



Original research article

Kids and Kilowatts: Socialisation, energy efficiency, and electricity consumption in New Zealand

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ABSTRACT

Socialisation into electricity consumption usually occurs during childhood, but little is known about the socialisation processes involved. Here, we use interviews and focus groups to investigate how nine to ten-year-old children from New Zealand learn about, and consume, electricity in their homes. The children used a wide range of electrical appliances and engaged in different energy saving behaviours, often without being conscious of their implications. Control over appliances and learning through modelling, reminders and rules helped to socialise children into saving electricity, while nagging and inconsistent behaviours from parents were counterproductive. Conversations about energy were uncommon, but helpful for creating consciousness about energy use. We discuss the need for a more structured approach, through developing energy literacy, in order for children to use their agency, surpass their parents' level of energy saving practices, and stabilise energy saving behaviours through life. In addition, we provide recommendations on how parents, schools, the media and product developers can help in this process.

1. Introduction

Energy efficiency holds major benefits for energy security, economic growth and the environment, and could halve the growth in primary energy demand by 2035 [1]. Improving energy efficiency requires a multi-pronged approach involving both technological improvements and adjustments in end-user behaviours [2]. Understanding behaviour is crucial in facilitating the adoption and proper use of energy efficient technologies, as well as encouraging people to diminish their overall energy consumption and reduce the number of appliances they own [3,4]. Energy-using practices start in childhood, and despite the many studies investigating energy behaviour [5,6], relatively few have investigated how energy saving practices initially develop. This is unfortunate, since it is generally during childhood that socialisation into electricity use occurs [7]: although adolescents tend to lose interest in conserving power [8,9], expectations and practices acquired at home during childhood are often carried through into adulthood [7,10].

Research on children and energy has mostly focused on the role of schools in developing energy literacy: a state of knowing, caring, and taking responsibility for the effects of energy production and consumption [11]. However, engaging in environmental practices, such as

conserving electricity, is not always a conscious decision based on knowledge and corresponding attitudes [6,12]. Instead, energy saving practices tend to be the product of poorly understood “repetitive, unconscious, routine aspects of household energy consumption” [3, p. 449], as well as – in the case of children – learning processes guided by parents [13].

Childhood learning experiences can be understood as socialisation, which teaches young people “the necessary skills, values, and behavioural patterns to become well-functioning members of their social group(s) and the culture in which they live” [14, p. 415]. Socialisation occurs either through indirect processes, such as observing others, or direct ones, i.e. purposely being taught [15]. Direct socialisation methods include positive (e.g. praise) and negative (e.g. punishment) reinforcement, as well as other forms of explicit parental guidance, such as rules, reminders, instructions, and explanations. Such measures aim to control the child's external behaviour, and cause it to develop a self-directed, internal framework guiding its thoughts, feelings, and actions [15]. By contrast, indirect socialisation often takes the form of modelling (i.e. socially reinforced imitation), as well as conscious inference and subsequent application of the guiding rules of the observed behaviour. Both types of socialisation shape consumer practices, including

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energy use [16], but indirect processes generally prevail [9,17].

Articles on children's everyday energy consumption in the household are rare, and mostly based on teenagers [9,16,18]. Studies focusing on younger children have recently started to emerge [7,19], but so far are limited to Europe. Here, we explore how nine and ten-year-old children in Dunedin, New Zealand, use energy – specifically, electricity – in their homes, and investigate the processes and family dynamics involved in their socialisation into saving energy. Specifically, we will focus on the following questions:

- How do children use energy in their homes?
- To what extent do children engage in particular energy saving behaviours?
- What processes and family dynamics are involved in developing energy saving behaviours in children?

2. Methods

This study is based on individual semi-structured interviews with (i) 26 children attending Year 5 of primary school; and (ii) one of their respective parents. Complementary information was provided by three focus groups involving a further 14 children.

2.1. Field work

The children were recruited from five primary schools in Dunedin, New Zealand³ (Supplementary Material, recruitment procedure) with different socioeconomic backgrounds (based on a decile system [20]), and varying levels of environmental teaching (Supplementary Tables 1 and 2). The participating families were diverse in terms of income level, parents' professions, family structure, ethnicity, and the characteristics of the dwelling.

