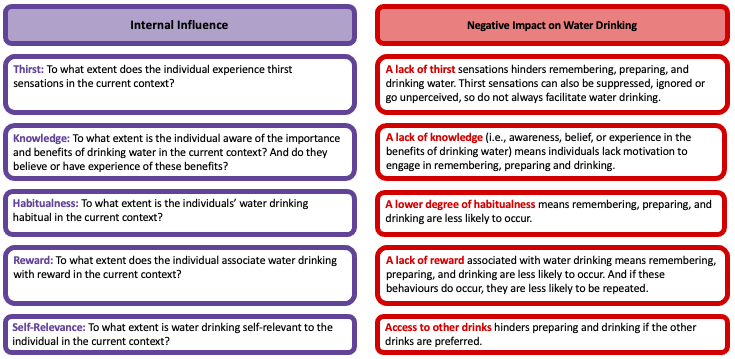
The influence of self-relevance is also further illustrated by commonly reported barriers to water drinking. Specifically, performing other, more valued behaviours that water drinking would interrupt (Rodger et al., 2021; Rodger, Vezevicius, et al., 2023), and the availability of other, preferred drinks (Rodger, Vezevicius, et al., 2023; Sylvetsky et al., 2020; Wippold et al., 2020). For example, perceived control over the availability of other preferred drinks predicted US-based college students’ intentions to initiate drinking water over SSBs (Sharma et al., 2017). These barriers indicate that water drinking is not performed when another behaviour is more self-relevant or rewarding. Additionally, these barriers were common in UK-based adults with high water intake, who exhibited habitual water drinking (Rodger & Papies, 2022). Therefore, even highly habitual water drinking associated with reward, self-identity, and social norms, may not occur if another behaviour is more self-relevant.

Finally, these barriers indicate that the self-relevance of water drinking fluctuates throughout the day. For example, UK-based adults’ ratings on where water drinking placed on their list of priorities was extremely varied across ten daily situations (Rodger, Barsalou, et al., 2023).

Figure 3 provides an overview of the key constructs regarding internal influences and their potential negative impact on water drinking. It is presented in the same format and has the same considerations as outlined for the external influences summarised in Figure 2.

**Figure 3**

**Internal Influences of Water Drinking: Key Constructs**

***Situatedness***

Situatedness is the idea that behaviour and the processes regulating behaviour are situation-specific, so vary widely across situations (Barsalou, 2019; Dutriaux et al., 2021). For decades, research in personality and social psychology has demonstrated the profound effects of situations on behaviour. Indeed, the preceding sections of this paper show that water drinking behaviour and the influence of relevant constructs regulating this behaviour seem to vary across situations. A prime example is research on UK-based adults that measured water intake and various influential constructs across ten daily situations, showing all these measures varied substantially across individuals, across situations, and within individuals across situations (Rodger, Barsalou, et al., 2023). Therefore, it is important to account for situatedness when defining constructs related to water drinking and establishing how they influence water drinking behaviour.

**Initial Theoretical Overview in Practice: A Case Study Illustration**

This section presents a comparative case study of interviews with two real UK-based participants from our prior research to illustrate that accounting for the definition and various influential constructs in the overview above can provide an in-depth understanding of water drinking behaviour.

The first case is Matilda, a university student with a high daily water intake who reported drinking water consistently throughout the day across most situations (e.g., at home, university, and work). The second is Ted, an office worker with a low daily water intake who reported drinking water inconsistently throughout the day across most situations, bar during exercise. We reanalysed their interview transcripts (available through the published manuscript; Rodger et al., 2021) to reiterate the relevance of our theoretical overview for understanding why water drinking does or does not occur in real-life settings. Specifically, in Figure 4, we show that Matilda conceptualises the steps, time, and effort needed to engage in water drinking as simple, unlike Ted conceptualises water drinking with a higher degree of complexity. In Figure 5, we show that Matilda does perceive any salient external barriers (e.g., water availability and toilet facilities) to drinking, unlike Ted, who reported being hindered by or not facilitated by all the external influences in our overview. Finally, in Figure 6, we show Matilda had internal influences that facilitated water drinking, unlike Ted whose water drinking behaviour was hindered by influences such as a lack of perceived rewarding outcomes and habitualness associated with water drinking.

