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AN INVESTIGATION ON FACTORS INFLUENCING PUBLIC'S WATER EFFICIENCY PRACTICE

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Abstract

Malaysians have been identified as heavy water users due to the amount of water consumed compared to consumers in other countries; hence are labelled water wasters. The Penang state in particular shows the highest per capita domestic water consumption at 293 litres per capita per day compared to recommended usage of 165 litres per day per person. The information indicates presence of water wastage and problem on sustainability of water resources in the country. Management prevention practice (for instance adopting water efficiency practices at home amongst the public) has been suggested as an alternative to help solve this issue. This study investigates the influences of five selected variables, namely, drivers, barriers, government practice campaigns, government practice policies and attitude towards water consumption on public's adoption of water efficiency practices at their home. To do this, a survey was carried out on willing Penang water consumers using convenience sampling method. Results showed that all five variables tested were determinants with attitude towards water consumption acted as mediating factor between the variables and water efficiency practice by the public. The findings imply that the effort to conserve water as limited resources can be achieved through public's behaviour in adopting water efficiency practice. Water operators (particularly in Penang) should consider using the five factors when planning for strategies to encourage the public to adopt water efficiency practice.

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Keywords: Drivers**,** barriers, campaigns, policies, attitude towards water consumption, public's water efficiency practice.

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1. Introduction

Although Malaysia is blessed with rainfall throughout the year, it is also recognized as a country full with population that waste water. Malaysians use 211 litres per person per day which is more than the recommended amount of 165 litres per person per day globally (UN-Water, 2015). This is a big problem for Malaysia. Promoting the act of water saving amongst the public (e.g. through water efficiency practices) has been one of the many alternatives carried out by the government to solve water wastage problem. The main benefits of practicing water efficiency for instance lie in its purpose (belief that water can be saved) and manipulation of the timing and level of usage by the individuals. The purpose of water demand management in Malaysia is to reduce water wastage and increase water use efficiency. As water demand and supply is balanced, the country can increase its water resources conservation, achieve sustainability of long term water resource availability and improve on the country's economic efficiencies. The literature has investigating variables, for instance, drivers, barriers, government practice campaigns, government practice policies and attitude towards water consumption as on public's adoption of water efficiency practices.

With a population of more than 30 million people today. Increased population has contributed towards increased amount of domestic water consumed by the public. According to Maidinsa (2014), Penang domestic water tariff has been sustained the lowest in Malaysia made possible through cross-subsidies from trade consumption earnings; in 2012, Penang average domestic water tariff is at 0.31 RM/m^3 for the first 35m^3 compared to 0.66 RM/m^3 of the national average. While the objective of providing lowest tariff is to benefits those unfortunate consumers the negative outcome or "by-product" is high domestic consumption. For instance, in July 2013, domestic consumption has reached 302 liters/capita/day (l/c/d) compared to 2012 with 212 l/c/d for the state. Penang state is identified to be the highest domestic water user compared to the other 13 states in Malaysia. It is important to note that the recommended usage for a person to consume water is capped at 165 litres per person per day (UN-Water, 2015). Since it is clear that Malaysians in general have water wastage issue, to help solve this problem, it is thus important to identify factors that influence public consumers in adopting water efficiency practice. Data shared earlier shows that Penang consumers face water wastage issue more compared to overall Malaysians justifying why this investigation is scoped only public consumers in Penang. Perbadanan Bekalan Air Pulau Pinang (PBAPP) has upgraded its infrastructure and initiated many programs or activities to encourage consumers in the state to consume water efficiently to avoid wastage. In its Friendly, Caring and Responsive (FCR) Customer Care Programme for instance, Customer Care Centres, 24-Hour Call Centre, Corporate website and email address and PBAPP Online are among services provided to customers so that they can updated information on services provided and on how issues are tackled. As will be discussed in the next sub-sections, few determinants have been proposed for investigation, namely, drivers, barriers, government practice campaigns, government practice policies and attitude towards water consumption on public's adoption of water efficiency practices.