Prior to the interviews and focus groups, all of the children were asked to take photographs on how they use electricity in their homes (Supplementary Material, recruitment procedure). These photos were then employed to guide the subsequent conversations, focusing on the ways electricity is being consumed, personal efforts and reasons to save it, learning about saving electricity, and relevant family conversations⁴ (Supplementary Material, Guides 1–3). All the sessions were audio-recorded and transcribed. The focus groups were furthermore video-recorded to differentiate between the children's voices.

In addition to their interviews, the parents were asked to complete a survey (developed by the Energy Cultures Group [21,22]) rating, on a five-point scale, their own level of engagement with various energy saving behaviours, as well as their personal attitudes towards energy efficiency and environmental values. They also answered specific questions on family structure, characteristics of the dwelling, and the appliances that their children operate (Supplementary Material, Guide 4).

2.2. Analysis

All transcripts were subjected to systematic thematic analysis (using the software NVivo, ver. 9⁵), which involves the identification of main themes, followed by their transformation into codes and aggregation into categories [23]. Specifically, we inductively identified relevant segments as they emerged from the data, focusing on the overall meaning and topics covered by the participants, rather than on specific

³ Following the guidelines, and with the approval, of the University of Otago Ethics Committee.

⁴ The vast majority of stoves, water heating systems and heaters in NZ use electricity. When gas was used instead, it was included and discussed in the interviews in the same manner as electricity.

⁵ NVivo was used only at its most basic level to save quotes and group them into nodes and themes. We did not employ any of the automatic coding and analysis features.

words. These segments were saved into nodes (e.g. setting heating temperature, no contact with appliance, talking about energy once a week), and then aggregated or subdivided into themes (e.g. using heaters, family communication, rules) in an iterative process. The results of this analysis constitute our primary findings, and were categorised in terms of the electricity saving behaviours performed by the children, the children's level of control as a prerequisite for engaging in such behaviours, and the various pathways used to socialise children into using electricity.

To explore the data further, we performed a content analysis of the key themes, and then used the latter to conduct a series of statistical analyses. Note, however, that the statistical analyses neither draw on a representative sample, nor aim to test particular hypotheses; they thus merely serve to complement the thematic analysis, and should not be considered on their own. For the statistical analyses, the codes from the interviews and the survey data were used to quantify (i) the energy saving behaviours performed by the parents and their children,⁶ divided into low, medium, and high categories; (ii) the level of agreement between the children and their parents as to which behaviours the children actually performed; (iii) the children's level of control over appliances; (iv) the number of electricity behaviours performed by children voluntarily and/or habitually; (v) the parents' behaviours, attitudes and values; and (vi) the presence or absence, within a given family, of the main socialisation processes identified in the thematic analysis. These numbers were then compared and analysed via exact chi-square tests [24] (the significance threshold was set to $p = 0.04$ to avoid unstable results), Kruskal-Wallis one-way analyses of variance, exact Mann-Whitney U tests [25], and correspondence analyses⁷ [28]. Exact tests are designed to cope with small, unbalanced or poorly distributed data sets, and are thus suitable for this kind of study [24].

3. Results

3.1. Control over appliances

The children were highly involved in using electricity at home, and identified 45 different appliances which they used regularly. Television sets, lights, computers, electric heaters and heat pumps,⁸ stereos, and microwaves were mentioned most often, whereas dryers, dehumidifiers and dishwashers tended to be operated primarily by the parents (Table 1). Interestingly, the majority of the children were operating electric heaters or heat pumps, contrasting with low levels of control over central household heating in France and the USA [17,29]. Many of the children were also involved in doing laundry and cooking.

In general, the children's perception of their own level of control over appliances was higher than that ascribed to them by their parents. For instance, in spite of Tim's⁹ mother commenting that her children are "not supposed to touch it [the heater], but they have, so it gets turned off [...]. They know now", Tim reported that he and his sibling had "put a line where we should put it [the temperature] with a pen on our heaters, so we just know where to put it [...]. We just did it." The children's use of electricity in excess of their parents' expectations is a common "poaching" practice [17,29, p. 70].

According to the thematic analysis, the children's level of control on their energy use depended on several interrelated factors:

⁶ This number primarily derives from the children's own answers (consistently performed behaviour = 1; occasionally performed = 0.5), but information provided by their parents was also taken into account to compensate for the fact that the children did not always realise the energy-saving effect of their own behaviour.

⁷ To be considered, correspondence analyses had to be significantly different from 0 ($p < 0.05$), and explain more than 20% of the total variance (total inertia values greater than 0.2) [26,27].