**Figure 4**

**Water Drinking Complexity: The Case of Matilda & Ted**

**A screenshot of a computer screen

Description automatically generatedFigure 5**

**External Influences: The Case of Matilda & Ted**

**A screenshot of a diagram

Description automatically generatedFigure 6**

**Internal Influences: The Case of Matilda & Ted**

A group of text boxes

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Considering Matilda and Ted’s water drinking behaviour within our theoretical overview helps us understand why Matilda has a high daily water intake, and Ted doesn’t. It also illustrates the diverse array of influences likely underlying these individuals’ water drinking through the day.

**Theoretical Implications**

**Acknowledge the Complexity of Water Drinking**

Conceptualising water drinking as a simple behaviour could impede water drinking research. Theoretical frameworks used for comparatively more complex consumption and health behaviours may be incorrectly perceived as inappropriate in this domain. For example, breaking down complex behaviours into chunks (i.e., into lower order behaviours and instigation versus performance) to inform theory and intervention development has been effectively applied to more complex health behaviours, such as healthy eating and exercise. However, advocates of this approach noted that it may not be relevant for water drinking as it is a simple behaviour (Gardner, 2015; Gardner et al., 2016). Conversely, our theoretical overview would suggest chunking may be an informative approach for water drinking research.

Additionally, acknowledging the complexity of water drinking will likely improve intervention development. For example, a key limitation of a planning-based water drinking intervention was that participants made plans for *drinking* in new situations (Rodger, Vezevicius, et al., 2023). This intervention did not account for *preparation behaviours*, which were needed to ensure water was readily available for participants to drink in these situations. Additionally, participants struggled to *remember* their plans during the follow-up. As a result of these issues, the intervention was ineffective compared to the control. Therefore, it is crucial to account for remembering and preparation behaviours when defining water drinking.

**Use Comprehensive Theories of Behaviour to Guide Research**

Our theoretical overview suggests that water drinking is likely influenced by a complex interplay of various internal and external constructs. Therefore, it is important to use theories of behaviour that account for these constructs.

To illustrate this point, we consider the usefulness of a relatively simple versus a relatively more comprehensive theory of behaviour to account for the various influences of water drinking. Specifically, we consider the usefulness of Stimulus-Response (S-R) habit theory (see Wood et al., 2022; Wood & Rünger, 2016) and the grounded cognition theory of desire and motivated behaviour (see Papies et al., 2022). We selected these two theories as they frequently guide consumption behaviour research and intervention development. However, this is not an exhaustive discussion of theories that could help explain water drinking behaviour. For example, goal-directed behaviour theory (Hommel, 2021), value-based decision-making (Berkman, 2018), and the COM-B model (Michie et al., 2011) present other potentially helpful perspectives. A complete discussion of all these theories is outside the scope of this paper. However, the principle of comprehensive theories being more informative applies to the other theoretical perspectives noted above. Readers can use the following section as an example of how they might assess whether their chosen theory of behaviour comprehensively accounts for the constructs influencing water drinking.

To evaluate a theory’s usefulness in explaining behaviour, researchers must first establish each theory’s assumptions clearly (Eronen & Bringmann, 2021; Scheel et al., 2020). Hence, in Figure 7, we outline how each theory would assume water drinking is performed, given their core assumptions. This figure shows that S-R habit theory and grounded cognition theory have different explanations of what influences water drinking. For example, S-R habit theory assumes reward does not influence habitual water drinking behaviour; however, grounded cognition theory assumes it does. This figure also shows that S-R habit theory identifies fewer constructs influencing water drinking than grounded cognition theory. For example, S-R habit theory relies on four key constructs: goals, habit, external stimuli, and repeated performance. However, grounded cognition theory relies on various constructs, including but not limited to sensory experience, external context, internal context, and more. Each of these constructs relates to various sub-constructs. For example, internal context relates to constructs such as physiological states (e.g., thirst) and psychological states (e.g., motivation). As such, we conceptualise S-R habit theory as a relatively simple theory of behaviour and grounded cognition theory as a relatively comprehensive one.

**Figure 7**

**Simple vs Comprehensive Theory’s Assumptions on Water Drinking Influences** A diagram of a problem

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Having established what each theory assumes influences water drinking, we now discuss how well these assumptions account for the influences established in our theoretical overview. We use the case of Matilda to ground our discussion, showing each theory has a different explanation of what regulates Matilda’s water drinking and differs in its ability to map its assumptions onto the various influences of Matilda’s water drinking. We focus on Matilda as she had highly habitual water drinking (unlike Ted), which allows us to access the usefulness of S-R habit theory’s definition of habits.

