Research Paper

Barriers and opportunities for behavior change in managing high water demand in water scarce Indigenous communities: an Australian perspective

Safaa Aldirawi, Regina Souter and Cara D. Beal

ABSTRACT

Managing water demand by reducing water consumption and improving water use efficiency has become essential for ensuring water security. This research aimed to identify the primary determinants of household water consumption in an Australian Indigenous community to develop evidence-based water demand management policies and strategies that might be implemented by the water service provider. A behavior change framework was applied to investigate the opportunity, ability, and motivational determinants affecting household water consumption and conservation in an Australian Indigenous community. The lack of water conservation knowledge and skills of high water users could be barriers to saving water. Low water users have positive attitudes towards water conservation and a higher level of awareness about their own water use. While there is a lack of a belief that water shortages will occur, low water users do have concerns of vulnerability to droughts, and that could be a driver for their sense of obligation to engage in water conservation practices. The research recommended communication messages and tools to address identified barriers to enabling positive changes to water use behaviors, which have wider applications in remote Australian Indigenous communities.

Key words | Aboriginal and Torres Strait Island, behavior change, demand management, WASH, water conservation

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INTRODUCTION

Many regions worldwide, including in Australia, are facing a decline in the availability of freshwater resources for human use. Remote Australia is a challenging environment for the delivery of well-managed and safe water services with small and often highly dispersed populations occurring across a large geographic area that is prone to extreme weather events (drought and cyclones) and seasonally scarce potable water supplies (Ali & Shahnia 2017). Hall (2019) demonstrated that several WASH issues including poor water quality, inadequate water supply, limited access to safely managed water sources, poor hygiene and sanitation status, and marginalized living conditions occur in remote Australian communities. All these issues have contributed directly to the low health status in these communities (Bailie *et al.* 2004; Hall 2019). McDonald *et al.* (2009) argued that the social and economic conditions of these Australian Indigenous communities could reflect the same conditions in other developing countries where all essential services are tenuous, including access to reliable health, education, water, and energy services.

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Seasonal or permanent scarcity of drinking water supplies has led to many of these communities depending on energy intensive water supply systems requiring high installation and operation costs (Werner & Schäfer 2007; Beal *et al.* 2016). Water demand is greater than supply in many remote communities, especially where a small land area for water storage combined with increasingly unpredictable climate has resulted in some Torres Strait Island communities having only days of water available, prompting mobile emergency desalination water delivery. Consequently, an increasingly urgent and targeted emphasis has been placed on water demand management strategies as one solution for achieving long-term water security in remote Indigenous communities.

A deep understanding of community water consumption patterns and their driving forces, as well as residents' attitudes and behaviors in water usage, is crucial to promote an effective water demand management program (Russell & Fielding 2010; Dreibelbis *et al.* 2013). Corral-Verdugo *et al.* (2002) found that some drivers will motivate people to save water, while other drivers act as barriers to prevent people from taking up water-saving behaviors. These barriers are different between communities. There is a need for more profound research in these fields, especially for Australian Indigenous communities where historically poor and largely superficial efforts have been made to understand the barriers and enablers to water conservation practices (Jackson *et al.* 2019). This is particularly relevant in remote communities where there is no charge for residential water use, and thus, there is no monetary incentive for behavior change with high water use practices. Understanding the barriers and enablers of behavior change prior to the development of a water demand management program is critical. Drawing on this, the objective of this research was to identify and describe barriers and opportunities for improving water conservation practices in a remote Australian Indigenous context. The research questions for the study were:

1. How do the main water-saving determinants of opportunity, ability, and motivation differ between high and low water users?
2. What behavior change strategies might be useful in influencing these determinants in order to reduce water consumption in a remote Indigenous community context?

After outlining the methods used to gather qualitative and quantitative data, a behavior change framework inspired by the FOAM framework (Coombes & Devine 2010) is presented. Using this framework, we identify the barriers and opportunities toward behavior change strategies for reducing water use in one community in Torres Strait Island, Australia. Finally, we suggest potential demand management strategies that may be appropriate for implementation in remote Indigenous communities.