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1.1. Drivers

Drivers are factors which lead and cause a particular phenomenon to happen (Oesterwind, Rau, & Zaiko, 2016); like the 'need to save water' which encourages the happening of water efficiency practice through public's changing behaviour towards water consumption and by adopting efficient technology that can help with improving water efficiency. Past studies suggested that driver consists of elements including water pricing, water quality, water quantity, water sources, and role of stakeholders' responsibility (Waidyasekara et al., 2016; Adams et al., 2013). For instance, both water pricing and allocation of water have significant impact towards water conservation; and that water pricing is elastic when demand for water is induced. Another study reported on how lower water price led to higher water consumption, and vice versa (Boyer, Adams, & Borisova, 2014). This is why higher water tariff is identified as an efficient way to prevent wastage (Wahid & Hooi, 2014). Water tariff factor influences water consumption to be under control and thus prevent wastage. Water quality is a significant driver for water conservation efforts (Adams et al., 2013); individuals' access to water quality was also found to be influencer over individuals' positive attitude towards how water is consumed (Adams et al., 2013). The literature also reported various possible drivers that affect public's water consumption positively or negatively. Amongst them include availability of water source which was found to have little effect on water consumption (Randolph & Troy, 2008); water supply which was identified as a significant factor influencing individual's willingness to conserve water in daily life, water shortage and drought which was reported to lead to individual's needs to practice water conservation (Randolph & Tray, 2008); and positive attitude that led to increased awareness to practice water monitoring (Waidyasekara et al., 2016). In short, some of the findings of past studies actually enhances the belief that public's behavioural practices can be implemented as individuals can personally take appropriate action on proposed drivers like increasing their awareness about water efficiency practice, changing towards positive attitude and monitoring and supervising on their daily water consumption.

1.2. Barriers

In general, barriers are described as stumbling blocks on success or achievement of a process. Thus, barriers are obstacles and circumstances that hinder and prevent people from progress. In this paper, barriers are defined as the filter which prevents adoption of water saving practices (Graymore, Wallis, & O'Toole, 2010). Barriers investigated in past studies include additional cost to water users, low priority on water management, resistance to change, value of water not apparent and unaware of new technology towards water management (Waidyasekara et al., 2016). Low water tariff for instance leads to high water consumption (Maidinsa, 2014). Low tariff charges on water supply can create major barriers on water consumption as consumers persisted on changing their attitude. Ignorance in making changes in attitude influenced individual's anticipation to accept new technology application. In short, the barriers bring negative results on effort for water efficiency practice amongst the public; whereby they would consume water highly instead of conserving it for sustainability; and that these barriers are due to lack of understanding on what water conservation is and on how it can be practiced.

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1.3. Government Practice Campaigns

Government practice campaigns refers to various campaign efforts taken by the government to motivate positive attitude and ethical practices amongst public at large. In Penang for example, Perbadanan Bekalan Air Pulau Pinang's (PBAPP) "Cleaner Greener Penang" campaign is aimed to encourage consumers to use less water and lessen water discharge through public awareness and education to reposition Penang as a sustainable city. Past studies have shown how government practice programs were successful in raising public awareness and built strong role in self-responsibility whereby government practice programs have brought positive results on water saving up to 25%, although these shown only short-term effect (Graymore, Wallis, & O'Toole, 2010). Other studies (Ouda, Shawesh, Al-Olabi, Younes, & Al-Waked, 2013) reported average savings have been increased up to 30% of water consumption through government practice campaigns. In short, government practice campaigns have an influence on individuals and group's attitude that lead towards behavioural changes.

1.4. Government Practice Policies

In Malaysia's context, water management is categorized under federal and state management. The federal parliament of Malaysia passed National Water Service Commission (SPAN) Act and Water Service Industry Act (WSIA Act 655) to ensure quality water services are provided for public at large. SPAN was appointed as regulator to monitor the water industry in Peninsular Malaysia; with vision to achieve affordable, sustainable and reliable water supply; thus, demands of water sources from different organization will be exerted with different tariff rate. Under WSIA, federal and state government shall respond and execute problems related to water issues within Malaysia and Wilayah Persekutuan (Kuala Lumpur, Putrajaya and Labuan) whereby licensing is used as tools and regulatory control for water distribution, water treatment and sewerage service. WSIA is used to judge and evaluate the compliance towards ones' application to ensure quality and reliability of water sources. As a result, water qualities were protected through management system while National Water Policy would be formulated to provide a framework for water conservation and management (Biswas, 2004). Government practice policy also establishes the safety and security of water system supplies within the country. Throughout practically of policy, it strengthens existing awareness programs and campaigns to achieve goals for water resources security and sustainability; for instance, relevant water policies implementation in Malaysia has seen improvement of rivers in the country; with the number of clean rivers increasing from 28% in 1993 to 64% in 2007.