⁸ Electrical heating, ventilating, and air conditioning devices used for space heating and cooling.

⁹ All of the participants were given pseudonyms.

Table 1

Survey results regarding the use of specific electrical appliances by family member. The percentage of family members using a particular appliance was calculated based on the number of families who both own and use the item in question.

	Families who own and use it		Operated by					
			Entire family		Children only		Adults only	
	#	%	#	%	#	%	#	%
Fridge	26	100	26	100	-	-	-	-
TV	26	100	25	96.2	-	-	1	3.8
Computer or laptop	25	96.2	25	100	-	-	-	-
DVD player	23	88.5	22	95.7	-	-	1	4.3
Sky TV	20	76.9	18	90.0	-	-	2	10.0
Electric heater	20	76.9	12	60	2	10	6	30
Electric blanket	18	69.2	13	72.2	-	-	5	27.8
Deep freezer	17	65.4	10	58.8	-	-	7	41.2
Dishwasher	17	65.4	6	35.3	-	-	11	64.7
Clothes dryer	17	65.4	2	11.8	-	-	15	88.2
Heat pump	16	61.5	11	68.8	-	-	5	31.3
Gaming device	16	61.5	7	43.8	9	56.3	-	-
Towel rail	9	34.6	8	30.8	-	-	1	3.8
Dehumidifier	6	23.1	1	16.7	-	-	5	83.3

- (1) Material culture: Appliances being either out of reach¹⁰ – which, however, interfered with only one of the possible electricity saving behaviours per household¹¹ – or programmed by the parents to operate automatically, thus removing the need for interaction.
- (2) Capability: Parents' perception of their offspring's capability to use devices correctly and safely. For example, open fires were generally seen as complicated and out of bounds, whereas heat pumps were considered easy and thus regularly used by the children.
- (3) Trust: Parents' willingness to delegate responsibility was affected by their children's – generally unintentional – misconduct (e.g. setting heaters at very high temperatures), as well as their own level of trust (see also [29]). Misconduct usually led to less control and increased supervision (e.g. having to ask before using an appliance), whereas a lack of trust tended to remove control entirely: "I just run around and do it [turn off lights and appliances] myself subconsciously [...]. I don't know if I trust them [her children] to do it" (Amy's mother).
- (4) Safety: Safety concerns were one of the most discussed topics by the participants (see also [16,17,19,29]). Both the children and their parents associated the word electricity with danger (e.g. electric shocks, fires). Safety concerns were the most common reason for the parents not to allow their children to operate cooking devices and, to a lesser extent, electric heaters. They were also a reason for parents turning off appliances at the wall themselves, in order to avoid children interacting with plugs. Previous studies reported a similar relationship between risk perception, control, and the adoption of technology [30]. However, any resulting restrictions only affected three possible electricity saving behaviours (i.e. turning off cooking devices, heaters and appliances at the wall), out of a maximum of ten performed by the most active children. Generally, the children were not barred from contact with electrical devices, but more closely supervised.

When safety concerns combined with a lack of trust, children were seemingly deprived of control over the vast majority of electrical

appliances: "I don't actually let her [daughter] turn anything on [...]. I am just a bit scared [...] she may not do it correctly and I may not have shown her, but I'm still... she is only nine so I don't want her getting electrocuted" (Marion's mother).

3.2. Electricity saving behaviours

At the most basic level, the degree to which the children engaged in electricity saving behaviours depended on their freedom to consume, and hence their control. Five of the children had almost no control over any appliances, and thus engaged in significantly fewer electricity saving behaviours than their more autonomous peers (Mann-Whitney exact test, $p = 0.015$). In these families, energy use was usually not discussed, and children were not making an effort to save electricity (Exact Chi-square, $p = 0.034$). By contrast, those children who operated most of the appliances in their homes also did the most to save electricity (including cleaning and cooking). Thus, having at least some control over electrical devices is necessary for the direct involvement of children in energy consumption and, ultimately, conservation. This is consistent with social cognitive theory [15] and the theory of planned behaviour [31], both of which pose that perceived control influences behaviour by allowing a person to believe that they can achieve a desired outcome.