METHODS

Overview

This project forms a component of a larger research project being conducted in the Torres Strait Island Regional Council (TSIRC) area which seeks to understand detailed water use at the household level and to identify opportunities for water use efficiencies through a community-based demand management program (Beal *et al.* 2019). All aspects of the project were reviewed and approved by the Griffith University Human Research Ethics Committee (GU Ref. No. 2017/936 and UQ ref. 2018000472).

Study site context

The data for this research were generated from the community of Hammond Island (Keriri), an inner island in the Torres Strait Island group (Figure 1). There has been no formal water demand management plan implemented on the island and the service provider, TSIRC, has communicated water conservation through the notification of restrictions, 'boil water' alerts and ad hoc face-to-face engagement with high water users.

Project participant recruitment

Local TSIRC officers assisted with participant recruitment, which involved door-to-door introductions to the team and then, if agreeing to participate, informed consent was collected for each household. Participants were selected to

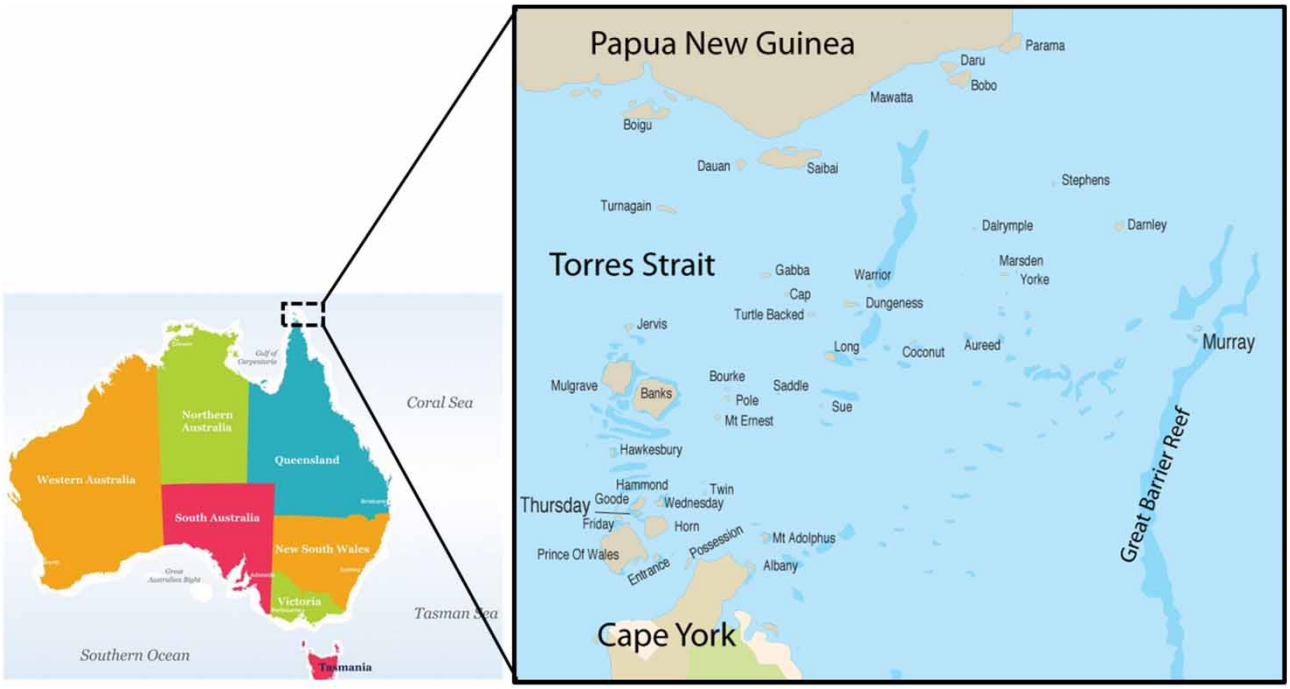

Figure 1 | Location of Torres Strait Islands, Far North Queensland, Australia (source TSRA).

obtain general representation on water use patterns (e.g. a mix of high and low water users), geographical location within the community, family size, and characteristics. At the end of the recruitment process, there was a total of 25 participating households, representing around 33% of the total households.

Demographic variable and water use categories

Demographic data for the recruited households are provided in Table 1. Note that aggregated water use was determined from TSIRC water use data, self-reported water use, and the household water use and stock survey responses. Also note that TSIRC is the water service provider for the island and therefore has access to household water use data.