1.5. Attitude towards Water Consumption

In general, attitude refers to strong belief, feelings and acting behaviours towards significant groups and events. According to Eagly and Chaiken (2007), attitude can be conceptualised as the inner tendency one possess as well as the evaluative responses that one expresses; however, the two are different from one another. An example of attitude is people's responses to assess efficacy or perception or expression of a view. In the context of water consumption, attitude would be focused on how water is managed and consumed. Water management for instance is the way of optimizing water usage, which is influenced by

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internal and external behaviours as results from nature and nurture of environment factors. Randolph and Troy (2008) found that lifestyle positions greatly and impacts on water saving that is reflected by one's attitude to water consumption. Positive attitude leads to positive and effective performance towards water sustainability, thus, people with positive attitude towards the environment (environment concern) will be keen to conserve water. A study by Adams et al. (2013) found that individual's pro-environmental concern (e.g. recycling, reuse and reduce practice) to show positive influence on their water conservation attitudes; thus they conclude that one's attitude towards environment can motivate water conservation practice. This view is supported by past studies whereby water conservation actions were found to be inherited from self-motivation to conserve valuable resource (Corral-Verdugo, Frias-Armenta, Pérez-Urias, Orduña-Cabrera, & Espinoza-Gallego, 2002; Moore, Murphy & Watson, 1994). In fact, Moore, Murphy and Watson's (1994) study reported that one's conservation knowledge to be weakly related to their conservation behaviour. What these studies indicate is that everybody can practice water efficiency. Example of simple practices include taking shorter shower, reducing toilet flush volume, and turning off taps when cleaning vegetables.

1.6. Public's Water Efficiency Practice

Positive behaviours increase public's water efficiency practice by adopting efficient technology and help in overcoming barriers that minimize positive impacts on water saving practice (Graymore, Wallis, & O'Toole, 2010). Robust monitoring and metering system have been identified as methods used to measure water usage; and complimentary of water efficient fittings and equipment have been found to increase water saving practices (Waidyasekara et al., 2016). While proper devices and installation increased water use and its value, regular maintenance was proven significant in ensuring that they can operate effectively (Gilg & Barr, 2006). Technology redirects the process of water flow by water reusing, recycling and water treatment and delivers positive results of water quality. Other efficient technologies available in the market include low-flow efficient showerheads, high-pressure trigger operated spray gun, and low flush urinals and vacuum toilets.

2. Problem Statement

Based on what has been discussed, the problem is to tackle is determining various factors that can help explain public's water efficiency practices behaviour. Although many past studies have identified various factors, including drivers, barriers, government practice campaigns, government practices policies and attitude towards water consumption as possible determinants of public's water practices behaviour; the gap lies in the studies that have been investigating the factors independently rather than combining them together. It is thus important to integrate the factors together to find out whether each of the proposed factors have direct effect on public's water efficiency practices in line with Attribution Theory that assumes every action or behaviour is subjected to factors that contribute to the behaviour in question.

3. Research Questions

In line with the problem statement, this study formulates one broad research question; namely; Do proposed determinants (drivers, barriers, government (practice) campaigns, government (practice) policies,

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consumers' attitude towards water consumption) have direct influences over public's water efficiency practice behaviour?

4. Purpose of the Study

The purpose of this study is to find out whether proposed variables (drivers, barriers, government (practice) campaigns, government (practice) policies, consumers' attitude towards water consumption) acted as determinants for public's water efficiency practice behaviour.