***Can S-R Habit Theory Account for Matilda’s Water Drinking?***

As habitualness seems to be a relevant construct of water drinking, it could be helpful to conceptualise this behaviour as an S-R habit response. This conceptualisation could apply to lower-order behaviours (i.e., drinking), for certain individuals, in specific situations (Phillips & Mullan, 2022). For example, Matilda described her thought process underlying her water drinking at university by simply picking up and drinking from her bottle, indicating that drinking, for Matilda, in this situation, might be an S-R habit response.

However, conceptualising these types of observations as S-R habits could be misleading. One cannot assume that a behaviour is an S-R habit response simply by observing a high degree of automaticity and the apparent association between a behaviour and a stimulus (De Houwer, 2019b; Trofimova, 2022). These observations could also be made for goal-driven behaviour (De Houwer et al., 2022; Hommel, 2021; Kruglanski & Szumowska, 2020; Papies et al., 2022). For example, thirst, reward, and self-relevance seem to regulate Matilda’s highly habitual water drinking, which does not align with S-R habit theory unless her drinking is conceptualised as being in the process of habit formation. We note that S-R habit theory would suggest that people provide reward-driven explanations of S-R habits (Mazar & Wood, 2022; Wood et al., 2022), which could explain participants’ reporting habitual water drinking being rewarding. However, we suggest that this perspective provides a convenient rather than comprehensive explanation for the substantial evidence suggesting reward may regulate highly habitual water drinking and habitual behaviour more generally (Kruglanski & Szumowska, 2020; Trofimova, 2022).

Additionally, various external influences seem to regulate Matilda’s drinking, not merely a sole external stimulus as assumed by S-R habit theory. For example, Matilda consistently had a water bottle in sight and within reach while working at her desk at university. In other words, she was consistently exposed to this stimulus. She nevertheless could go for periods without drinking from her water bottle at university while doing her work. S-R habit theory would suggest that this observation is due to goal-driven behaviour (e.g., completing coursework) inhibiting the default S-R habit response (Wood et al., 2022). However, the constant need to inhibit the default habit response calls into question a core assumption of S-R habit theory: defaulting to S-R habit responses in most instances of behaviour is the most efficient means of behavioural control. For Matilda, it does not seem efficient to default to water drinking when she sees her bottle while working at her desk. A more comprehensive explanation is that reward-driven behaviour is the default (see De Houwer, 2019a) and therefore, a range of external and internal influences are needed for Matilda’s highly habitual drinking to occur (Hommel, 2021; Kruglanski & Szumowska, 2020; Papies et al., 2022).

If Matilda’s water drinking were conceptualised as being in the process of habit formation, this would allow various influences to regulate this behaviour (Verplanken & Orbell, 2022; Wood et al., 2022). Indeed, habit formation seems to account for many of the potential influences of water drinking (Phillips & Mullan, 2022; Verplanken & Orbell, 2022; Wood et al., 2022). Therefore, it could be an informative perspective for understanding and changing water drinking behaviour. However, habit formation assumes that an S-R habit response will eventually develop, and influences other than the external stimulus will not regulate its maintenance (Fontanet et al., 2021; Wood et al., 2022). These assumptions potentially limit the use of habit formation to understand water drinking and maintain established water drinking behaviour, as previous research has questioned whether the extensive overtraining involved in forming S-R habits is replicable in real-life settings (Kruglanski & Szumowska, 2020). For example, Matilda’s highly habitual water drinking in the morning still seemed to be regulated by reward (i.e., quenching thirst), even though she has been doing this for years, which should be long enough for this behaviour to develop into an S-R habit response.