Qualitative data collection methods

Semi-structured interviews were administered face-to-face from 11 to 17 March 2018. Standard demographic information and water use-related questions were designed to understand the existing uses of water by each household, as well as the knowledge and attitudes of different water users, and the ability and opportunities they had to conserve water. The data were analyzed at two levels: firstly, a thematic analysis to summarize the common themes in the data, followed by the behavior change framework analysis to identify the barriers and opportunities to reducing water use.

Thematic analysis

Thematic analysis is a method used to analyze qualitative data that is in the form of textual data (such as interview transcripts), with the aim of understanding complexity through iterative learning and providing a depth of knowledge about participants (Bawden 1992). For this research, coded ID numbers relating to each household were used to anonymously identify the participants in the data analysis process, and the response for each question was summarized (using the respondents' words as much as possible) and tabulated. All questions were sorted according to the categories of information (demographic data, water consumption, water values and attitudes, water security, water conservation attitudes and intentions, and water conservation opportunities and strategies). During the data analysis

Table 1 | Demographic characteristics and water use categories of participants

Gender	Age	Family size small (1–2), medium (3–6), large (>7)	Water use category		
			TSIRC data	Self-reported	Aggregated
Female	36–50	Large	Low	High	Low
Female	>65+	Small	High	Low	High
Male	51–65	Large	High	Medium	High
Male	36–50	Medium	High	Medium	High
Male	36–50	Medium	Low	Low	Low
Male	36–50	Medium	Low	Medium	Low
Female	26–35	Medium	–	Medium	High
Female	26–35	Medium	–	Medium	High
Female	26–35	Medium	–	Low	Low
Female	>65+	Small	–	Low	Low
Female	36–50	Small	High	Low	High
Male	51–65	Small	High	High	High
Female	51–65	Medium	–	Medium	High
Female	26–35	Medium	Low	Low	Low
Male	51–65	Large	High	High	High
Female	26–35	Medium	–	Low	Low
Male	36–50	Large	–	Low	High
Female	36–50	Small	High	Low	High
Male	26–35	Large	Low	Medium	Low
Female	18–25	Medium	–	Medium	High
Male	26–35	Medium	High	Low	High
Female	>65+	Small	High	Medium	High
Female	>65+	Small	Low	Low	Low
Female	>65+	Small	Low	Low	Low
Female	26–35	Medium	Low	Medium	Low

Note: for TSIRC water use data, low water use <300 L/p/d and high water use ≥300 L/p/d.

process, the main differences in responses between low and high water users were identified.

The FOAM framework

The FOAM behavior change framework was used to guide a systematic analysis of determinant, in particular barriers and opportunities, to household water conservation. FOAM can be used to prioritize target populations and behaviors on which to focus a behavior change campaign, to systematically analyze the results of formative research, and inform the design of intervention-targeting determinants. The FOAM framework was designed by the World Bank Water and Sanitation Program to help in the development, monitoring, and evaluation of handwashing behavior change programs (Coombes & Devine 2010) and was followed by SaniFOAM, a light modification of FOAM that is more focused on sanitation behaviors (Devine 2009) (Figure 2), which was useful as a guide to identify potential determinants for water use and conservation.

The main categories of the FOAM framework (Focus, Opportunity, Ability, and Motivation) were derived from a classification system commonly used in the sectors of consumer behavior and social marketing (Chapman 2010). Consistent with several behavior change theories that investigate the internal and external determinants that influence whether or not a person engages in a given behavior, the FOAM framework draws on a range of models, including the Health Belief Model, the Theory of Planned Behavior, and Social Learning Theory (Coombes & Devine 2010).

The first element of the behavior change framework, 'Focus', requires identifying suitable target behaviors and audiences for future behavior change strategies. For this study, the suitable target behaviors are ones that result in using less water through different choices about how much water to use. The target populations for these behaviors were the adults in the house who use most of the water or oversee water use by children. Specific determinants for the O, A, and M elements of the FOAM framework that were relevant to household water demand management were identified and used to guide the analysis, based on the literature, field data collection, and participant observation. These determinants are presented in Supplementary File A.

RESULTS AND DISCUSSION

Each of the behavioral determinants of opportunity, ability, and motivation are examined and discussed in the context of community engagement in water-saving behaviors (see Supplementary File B for detailed findings).