5. Research Methods

To achieve the study's objectives, a survey was conducted on willing Penang domestic water consumers aged 18 years old and above using convenience sampling technique. Except for profiling data of consumers, questionnaire items were based on those found in relevant literature pertaining to factors influencing public's water efficiency practice topic (Waidyasekara et al., 2016). Responses to item statements were measured using a 5-point Likert scale, ranging 1="strongly disagree" to 5="strongly agree"; basically because using 5- instead of 7- or 9-point Likert scale reduces time needed for respondents to answer item statements provided in the questionnaire (Wahid, 2017). Sample size for the study was decided to be within a range of 30-500 respondents. As researchers tried their best to achieve the maximum number of samples, thus, 500 questionnaires were distributed to potential respondents through Internet's Google form. Smart PLS-SEM was chosen for data analysis.

6. Findings

Of the 500 questionnaires distributed, 427 questionnaires were returned (85.5% response rate) However, only 400 questionnaires were usable and analysed. Profile of respondents shows domination of the Chinese ethnic (222 or 55.5%) over Malay (105 or 26.3%), Indian (68 or 17.0%) or other ethnic (5 or 1.4%) groups. Majority were males (212 or 53.0%), married (219 or 54.8%), have high educational background with Bachelor's degree and above (265 or 66.3%), and earning in the ranges of RM2000-RM5999 (303 or 75.8%). As for water efficiency practiced at home, two activities, taking short shower (189 or 47.3%) and gardening (88 or 22.0%) were the top two identified by respondents.

To ensure the PLS model is valid, three tests on construct, convergent and discriminant validity were carried out (Hair, Hult, Ringle, & Sarstedt, 2014). Test results on construct validity show that the requirements for minimum threshold value to be more than 0.5 have been met (Figure 1).

Convergent validity is verified by factor loadings, composite reliability and average variance extracted (AVE) by using Smart-PLS. Hair et al. (2014) recommended threshold value for the loadings at 0.5; AVE of construct must be more than 0.5, and composite reliability which must more than 0.7 for validity which was found to be met in this study (Table 1).

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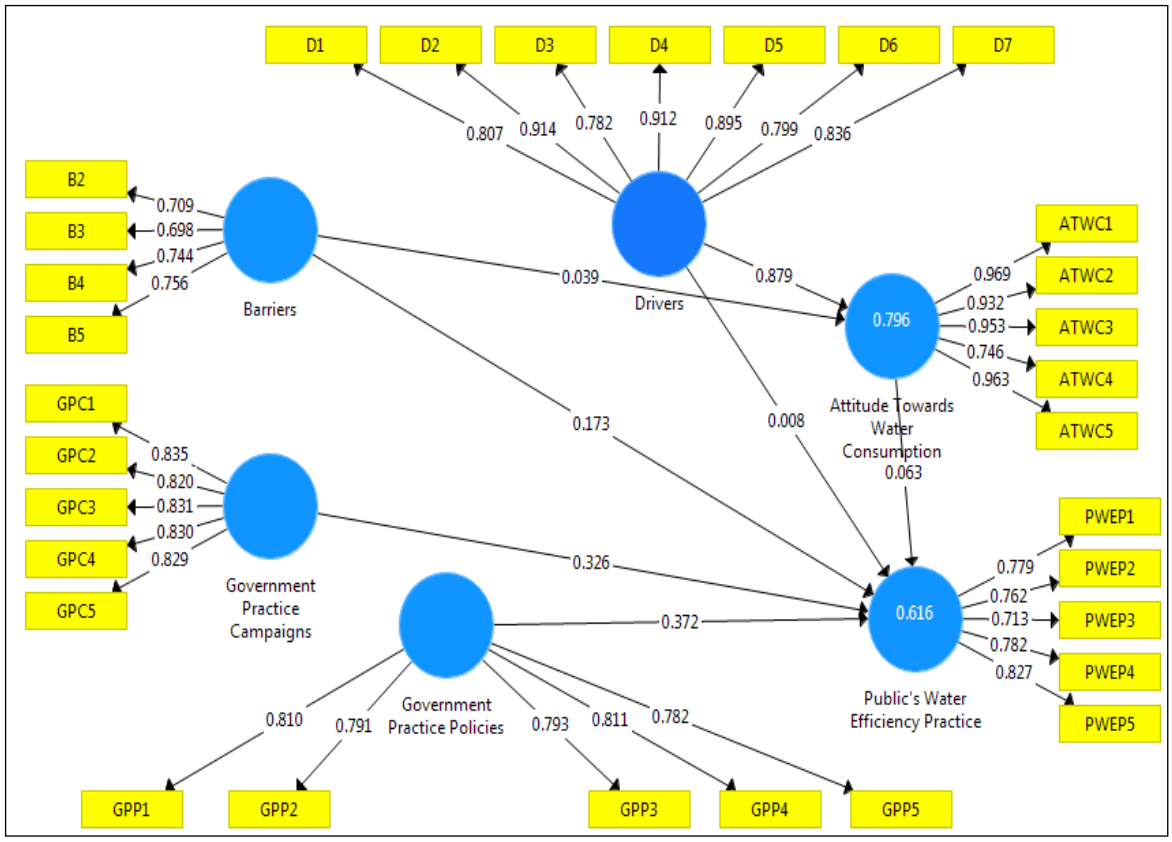