Finally, S-R habit research mainly focuses on simplified behaviours in highly controlled experimental settings (Kruglanski & Szumowska, 2020; Marien et al., 2019). Therefore, this theory may not generalise to higher-order behaviours in real-word settings (Marien et al., 2019; Verplanken & Orbell, 2022), such as those requiring preparation in changing external circumstances. Additionally, S-R habit research in real-world settings relies on continuous self-report measures of habit (Gardner et al., 2012; Verplanken & Orbell, 2003), which do not align with this theory’s dichotomous distinction between S-R habits and goal-driven behaviour. This distinction may also not be appropriate (De Houwer, 2019b; Hommel, 2021; Hommel & Wiers, 2017; Kopetz et al., 2018), as there is both empirical and theoretical evidence that habitual and goal-driven behaviour could result from the same underlying mechanisms, namely associations in memory that contain information regarding features of the situation, behaviour *and* rewarding outcomes (De Houwer, 2019b; De Houwer et al., 2022; Kopetz et al., 2018; Kruglanski & Szumowska, 2020). Finally, research using these continuous habit measures suggests that habitualness *and* other influences may regulate behaviour (Phillips & Mullan, 2022). For example, habitualness *and* reward (e.g., fatigue) predict coffee drinking (Mazar & Wood, 2022).

***Can Grounded Cognition Theory Account for Matilda’s Water Drinking?***

It may be more useful to conceptualise water drinking as stimulus-driven to some degree while also being influenced by other external and internal influences. Grounded cognition theory assumes that internal and external influences are part of the learned associations in memory (i.e., situated conceptualisation) that guide even highly habitual behaviour (Hommel, 2021; Papies et al., 2022). As such, any of these features can initiate water drinking, meaning water drinking behaviour can occur in response to external influences while also being regulated by internal influences (Papies et al., 2022). This theory also predicts that individuals’ water drinking behaviour varies between different situations *and* within the same situation (Barsalou, 2020; Papies et al., 2022).

For example, Matilda would drink water at her desk at university when internal (e.g., dry mouth), external (e.g., her water bottle), or sets of both internal and external influences activate her situated conceptualisation of drinking water. This would lead to rewarding simulations of water drinking and in turn, the performance of drinking behaviour (Papies, 2020; Papies et al., 2022). As Matilda has repeatedly performed this behaviour at university, her situated conceptualisation of drinking in this situation is likely deeply encoded (Barsalou, 2020). Consequently, her drinking would exhibit features of habitualness (Barsalou, 2020; Papies et al., 2022). Still, Matilda would not drink water, even in the presence of relevant external influences (e.g., her water bottle), if the best matching situated conceptualisation activated (e.g., by an email notification) did not relate to water drinking behaviour (e.g., responding to an email) (Papies, 2020; Papies et al., 2020, 2022). Similarly, she would not drink water when simulations of other drinks or activities are more rewarding (e.g., she prefers to drink orange juice when she is hungover) (Papies, 2020; Papies et al., 2020, 2022).

Matilda's highly situation-dependent water drinking does not seem to be accounted for by a simple S-R habit theory account. Instead, the emerging research suggests that the learned associations that guide water drinking likely contain information on the situational context in which a behaviour is performed (i.e., both external and internal influences), the behaviour itself (i.e., motor or mental actions involved in remembering, preparing and drinking), *and* its outcomes (Trofimova, 2022). Grounded cognition theory accounts for this, allowing external stimuli and other external and internal influences to regulate even highly habitual water drinking behaviour.

Grounded cognition theory’s conceptualisation of water drinking seems to have utility in accounting for most of water drinking’s potentially relevant influences, but it also has theoretical and empirical problems. Specifically, proponents of S-R habit theory have noted that claiming all behaviour is goal-driven to some degree (e.g., claiming water drinking is always partially influenced by thirst, reward, or self-relevance) is not falsifiable (see Wood et al., 2022). However, De Houwer et al., (2022) have noted that this criticism does not provide sufficient grounds for dismissing goal-driven theories of behaviour for the following reasons: (1) The assumption that behaviour can be goal-driven is well evidenced and accepted within psychology. Therefore, the burden of proof remains with those trying to evidence that behaviour is driven by S-R habit associations, as current evidence has substantial limitations (e.g., proxy measures for S-R habits typically lack validity). (2) While the goal-driven perspective may be unfalsifiable in theory, it can be falsified (or accepted as falsified) in practice by evidencing that a *comprehensive* set of relevant goals does not drive a specific behaviour. However, S-R habit theory research typically only falsifies one relevant goal, while ignoring alternative goal-driven explanations.