All of the children reported 3–10 electricity saving behaviours (Supplementary Table 3). Nevertheless, many were only half as active as their most engaged peers, demonstrating that there is room to improve saving performance. Furthermore, very few of the children were saving electricity voluntarily¹² (Supplementary Table 3), with about half of them either not taking any responsibility for saving electricity at all, or only with reference to a single behaviour. Finally, many of the children discussed their electricity saving behaviours without relating them to energy consumption at all. This may indicate a general lack of concern in this regard, as seen in teenagers [8], possibly owing to a low level of awareness about the consequences of energy use beyond its cost [13] (see discussion Section 4.3).

¹⁰ Usually light switches, plugs, and curtains, or appliances located above the kitchen counter (e.g. microwaves, kettles, toasters).

¹¹ E.g. turning off bathroom heaters, unplugging appliances at the wall, and closing curtains.

¹² A behaviour was coded as "voluntary to save electricity" when the children reported that they perform it without being asked or being required to do so by their parents, and without contradicting their parent's interviews in that regard (i.e. voluntarily). The children furthermore had to mention saving electricity or reducing the power bill as at least one of the reasons for engaging in the behaviour in question (i.e. energy conscious).

Table 2
Electricity saving behaviours performed by the interviewed children voluntarily and/or habitually (i.e. consistently and autonomously).

	Total	Voluntarily to save electricity		Habitually (consistently and autonomously)	
	Children	Children	%	Children	%
Lights off	25	14	56	10	40
TVs off	22	12	54.5	8	36.4
Closing curtains	21	1	4.8	7	33.3
Short and medium showers	19	3	15.8	4	21.1
Computers off	16	5	31.3	10	62.5
Heaters off or low	13	5	38.5	6	46.2
Wearing extra clothing	13	2	15.4	8	61.5
Appliances off at the wall	12	8	66.7	7	58.3

The majority of the children turned off lights, TVs, and appliances at the wall voluntarily and with the intention to save electricity, but only about half of them did so consistently. Conversely, the majority of the children consistently turned off computers and wore extra clothing before turning up the heating, but usually did not do so with the intention of saving power. Finally, short showers were neither used consistently, nor frequently associated with reducing electricity consumption (Table 2). Very few children talked about energy efficient infrastructure, unplugging mobile phones after charging, and turning off electric blankets. Previous studies obtained similar results [7,32–36].

All of the children were aware that lights require electricity, and that turning them off saves power and/or reduces cost. This might be related to its high degree of visibility [37,38], and seems to result in more reciprocal reminders (see Section 3.4.3), and explicit communication about the topic (Section 3.4.2). By contrast, the reasons given for most other electricity saving behaviours often were unrelated to energy consumption (see discussion Section 4.3), such as having short showers to leave enough hot water for others (about half of the children were not aware that heating water requires energy), or closing curtains for privacy.

3.3. Habits

Habits are automatic and relatively fixed behaviours [39], and an important part of the children's socialisation process into saving electricity. Although only a small proportion of the children's electricity saving behaviours were habitual,¹³ most of them had acquired at least one habit by the time of the interview (Supplementary Table 3). As explained by several participants, the establishment of habits followed naturally from prolonged engagement in a particular behaviour: "I remember [to turn off the heat pump]. Before, I used to use it so much, my Mum always told me to turn it off once I was finished with it. [...] I have been doing this] probably since I was about seven [years old]" (Tanya).

The time the children had been involved in a behaviour seemed to be determined by its perceived level of danger. Thus, the children had started to use potentially hazardous cooking appliances only recently, and had been using heat pumps for less than two years, but had been closing curtains and turning off lights for a long time (see also [7]). However, there was no simple relationship between the 'age' of a particular behaviour and the number of children who performed it habitually. For example, only four of the 19 interviewed children who took short showers had made a habit out of it, only ten (out of 25)

¹³ A habit in this study is considered to exist only when a particular behaviour was performed consistently and autonomously (i.e. without parental interference), regardless of the underlying rationale.

persistently switched off lights, and only seven (out of 21) regularly closed curtains. It therefore seems that engaging in an energy saving behaviour for a long time does not necessarily, by itself, create a habit.

Some of the parents considered their children's daily routine – several habitual behaviours performed consecutively (e.g. wake up, turn off electric blanket, open curtains) in a specific context (e.g. going to school, dinner, or bedtime) – to play a key role in creating electricity saving habits: "Routines, routines work with children." (Amanda's mother). Routines are effective because they decrease the tension associated with day-to-day mundane decisions, thus reducing family conflict and ensuring stability [40]. Children's lives are generally organised around several already established routines [41], which provide an ideal and relatively effortless opportunity to include energy efficient practices. Maybe unsurprisingly, then, the children of the four parents who talked most emphatically about daily routines also had a comparatively high number of electricity saving habits.