Opportunities to engage in water-saving behavior

All householders on the island had an equal opportunity to access the piped mains water for no charge, and many

Figure 2 | SaniFOAM Framework (Devine 2009).

households also had at least one rainwater tank at the time of the study.

There were a few barriers relating to opportunities to conserve water, including the lack of availability of the products that support water conservation (e.g. water efficient/saving appliances and devices). The local store was not well stocked with such products, and the expense relating to shipping and supplying these goods would be quite prohibitive due to the remote location. This is seen as quite a substantial barrier to adopting technical strategies to promote behavior change in the Torres Strait region.

While both low and high water users essentially had the same opportunities for conserving water in terms of accessibility and availability, low water users tended to demonstrate stronger social norms toward water saving. In general, high water use was considered a social norm, thus presenting a potential barrier to behavior change (Table B1 in Supplementary B). Both high and low water users generally perceived there to be legitimate reasons for high household water use (Figure 3(a)).

The influencing power of social norms on behavior has been confirmed by Schultz *et al.* (2008) who argued that social norms have a crucial role in making residents engage in a behavior observed in others, and they usually have subconscious pressure to follow. Also, the social acceptance of the behavior is essential to take into account when introducing a behavior change strategy, and the water-saving strategies should seek to gain widespread community support for water conservation (Fielding *et al.* 2013). Findings from the behavior change analysis suggest that Hammond Island residents are in need of 'convincing' about the value of water and the importance of water conservation in order to change their attitudes and behaviors around high water use (particularly outdoors).

Ability to engage in water-saving behavior

In terms of all the ability determinants to engage in water conservation behaviors, the main differences between high and low water users related to their knowledge, skills, and self-efficacy in how to use less water (Table B2 in Supplementary B). All participants knew the causes of high water consumption on the island and knew about their local water supply source and system. However, both low and high water users lacked detailed knowledge about their actual water use as there were no individual reports or any communication systems for this purpose, except in the case of using an excessive amount where residents were visited by the council water officer. Even though there was a lack of detailed information, low water users were more aware of their water

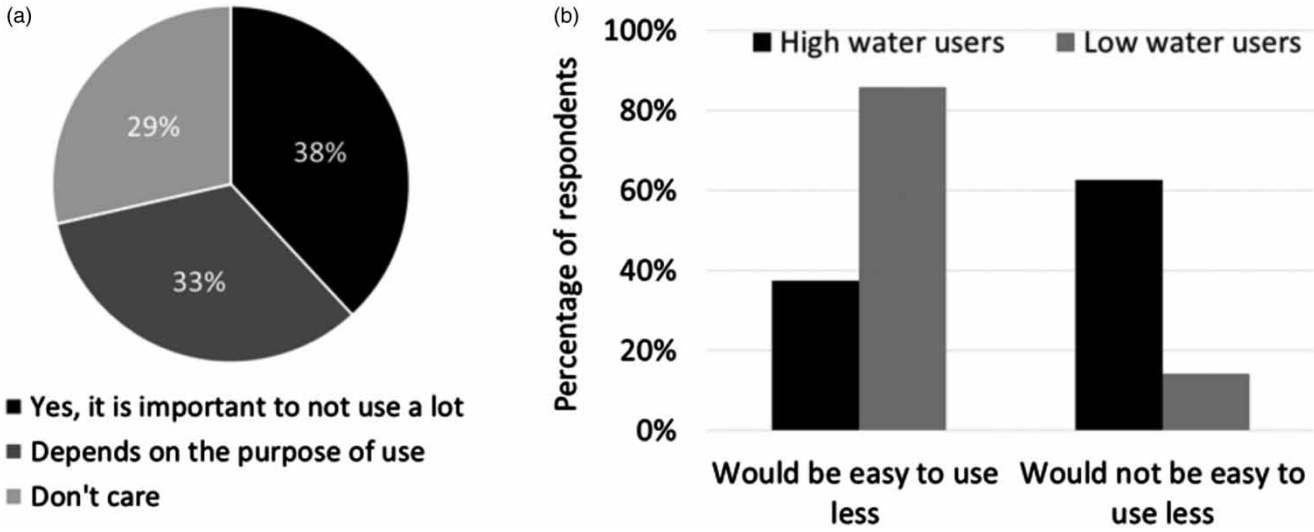

Figure 3 | Water conservation attitudes about (a) high water use and (b) ease of using less water.

consumption, and thus, they were more able to accurately predict their overall water consumption level (Table 1).