Overall, this discussion illustrates that comprehensive theories of behaviour are likely more useful in accounting for the complex interplay of influences that underly water drinking behaviour in daily life. Specifically, theories that can account for research suggesting the following:

1. External and internal influences underly habitual water drinking,
2. The contexts in which water drinking is performed, and the performance of water drinking itself are highly variable and complex, and
3. Various contextual (internal and external), behaviour, and outcome constructs seem to influence water drinking rather than solely external stimuli or reward.

This recommendation aligns with a growing literature advocating that S-R habit theory currently provides a limited framework for understanding and changing behaviour in real-world settings (De Houwer, 2019b; De Houwer et al., 2022; Du et al., 2022; Hommel, 2021; Hommel & Wiers, 2017; Kruglanski & Szumowska, 2020; Papies et al., 2022; Trofimova, 2022). This recommendation is also important as researchers’ choice of guiding theory will substantially influence their research question, study design, and how they interpret and discuss their results. Therefore, researchers should carefully and explicitly consider the appropriateness of their selected theory; can it comprehensively explain water drinking behaviour in real-life settings?

**Relevance to Other Consumption Behaviours**

Water drinking differs from other consumption behaviours in some key ways. For example, water drinking is less complex than eating behaviour, as it takes relatively fewer steps to facilitate intake and time to engage in these steps than, say eating a plant-based meal. In addition, it is drunk in different situations and for other purposes than other drinks such as alcohol, which has different rewarding outcomes associated with it (e.g., relaxing, socialising) (Rodger, Vezevicius, et al., 2023). However, if research from other consumption domains indicated that influences similar to the constructs in our theoretical overview motivate these behaviours, water drinking research could also be used to inform research in wider consumption domains (Busse et al., 2017). Although a review of consumption behaviour research is outside the scope of this paper, we highlight examples of research from other consumption domains that indicate similar influences are evidenced in these domains.

First, our definition of water drinking aligns with research that highlights the importance of including preparation within conceptualisations of eating behaviour. For example, meal preparation (Wijayaratne et al., 2021) and interventions targeting meal preparation (Fraser et al., 2022; Mendez et al., 2021) facilitate healthy eating. Additionally, the external influences we outline align with wider consumption behaviour research evidencing the influence of constructs such as availability and affordability. For example, adolescents' unhealthy snacking at home depended on what was available (i.e., their parents bought for them) (Gangrade et al., 2022). Maintaining transitions to sustainable diets was hindered by the cost of buying vegan food (Williams et al., 2023). Finally, the internal influences we outline align with wider consumption behaviour research, evidencing the influence of constructs such as habitualness, reward, and self-relevance. For example, habitualness is associated with the consumption of coffee (Mazar & Wood, 2022), soft drink (Kulbida et al., 2022), and alcohol (Albery & Spada, 2021; Cooke et al., 2021) (Werner et al., 2022), as well as fruit and vegetable intake (Craveiro et al., 2021), snacking (Rose et al., 2022), and young adults’ diet quality (Baldwin et al., 2022). Reward motivates unhealthy snacking behaviours (Rose et al., 2022) and aids transitions to sustainable diets, specifically forming habitual preparation behaviours (Wehbe et al., 2021). Finally, Self-identity is associated with habitual healthy eating (McCarthy et al., 2017; Ryan et al., 2022). For example, framing a healthy eating goal as a self-identity change, rather than a behavioural change, leads to healthier food choice (Dominick & Cole, 2020).

Therefore, our theoretical overview and its implications may also be relevant to other consumption behaviours. However, researchers should carefully consider the extent to which each influence or wider implication can be generalised to wider consumption domains.

**Applied Implications**

Developing a better theoretical understanding of water drinking behaviour can help inform applied research as comprehensive theory provides insights into what influence(s) the intervention should target and how best to target that influence. We illustrate this point below:

Given the complex interplay of influences underlying water drinking, interventions that target one sole influence may not be effective. Regarding internal influences, a prime example is the potentially necessary but insufficient influence of knowledge. For example, for individuals who lack knowledge of the importance and benefits of hydration, education is likely a necessary intervention component to create a motivation to drink water (Rodger, Vezevicius, et al., 2023). However, education is insufficient on its own as even motivated individuals report issues related to constructs such as complexity, lack of availability, lack of reward, and availability of preferred drinks, all which hinder them from drinking more water in daily life. Regarding external influences, a prime example of the limitations of targeting a sole influence is the impact of public disapproval towards policy and infrastructure plans to tackle low water security by using recycled wastewater as a drinking water source (Tortajada & van Rensburg, 2020). Although this recycled wastewater is objectively safe to drink as it is subjected to stricter regulations, public scepticism has seen many projects to introduce recycled wastewater as a source of tap water in local communities go unimplemented (Tortajada & van Rensburg, 2020).