3.4. Pathways to socialisation

Electricity saving behaviours were almost exclusively passed on from parent to child. Overall, the more socialisation strategies were followed by the parents, the more the children were saving energy. Thus, children who engaged in a high or medium number of electricity saving behaviours, and performed more than half of them habitually, had been socialised into them through a combination of modelling, reminders, and frequent conversations about energy. By contrast, children who engaged in comparatively few (habitual) behaviours also had parents who set a poor example, rarely talked about energy use, and did not impose rules. Below, these socialisation strategies are explored in detail.

3.4.1. Modelling behaviour

Parents seem to play a major role in helping their children acquire and habitualise electricity saving behaviours through specific socialisation strategies (see also [7,9,14]). Following the example set by parents was mentioned in connection with all of the analysed behaviours, and by members of more than half of the participating families. In line with previous studies [14,32], visible behaviours with obvious consequences (e.g. turning off lights and computers) were particularly likely to be passed on in this way. Mary is a typical example, reporting that she turned off the lights because "I watch my mum, and I learnt from her". In this, and in some other cases, parents did not explain the reasons for performing particular behaviours, leading children to perform them without the intention to save energy.

In most of the families, the children were modelling their parents' behaviours in addition to receiving specific instructions or explanations, with parents generally being consistent in terms of their speech and actions. Nonetheless, there were several exceptions, particularly as concerns shower times. While some of the children did not seem to be

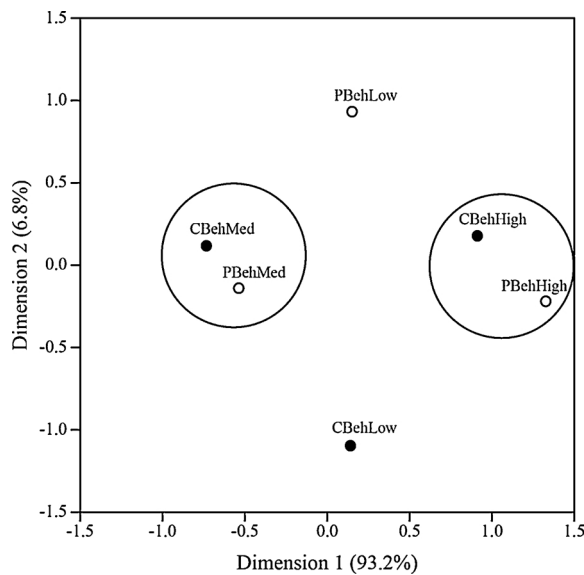


Fig. 1. Correspondence analysis for parent's (P) and children's (C) level of engagement in energy saving behaviours (Beh) (Med = Medium). The explained variance per dimension is noted in parentheses (Supplementary Table 4).

upset by such inconsistencies, others were: "I say, 'Mum, you have to turn the light off, because you always say that we have to turn the light off.'" (Lisa). Lack of consistency on the part of the parents may represent a barrier for their children to help save electricity, as pointed out by Karla's mother:

It's partly to do with us [parents], because [...] there's just so many [electrical] things around the house and she [Karla] says, 'Oh if that thing's on, I may as well leave that thing on then.' [...] It's not really fair on me to say, 'Oh Karla, five minutes [in the shower]' and then I'll just go and... (laughs).

These observations suggest that setting an example for children is highly beneficial, whereas the opposite may be counterproductive (see also [9]). This finding is unsurprising, and reflected in the fact that the number of electricity saving behaviours performed by the parents (as judged from the surveys) and their children (based on the interviews) seemed to be positively correlated (Exact Chi-square, $p = 0.018$). Similar results have been reported with regard to teenagers [14].

A correspondence analysis of the same data associated parents and children engaging in a high or medium number of electricity saving behaviours, respectively, but not those with low levels of engagement (Fig. 1; Supplementary Table 3). Possible explanations for this pattern might include a lack of control over appliances on the part of the children, the existence of rules obliging children to engage in electricity saving behaviours even when their parents do not, and children being particularly receptive to the few examples actually set by their parents.

3.4.2. Conversations and explanations

Most of the families had at some point discussed energy savings at home, focusing in particular on the financial cost of power and, much less frequently, on environmental concerns and energy security [13]. More than half of the children were proactive in asking questions, with over a third of the participants recalling specific examples related to energy consumption and production. Some parents also pointed out that the children often initiated the conversations, which provided a perfect, though often lost, opportunity for more in-depth explanations and conversations.