Figure 01. Model of loadings upon applying PLS logarithm

Table 01. Summary result of construct's model on public's water efficiency practice

Variable	Items	Loadings	Average Variance Extracted (AVE)	Composite Reliability	Cronbach's Alpha
Attitude Towards Water Consumption (ATWC)	ATWC1	0.969	**0.840**	**0.963**	**0.950**
	ATWC2	0.932			
	ATWC3	0.953			
	ATWC4	0.746			
	ATWC5	0.963			
Barriers (B)	B2	0.709	**0.529**	**0.817**	**0.708**
	B3	0.698			
	B4	0.744			
	B5	0.756			
Drivers (D)	D1	0.807	**0.724**	**0.948**	**0.938**
	D2	0.914			
	D3	0.782			
	D4	0.912			
	D5	0.895			
	D6	0.799			
	D7	0.836			
Government Practice Campaigns (GPC)	GPC1	0.835	**0.687**	**0.917**	**0.886**
	GPC2	0.820			
	GPC3	0.831			
	GPC4	0.830			

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	GPC5	0.829			
Government Practice Policies (GPP)	GPP1	0.810	**0.636**	**0.897**	**0.857**
	GPP2	0.791			
	GPP3	0.793			
	GPP4	0.811			
	GPP5	0.782			
Public's Water Efficiency Practice (PWEP)	PWEP1	0.779	**0.598**	**0.881**	**0.831**
	PWEP2	0.762			
	PWEP3	0.713			
	PWEP4	0.782			
	PWEP5	0.827			

Discriminant validity using Fornell-Larker to evaluate the relationship between constructs within the model found that each item loaded heavily within its own construct and the shared average variance between items of same construct were greater than average variance shared between other constructs and square root of average of constructs were also larger than 0.7 to meet up the requirement for validity. The Heterotrait-Monotrait (HTMT) criterion was found to be lesser than 0.9 for all constructs.

In line with the research objectives, the study developed and tested seven hypotheses. A model was developed in SmartPLS3 and further carried out with bootstrapping on 5000 subsamples. The hypotheses will only be supported with condition that the T-values with one-tailed test statistical significance must be greater than 1.645 at 0.05 significant levels. Figure 2 and Table 2 illustrates that the summary of hypothesis testing on the direct effect found in this study whereby H1 is the only hypothesis not supported.