Effective interventions will, therefore, likely need to take a complex intervention approach that targets multiple influences in a staged or tandem manner. Interventions may be considered complex in two ways: (1) because of certain properties the intervention has, such as the number of components, number of target behaviours, skills and expertise needed for delivery, and the flexibility of the intervention delivery, and (2) because it there unlikely a simple linear relationship between intervention components and their influence on behaviour change in the target context (i.e., complex mechanisms of change exist such as feedback loops). Skivington et al. (2021) provide an in-depth framework for complex intervention development and evaluation.

Going back to the education example, education likely needs to be done in tandem with other intervention activities that help individuals, for example, identify daily situations where it would be feasible to drink more (e.g., script elicitation; Mohideen et al., 2023), combat the competing influence of short-term reward associated with preferred alternatives (e.g., goal priming or health warning labels; (Bauer et al., 2022; Miller et al., 2022; Papies, 2016), combat social norms for preferred alternatives (e.g., peer influence; Smit et al., 2016), or promote the repeated performance of lower-order behaviours that facilitate drinking (e.g., reminders; Rodger et al., 2023). Regarding the wastewater example, this policy and infrastructure change likely needs to come after concerted efforts to change public acceptance (e.g., public engagement & education; Tortajada & van Rensburg, 2020). In both examples, the interventions are complex because they have certain properties, such as multiple components that target different influences (e.g., knowledge and reward) of different lower-order water drinking behaviours (e.g., remembering, preparing, drinking).

Additionally, it is likely that a combination of individual and system-level intervention is needed to tackle inadequate water intake. A study of stakeholders’ perspectives on increasing water intake across academia, government and education showed stakeholders’ perceived system-level interventions (e.g., improving individuals' access to drinkable water via infrastructure changes, such as recycled wastewater) as more effective, indicating a shift in focus away from individual-level interventions (e.g., education; Vercammen et al., 2018). However, this dichotomous distinction that pits top-down system and bottom-up individual-level change against one another naively ignores the fact that individual actions are central to any system (Sniehotta et al., 2017). For example, regarding recycled wastewater, we illustrated that individuals have the agency to hinder top-down efforts. Water drinking research also shows individuals have the agency to ignore top-down efforts (e.g., public health communication) and perform behaviours that do not align with top-down changes. For example, implementing a sugar tax in Mexico did not effectively combat constriction workers' deep-seated social norms that drove their preference for sugar-sweetened beverages over water (Álvarez-Sánchez et al., 2022).

Therefore, a complex intervention approach to water drinking that acknowledges this behaviour is performed within a system and dynamically influenced by a myriad of interconnected components (e.g., individuals, immediate external environments, policy, etc) is likely the most effective approach moving forward. This approach embraces complexity by accepting that a system can never be fully mapped or predicted, but there are research methods allowing researchers to assess why the system behaves in a certain manner and how it may be changed to produce more desirable behavioural tendencies, such as adequate water intake (McGill et al., 2021; Sniehotta et al., 2017). This aligns with recommendations from research in other domains, such as health and sustainable behaviour (Jarman et al., 2022; Papies et al., 2023). For example, a recent systematic review of influences underlying adolescent dietary intake concluded that applying systems thinking to understand and change this behaviour was a crucial next step to improve upon the study's social-ecological modelling perspective (Jarman et al., 2022). The authors advocated that systems thinking (a perspective within the complex intervention approach) and its associated methods would allow researchers to explore complex and dynamic relationships between consumption behaviour and its various influences across various levels. McGill et al (2021) provide an overview of key concepts involved in systems thinking and a systematic review of the different research methods used to assess complex interventions in the public health domain.