The differences between low and high water users were evident in the knowledge and self-efficacy of water conservation strategies or actions. High water users did not indicate a strong self-belief in their ability to conserve water compared with low water users, as shown in Figure 3(b), where high water users clearly felt that it would not be easy to reduce their existing water use levels. In contrast, the low water users generally believed that water conservation was within their control.

Both high and low water users believed that more personal engagement from the council, including the provision of detailed feedback of individual water use and information of ways to save water, would greatly assist their ability to save water. There was a clear lack of knowledge from many the residents about how to conserve water, and this absence of knowledge has been identified by others as a barrier to saving water. Stern's study (2000) highlighted the role of personal capabilities such as knowledge and skills in performing water conservation behaviors as people with a greater awareness of the need for water conservation may use less water.

Finally, most participants believed that although water bills would be likely to contribute to greater levels of water conservation, this would, in reality, be unaffordable for most families. This is particularly so given that residents do not pay for their water, so they have no prior experience in budgeting for their household's water use.

Motivation to engage in water-saving behavior

The differences between high and low water users were generally quite disparate between most determinants that may motivate water-saving behaviors (Table B3 in Supplementary B). Attitudes to water use and water conservation appeared to be the primary determinants that motivated low water users to use less water. Low water users generally indicated stronger water conservation attitudes compared with the high water users and tended to be more aware of their responsible behavior in water consumption and conservation. For example, when questioned about some household water-saving behaviors that they had previously engaged in, low water users indicated a greater degree of previous engagement in the reduced shower and outdoor water times (Figure 4). Previous intention or engagement in water-saving behavior is more likely to motivate future behavior (Russell & Fielding 2010) and thus provide an opportunity rather than a barrier to behavior change – for the low water users in particular in this example. There is also some evidence of cognitive dissonance occurring with the high water users where self-perceived low water use is quite different from their actual high water use. This may further inhibit motivation to change as this phenomenon

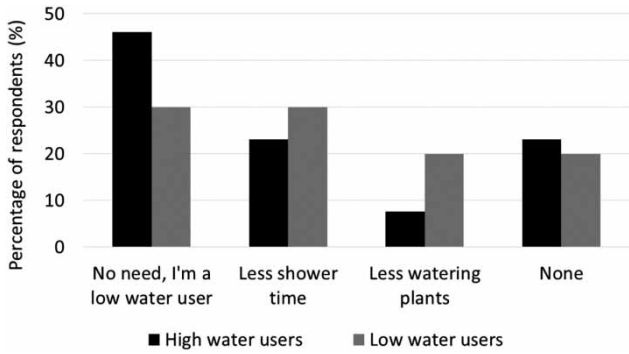

Figure 4 | Responses to the question: 'What previous water savings action have you taken?'

has been reported in the literature by others in the context of presenting a barrier in motivating water conservation behavior change actions (Beal *et al.* 2013; Lede *et al.* 2019).

Respondents consistently expressed a desire to receive more information from the council about how to save water. While the council is the responsible body for everything relating to water, it appeared that the community hardly engaged in any component of community water management and only received sporadic information or water restriction notices through the water officer. Jackson *et al.* (2019) emphasizes the importance of community participation in the success of water management programs and also identifies how this involvement can motivate Indigenous communities to recognize the value of conserving water. When asked about their concern regarding the community's water supply security, high water users generally exhibited a lower degree of concern than that of low water users. They also suggested that there were competing priorities to conserve water, such as maintaining green gardens, social gatherings, and cleaning/cooling activities. These high water use priorities in remote Indigenous communities have also been reported by Beal *et al.* (2018).

