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**Increasing Water Intake of Children and Parents in the Family Setting: a Randomized
Controlled Intervention Using Installation Theory**

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Abstract (216 words)

Children and adults in developed countries on average consume too little water, which can lead to negative health consequences. In a one-year longitudinal field experiment in Poland, we compared the impact of three home-based interventions on helping children and their parents/carers to develop sustainable increased plain water consumption habits.

Fluid consumption of 334 children and their carers were recorded over one year using on-line specific fluid dietary record. They were initially randomly allocated to three conditions: Control, Information (child and carer received information on the health benefits of water), Placement (in addition to information, free small bottles of still water for a limited time period were delivered at home). After three months, half of the non-controls were randomly assigned to Community (child and carer engaged in an on-line community forum providing support on water consumption).

All conditions significantly increased water consumption of children (by 219-567%) and adults (by 22%-89%). Placement + Community generated the largest effects. Community enhanced the impact of Placement for children and parents, and the impact of Information for parents but not children.

The results suggest that the family setting offers considerable scope for successful installation interventions encouraging children and carers to develop healthier consumption habits, in mutually reinforcing ways. Combining information, affordances, and social influence gives the best, and most sustainable, results.

Paper 1222 words

Introduction

Adequate water intake contributes to overall health and well-being, enabling the body to maintain its mental and physical capabilities, helps in reducing energy intake and consequent risks of obesity [1]. However, in Europe the water intake of children and adults remains below recommended levels [2]. There is therefore a public health issue of establishing healthy intake patterns in adult and children (whose habits may continue into adulthood).

This research assessed, over 12 month, the impact of home interventions on the water intake of children and parents. Home setting interventions are rare [3]; we identified only two such interventions on hydration habits [4, 5] –these focused on adolescents but did not involve parents. To the best of our knowledge, ours is the first research on families at home specifically designed to involve parents and evaluate the impact on young children’s fluid intake.

Interventions targeting children’s fluid intake frequently focus on the school environment [1, 6 – 8]. However, there is evidence that home environment significantly influences eating patterns in young children [9]. Parents play a crucial role – as role models [10], as a source of imitation, whose food preferences influence children’s preferences [11]. Such effects are strongest for children aged 3-5 [12].

We aimed to identify which of a range of interventions have greatest impact on the water consumption of children. During the first intervention, as in traditional health belief studies [13], we provided information, relayed by parents, about the health related benefits of water drinking. In the second, small “kid size” bottles of water were delivered at the participants’

home in order to increase the visibility and availability of water, following ideas of affordances from ecological psychology [14, 15] and echoing ‘nudge’ in behavioural psychology [16]. During the third, parents had access to an online discussion forum that provided norms of consumption and tips for change, following studies on the social influence of community for lasting behavioural changes [15].

Installation Theory [18, 19] states behaviour is channelled by the combination of three layers of determinants: embodied knowledge, contextual affordances and social influence. Therefore our hypothesis was that the greatest behaviour change (e.g. the largest increase in water intake) would involve all the combination of all three interventions, reflecting the three “layers” of the “installation” of the household.

Methods

Participants. 439 households in eight cities in Poland. Eligible children were 3 to 6 years old, who drank maximum 250 mL/day of plain water of all kinds, a minimum of 800 mL/day of sweet hot or cold beverages and failing to meet EFSA adequate intake of total water intake.

Study design and Intervention

The design (see Figure) reflects the three layers of Installation theory. Initially participants were randomly allocated to one of three conditions (see Figure): *Control*, receiving no intervention at all; *Information*, offered information and advice about water consumption; *Placement*, offered in addition to information also free water bottles at home. Three months later, half of the members of the *Information* and *Placement* groups were randomly allocated to the *Community* condition: being invited in an on-line community forum to exchange support. See [20] for further details. The study lasted from May 2012 to May 2013.

[Insert Figure here]

The Research Ethics Committee of the Social Psychology Department at London School of Economics and the Bioethics Committee at the Institute of Food and Nutrition in Warsaw approved the protocol. Parents provided written informed consent.

Measures. The parent participating in the research completed a fluid-specific dietary record on the intake of all fluids for children and themselves, over 7 consecutive days [21] in each of six “waves” (see Figure); here we focus on baseline (wave 1) and final results (wave 6). For in-depth analysis and methodological control a subsample of five mothers recorded two full days of interaction with their child using wearable miniature video-cameras, and participated in “replay interviews” [22] on those recordings.

Data Analysis. We analysed volumes of water intake, using ANOVA carried out on SPSS (18.0) software.

Results

At baseline, water intake was well below the recommended levels [2]: children’s mean was below 55 mL/ day and parents’ was below 280 mL/day.

[Insert Table here]

Water intake increased significantly during and after intervention for parents and children in all conditions; all intervention groups increased significantly more than control. The largest increases in water intake were observed in the conditions with product placement (placement + community 567% for children and Placement only 88.6% for parents).

All conditions showed large effect sizes for children (η^2_p varied between 0.34 for the *Control* group to 0.54 for *Placement + Community*), whereas for parents only *Placement Only* ($\eta^2_p = 0.32$) and *Placement + Community* ($\eta^2_p = 0.26$) showed large effect sizes. For children, *Community* increased intake for *Placement* (i.e. *Placement + Community* > *Placement Only*),

but not for *Information* (i.e., $Information + Community < Information\ Only$), whereas for parents, *Community* increased intake for *Placement* and (to a lesser degree) for *Information*. For children, *Control* saw an increase effect roughly 50% that of interventions, whereas for parents it was 20% or less.

Discussion

These findings suggest that the habit of drinking water can be changed among both children and parents; indeed combining the layers of installation led to the greater increase.