**Strengths, Limitations and Future Directions**

A strength of this manuscript is that it is foregrounded by current best practice recommendations on theory development from the wider psychology research methodology literature. As such, our theoretical overview was informed by diverse methods providing rich insights into describing and understanding how water drinking occurs in naturalistic settings. It is not hindered by the various limitations of overreliance on experimental research that typically dominates psychology and impedes the development of comprehensive theories of behaviour (Diener et al., 2022; Scheel et al., 2020). Drawing on varied research methods will likely create the richest understanding of water drinking and broader consumption behaviours (Barsalou, 2019). For example, cross-sectional research showing a positive association between a specific influence (e.g., thirst) and water drinking was informative for establishing the relationship between water drinking and its potential influences. However, other more in-depth methods, such as qualitative interviews, were able to establish when and for whom this influence leads to water drinking throughout the day (i.e., boundary conditions; Busse et al., 2017). Finally, we note our and others' critiques of experimental hypothesis-driven research are not advocating for the disuse of this method, merely a more balanced and appropriate use (Diener et al., 2022; Scheel et al., 2020). This recommendation is important as water drinking is an emerging domain, likely in the early stages of theory development, which benefits from exploratory rather than hypothesis-driven research methods.

Another strength of this manuscript is that it is informed by water-drinking research in various contexts on various groups (see Appendix A), meaning the influences and implications we covered have the capacity to transfer across these dimensions (i.e., transferability; Korstjens & Moser, 2018). However, it is essential to carefully consider the relevance of these influences and how they emerge across these dimensions. For example, water availability might be conceptualised differently in a school compared to an office context as researchers have to contend with adults (e.g., teachers) having control over adolescents’ water availability, unlike with office workers. Water availability is likely important in both cases, but there will be context and participant-specific considerations regarding this influence. Researchers should use prior research and familiarity with their target context and participant groups to inform these considerations. Where this cannot be done, this likely indicates a need to better understand how those specific participants perform water drinking in that specific context. For example, researchers could use naturalistic observation or qualitative research to explore these gaps in knowledge (Bonetto et al., 2023; Scheel et al., 2020).

On the transferability of our theoretical overview and its implications, we caveat that the research we reviewed was predominantly Western, specifically situated within the UK and the US. This means further work must be done to consider how likely these insights will transfer to other cultural contexts. For example, Duan et al. (2022) conducted cross-sectional research on middle-aged and elderly residents’ willingness to use water filters in rural Tengchong, China, where water quality is a concern. The authors noted that although their results showed similarities to Western countries, there were differences that could be partially accounted for by Chinese tradition. For example, older residents were more unwilling to use filters than middle-aged residents, partly due to their traditional life practices promoting other preparation behaviours such as boiling tap water. Researchers aiming to understand water drinking in this context or develop an intervention must consider our theoretical overview regarding Chinese traditions. For example, preparation behaviour, including filtering or boiling tap water, seems to be a key facilitator of healthy water intake in this context. However, interventions in this context may wish to promote one or the other depending on the residents’ age group and how traditional their lifestyle is.

Another key limitation of this manuscript is that water-drinking research is relatively novel, so this literature is not yet comprehensive. Future research is *essential* to substantiate, challenge, and build on the influences and implications we have covered. However, we advocate that our manuscript is informative for this work as it establishes influences and their relationship to water drinking and broader theoretical considerations that researchers can use to inform their research. For example, access to other preferred drinks is a common barrier to water intake. However, more research is needed to establish the dynamics of drink choice when competing options exist. This is especially true in intervention contexts where the availability of other preferred drinks can hinder the effect of intervention components (i.e., implementation intentions) that do not address this issue (Rodger, Vezevicius, et al., 2023). Additionally, we highlight examples of research on other consumption behaviours suggesting these behaviours may have similar influences as water drinking. To better substantiate whether the insights from this paper apply to these behaviours, researchers should consider this literature in more depth.

Another key issue researchers must contend with moving forward is measuring water drinking behaviour and its underlying influences. Measurement development is a key stage of theory development (Flake & Fried, 2020; Scheel et al., 2020). Regarding water drinking behaviour, nearly all the research we reviewed measured drinking and did not capture other lower-order components such as preparation. Specifically, they relied on retrospective self-report measures, such as measures of typical daily intake or daily drinks diaries. These measures likely involved measurement error, as participants needed to estimate their intake. Many of these measurement approaches have also been validated for food, not fluid intake (Rogerson et al., 2023). To gain an accurate measure of intake, researchers could use more advanced technology, such as bottles that measure exact intake amounts (e.g., Pül Hydration’s Smart Cap; www.pulhydration.com). However, access to this type of technology may not be feasible regarding cost or desirable given the research aims and design. Additionally, water bottles can act as an intervention tool, therefore, unless participants already had these bottles available in their daily life, providing them would potentially alter their water intake. Therefore, more research is needed to validate accessible water intake measures against an objective marker of fluid intake (Rogerson et al., 2023). Additionally, measures of important lower-order behaviours, such as preparation, must be developed and used in future research to better understand how lower-order behaviours facilitate intake.