The Theory of Planned Behavior postulates that intention (motivation or plan to engage in the behavior) is the most immediate predictor of behavior (Ajzen 1991). Clark & Finley (2007) found people who had more positive attitudes to taking shorter showers, doing less washing, and installing more efficient water appliances had stronger intentions to engage in them. Further, Corral-Verdugo & Frías-Armenta (2006) found that when people perceived that others in their community were wasting water, this prompted lower levels of motivation for ongoing water conservation and consequent increases in their own water consumption. On Hammond Island, the combination of distinct differences in the intentions and priorities of low and high water users together with low drivers of water conservation (e.g. active council engagement), absence of price signal (no water fees), and competing priorities to conserve water relative to other interests, motivation is perhaps the biggest barrier to realizing a behavior change toward water conservation.

Opportunities to influence water use behaviors

The research findings suggest a need for strategies to bring about change by influencing the 'ability' determinants of behavior that help high water users gain water-saving knowledge and skills in order to break the habitual patterns of high water use. The strategies should emphasize the motivation determinants by attempting to change attitudes to water conservation. Research indicates that low water users generally had positive attitudes about water saving as well as their concerns about their community, all of which drive their attitudes to save water. Leveraging these emotional drivers in the behavior change strategy on the island could be useful to encourage uptake of water conservation behavior. Kaplan & Kaplan (2008) argued that people are more likely to behave reasonably and constructively if the environment supports their needs for information, the need to participate in meaningful ways, and the need to feel productive and competent. For Hammond Island residents, consideration of establishing positive social norms around water conservation and negative social norms around high water use would be an important end goal of a behavior change program.

On Hammond Island, the driver of fear (of water shortages) could motivate people to save water in the short-term, but in the wet seasons, this emotional driver could disappear if there is no immediate threat to the island's water supply. The behavior change strategy could use the fear driver to initiate the uptake of water-saving behaviors in the community, but this message should be delivered along with improving awareness and knowledge about the seriousness of potential water shortages. Adjusting the social norms of public water use behaviors could be encouraged through developing norms that leverage pride

in reducing water use, or norms of disapproval when using a lot of water for these activities.

The research indicated participants' preferred activities of water-saving programs; effective communication activities for a behavior change strategy would be community meetings that provide information about water use and conservation. Some other appropriate behavior change strategies could include message communication through media such as TV commercials in the local shop and on local radio as well as information booklets and brochures. Hammond Island is a small community, and many islanders expressed that they would have time for these kinds of face-to-face community activities; thus, water conservation awareness and education may be feasible and potentially well attended.

Assessment of the use of the FOAM behavior change framework

Considering several types of determinants in FOAM's list enabled a structured exploration of the kind of information, knowledge, skills, infrastructure, instruments, and emotional drivers that influence low water users to save water. Also, the analysis emphasized the importance of social norms related to water use and conservation in the community and encouraged investigation of the level of priority of water conservation relative to other interests. These points appeared implicitly in the analysis of interview questions at some levels but did not come up as direct responses of the participants. The determinants of the FOAM behavior change framework enabled us to systematically connect the observations from the field visit and the interview data.

RECOMMENDATIONS AND CONCLUSIONS

For Hammond Island, there are several behaviors contributing to high water use, including watering gardens, cleaning, and other water-consuming outdoor activities. These high water use activities are socially acceptable behaviors in the community. This research has indicated that the following recommendations should be considered:

- Enhancement of community knowledge and skills to enable them to adapt their behavior toward water conservation. Specific knowledge that could be improved includes:
  - Raising awareness about water scarcity to drive them to engage in water conservation behaviors.
  - Providing information for households about their actual water use and consumption patterns.
  - Sharing knowledge and skills of water conservation practices.
- Establishment of social norms about water conservation behaviors would provide more opportunity to adopt such behaviors, specifically the creation of social norms of using less water for gardens and social events.
- Face-to-face meetings and monthly reports on the residents' actual water use could be effective communication tools for promoting behavior change.
- Sustainable water demand management may not succeed under the application of a top-down approach, driven by the TSIRC. There is a need to improve communication and build trust between the council and the community, as well as residents' engagement in decision-making processes (i.e. a balance of top-down and bottom-up participatory approaches).

This research indicates that the FOAM Behavior change framework, which is widely used in the WASH sector, can be useful in its application to investigating household water conservation and informing demand management strategies. Future research about water conservation behavior change needs to move toward applying such systemic frameworks, which may yield more useful and site-specific insights that can underpin water policy strategies.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this paper is available online at http://dx.doi.org/10.2166/washdev.2019.091.

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