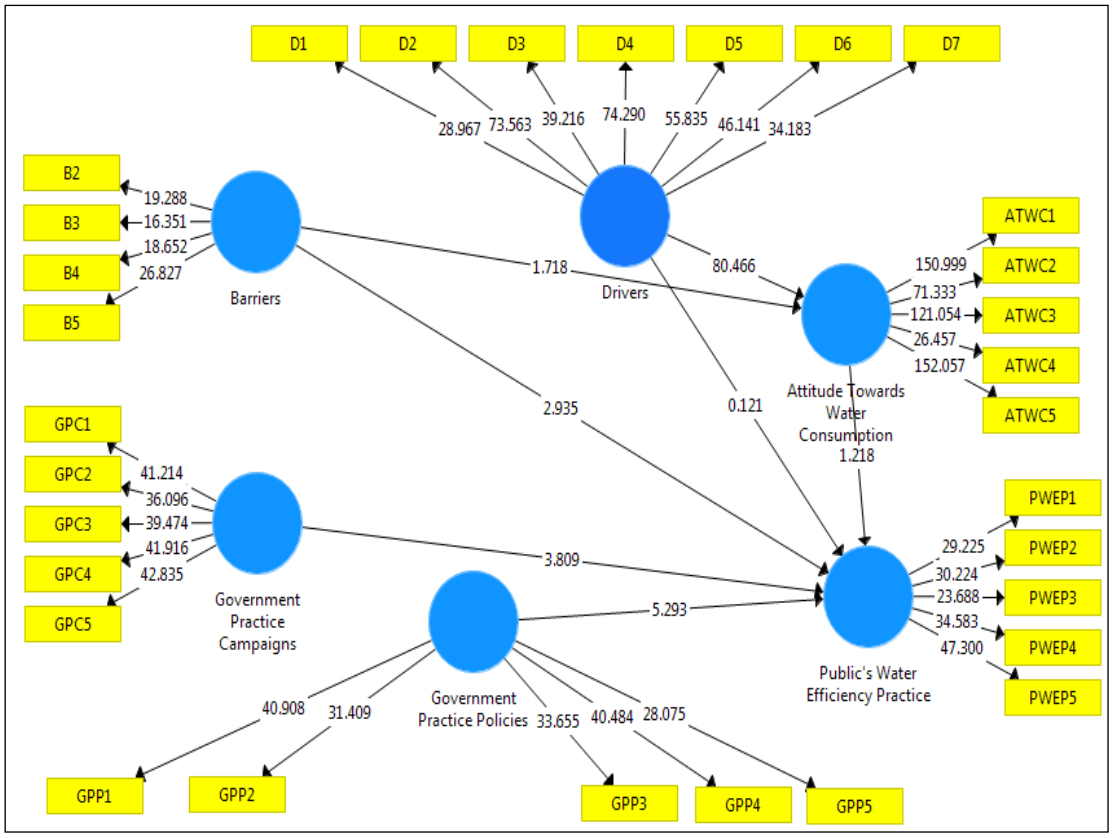

Figure 02. Structural Model of direct effect

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Table 02. Summary result of direct effect on hypotheses testing

Path	Path Coefficient	Sample Mean	Standard Deviation	t-Value	p-value	Status
H1: Drivers -> Public's Water Efficiency Practice	0.008	0.008	0.062	0.121	0.452	Not supported
H2: Drivers -> Attitude Towards Water Consumption	0.879	0.879	0.011	8.466	0.000**	Supported
H3: Barriers -> Public's Water Efficiency Practice	-0.173	0.173	0.059	2.935	0.002**	Supported
H4: Barriers -> Attitude Towards Water Consumption	-0.039	0.039	0.023	1.718	0.043**	Supported
H5: Attitude Towards Water Consumption -> Public's Water Efficiency Practice	0.295	0.300	0.053	5.525	0.000**	Supported
H6: Government Practice Campaigns -> Public's Water Efficiency Practice	0.326	0.328	0.086	3.809	0.000**	Supported
H7: Government Practice Policies -> Public's Water Efficiency Practice	0.372	0.373	0.070	5.293	0.000**	Supported

Note: **p<0.05, non-significant, with one tailed test

7. Conclusion

The study concludes that public's water efficiency is directly determined by multiple factors; namely, this study identified barriers, attitude towards water consumption, public's attitude towards water consumption, government practice through campaigns and government practice policies as the determinants. In addition, both drivers and barriers were direct determinants for attitude towards water consumption. The findings imply not only the importance of each of the factors investigated in this study, but the fact in particular, the government needs to continue its efforts to develop awareness campaigns and develop relevant policy that would encourage the public to practice water efficiency. It is through these acts that public's positive attitude towards water consumption and motivation to act on can be developed.

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