The changes in water intake observed in control group over the 12 months may suggest that adults are less susceptible to social desirability and/or Hawthorne effects [23] than children. Parents intervened with strategies varying by treatment in the children's water consumption, acting as gatekeepers of children's consumption. Analysis of video replay interviews illustrated this variation: following *Information* recommendations, they offer children water, also drinking it themselves as role models. Following *Placement*, the visible presence of water bottles triggers water intake by children, by parents, and reminds parents to encourage children's drinking. The effect of *Placement* is even more massive when the affordances (here small water bottles) are actually present (at month 3: 801% for children and 118% for parents in *Placement + Community*), but of course decreases when the affordance is discontinued (water bottles were no longer made available to the household after month 3), before stabilizing at the final measure discussed here [20].

The impact of *Placement* on parents was also striking (delivering parents' only large effect size $\eta^2_p > 0.26$): being a gatekeeper (i.e., organizing the choice of available drinks) for others does not mean not being influenced oneself – in fact, the opposite. The free water was in child-sized bottles for children's use but taking concrete steps to make this choice available – directing the child's affordances for water drinking – increased both the child's consumption

and the parents' own consumption. An important implication is that installation interventions develop feedback loops: being active in nudging or influencing someone else's choices may also influence one's own choices: parent and child changes towards more healthy consumption are mutually reinforcing. This provides strong vindication for implementing health change in family settings.

Conclusion

Increasing water consumption by children and parents is an important matter of public health policy, and our interventions show that this is possible. Informing parents and children about the health benefits of water can increase their water consumption. Combining this with the right affordances e.g. an increased availability of water, the effect is greater; and even more if combined with social influence (e.g. a community). Addressing the complete home "installation" therefore appears a good ecological strategy for behavioural change.

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Children						Parents				
Conditions	Baseline	12 months	Mean change (mL)	% change	<i>p</i> -value and η^2_p *	Baseline	12 months	Mean change (mL)	% change	<i>p</i> -value and η^2_p *
Control	53.7 (83.4)	171.4 (156.5)	117.7	219.2	0.00 0.34	277.2 (277.4)	338.6 (244.3)	61.4	22.1	0.02 0.08
Information only	44.0 (67.3)	265.9 (315.0)	221.9	504.3	0.00 0.36	262.8 (315.1)	477.4 (518.8)	214.6	81.6	0.00 0.23
Information + community	45.9 (67.0)	244.3 (275.5)	198.4	432.2	0.00 0.34	277.8 (287.9)	491.9 (486.7)	214.1	77.1	0.00 0.18
Placement Only	39.6 (57.4)	197.5 (195.8)	157.9	400	0.00 0.41	181.1 (229.3)	341.5 (293.5)	160.4	88.6	0.00 0.32
Placement + community	38.1 (79.4)	254.4 (219.5)	216.3	567	0.00 0.54	250.4 (256.9)	419.6 (318.1)	169.2	67.5	0.00 0.26

Table. Evolution of total water intake for all groups at baseline (wave 1) and 12 month follow-up (wave 6)

*Mean and Standard Deviation (in parentheses) of plain water intake (in mL), and % change. By convention, a partial eta squared (η^2_p) value of 0 to 0.02 is a weak effect, 0.02 to 0.13 is a modest effect, 0.13 to 0.26 is a moderate effect and >0.26 is a large (practically significant) effect.

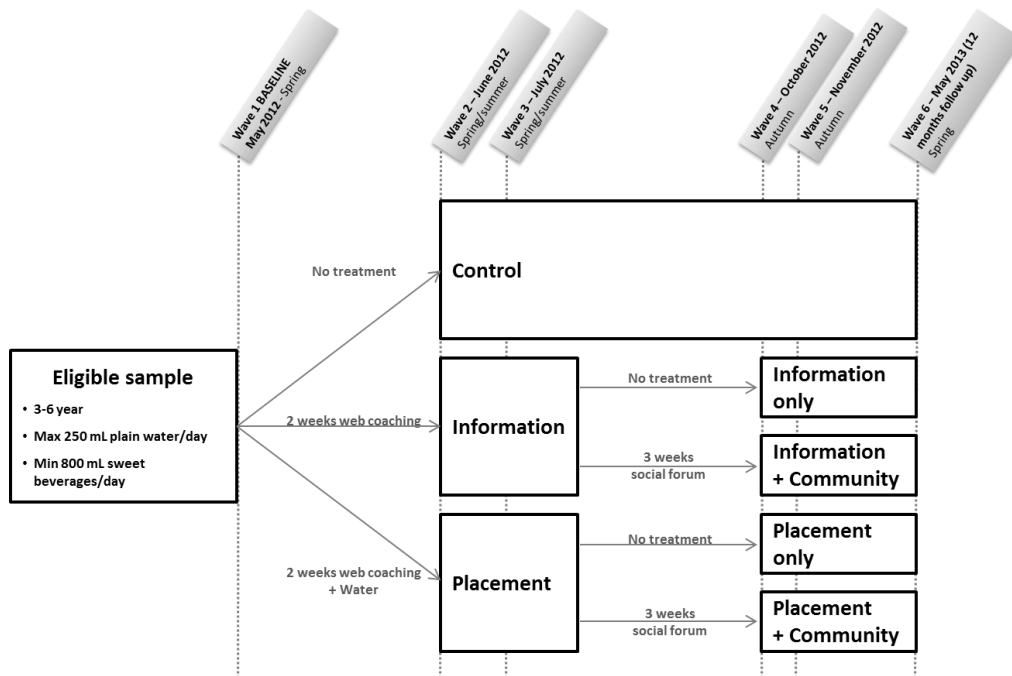


Figure. Study protocol over 12 months