Regarding measuring underlying influences, there is some initial research developing quantitative items for some of these influences (see Rodger, Barsalou, et al., 2023; Veilleux et al., 2020). However, more work must be done to develop and validate more comprehensive measures. Flake & Fried (2020) present a framework to help researchers establish valid measurements and avoid common questionable measurement practices within psychology. Additionally, more work should be done to consider when these measures should be taken, especially given how variable these influences are across different daily situations. In the wider field of psychology, there is an uptake in the advocation and use of methods that allow researchers to account for this variability. Ecological Momentary Assessment (EMA) and the Situated Assessment Method (SAM2) have been used in the domain of eating and drinking to better understand what influences these behaviours through the day, and how these influences fluctuate across different individuals and situations over time (Dutriaux et al., 2023; Perski et al., 2022). Specifically, an EMA study on eating motives showed that typical motive ratings overestimated actual in-the-moment motives (Wahl et al., 2020). Therefore, water drinking research will likely benefit from using newer measurement approaches in tandem with more traditional methods.

Finally, as previously discussed, we advocate future researcher should use a complex intervention approach to guide their research and intervention development. An overview of this approach and methods is outside the scope of this manuscript. However, we provide an example of research that could be done using this approach, as illustrated by other domains. For example, a useful first step in this approach is to map out the system in which a behaviour occurs, considering who and what is part of that system and how they interact. These maps can be developed based on prior literature and co-production with relevant stakeholders (Cavill et al., 2020; Waterlander et al., 2021). They can also inform many lines of inquiry, including but not limited to identifying opportunities to change the system, stakeholders needed to effect change in the system, the best means of changing the system, and the type of data that should be collected to evaluate changes within the system (Allender et al., 2019; Cavill et al., 2020; Moore et al., 2019). For example, Gerritsen et al. (2019) used this system mapping approach to co-produce an in-depth understanding of the systemic barriers to fruit and vegetable intake with members of a low-income community in New Zealand. From this mapping exercise, they established that fast-food availability and marketing needed to be reduced. However, community members struggled to determine how to do this, indicating a need for additional stakeholder involvement (e.g., policymakers). Regarding water drinking, researchers could work with a school community (e.g., students, teachers, and parents) to map out the underlying influences of water drinking behaviour in the school setting. This map could be used to identify a range of potentially effective intervention components that aim to facilitate water intake and the key stakeholders needed to make these feasible. For example, support from senior management may be needed for enacting policy and infrastructure changes (e.g., increasing water availability, decreasing availability of other drinks, and improving toilet facilities), and advocacy from parents and students that these changes are desirable may facilitate senior management’s support.

**Conclusion**

The purpose of this paper was not to cement a theory of water drinking but to provide a snapshot of our current understanding of this behaviour. Water drinking is a relatively new and emerging research domain, so we cannot conclude with certainty which constructs, and theories are relevant for understanding and changing water drinking. However, this research's in-depth insights into the core influences of this behaviour informed our theoretical overview regarding which constructs, and theories should be considered when designing theoretical and intervention-focused water drinking research. Specifically, conceptualising water drinking as a simple behaviour does not align with people’s lived experience and will likely impede research in this domain. Water drinking conceptualisations should instead account for the complexity of water drinking regarding the lower-order behaviours, relative time, and subjective effort underlying water intake. Additionally, given the complex interplay of external and internal influences underlying water drinking, researchers should use comprehensive theories of behaviour to guide their research.

We hope this work can be used to inform further research building on this understanding of water drinking by challenging, supporting, or adding to our theoretical overview. We also hope this work can be used to inform more effective water drinking interventions. Finally, we hope researchers in other domains can learn from the case of water drinking behaviour and apply relevant insights to their research. As such, we leave readers with the following questions:

1. Are you accounting for the complexity of performing your target consumption behaviour in daily life?
2. Are you using theoretical frameworks that comprehensively account for the complex interplay of influences that likely underlie your target consumption behaviour in daily life?

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