Overall, the extent to which each family communicated about energy-related topics varied widely. In line with previous research [19,32,42], actual conversations about saving energy were rare in the

majority of cases, with two families never discussing the topic at all. For instance, Mike stated that "we don't talk about it [saving energy] that often", although his parents did explain that saving electricity would mean that "they don't have to pay so much". These children only had a limited understanding of how electricity use relates to certain behaviours, such as having a short shower or closing the curtains.

By contrast, roughly one quarter of the families stood out for talking often and deeply (weekly) about electricity consumption:

We talk about, you know, especially in the news [...], we need to save power, and why, and the increase of industry and all that; and that households have a higher consumption of power because [...] these big devices that we have nowadays use more power, and we have more of them [...] (Charlie's father)

This high level of communication included (i) clear explanations as to why and how to save energy; (ii) talking about energy consumption in context; and (iii) frequent, dedicated conversations on the topic, often revolving around reasons for performing a specific energy saving behaviour, or the effects of efficient technology on the family (e.g. keeping warm or saving money). Such conversations occurred mostly while the child was learning to use a device, with the children also talking and, usually, asking questions. A few of the families also had more complex conversations about energy consumption and production (e.g. relationships between energy production, the family's energy consumption, and environmental issues) over dinner, after watching a related documentary or the news, or as a result of homework.

Most of the children who frequently talked with their parents about energy consumption also engaged in a high number of electricity saving behaviours, which is consistent with the findings of DeWaters and Powers [43]; however, this relationship is not statistically significant. Instead, there is a significant association of the parents' attitudes (measured in the surveys) with the number of electricity saving behaviours performed by both themselves (Kruskal Wallis, $p = 0.017$) and by their children (Kruskal-Wallis, $p = 0.023$). Rather than through conversations, parents with a strong attitude towards energy efficiency thus seem to influence the behaviour of their children primarily by setting a good example. This marks an important difference between the complementary effects of indirect (e.g. modelling) and direct socialisation methods (e.g. conversations): whereas the former are likely the predominant factor leading children to adopt electricity saving behaviours, frequent and deep family conversations allow them to rationalise their own actions.

3.4.3. Instructions and reminders

Instructions and reminders¹⁴ were the most direct, simple and common form of communication about energy between children and their parents. All of the participants gave or received them regularly, except for two families where they were deemed unnecessary because the children already performed several energy saving behaviours habitually. Most of the reminders were in relation to turning off lights, having short showers and, to a lesser extent, turning off devices or closing the fridge and doors.¹⁵

Unlike other socialisation strategies, reminders and instructions were the cause of some mild conflict in about a third of the families (see also [17,44,45]). In a few cases, avoiding conflict was the children's only reason for engaging in an electricity saving behaviour:

Alex: [I] just turn it [the light] straight off when I go back out.

Researcher: Okay, and why do you do that?

Alex: Because Mum gets angry with me if I keep it on.

¹⁴ An instruction is a short command to perform a specific behaviour, or to perform it in a certain way. A reminder is a subsequent repetition or reference to this instruction.

¹⁵ Central heating is rare in New Zealand homes. Therefore, closing doors is necessary to regulate room temperature.

Several of the participants explained how extremely frequent reminders could turn into nagging: “Oh just, you know, ‘Can you turn the lights off after [...]’ you know, ‘when you’re not using it’, or ‘when you’ve left the room’; or, ‘Why are all the lights in the house on?’, or that kind of more – nagging, actually” (Blake’s mother). Such a dynamic creates a vicious cycle: the child does not follow an instruction, leading the parents to give it more often. Eventually, the child gets used to frequent reminders, which makes them largely meaningless: “‘It’s time to get out of the shower now’ [...] I don’t... I don’t listen. They have to drag me out” (Miles).

Interestingly, most of the children who experienced nagging found that their parents were themselves not consistent in following the behaviour. For instance, Tabatha’s mother “nag[s] her [daughter] to turn the lights off”, but Tabatha said: “I don’t know why she keeps telling me off, because she does it sometimes, too”. This lack of consistency might erode the parents’ credibility, and contribute to children either ignoring an instruction, or feeling conflicted about it.

In stark contrast to the issues created by nagging, there were also a few families where gentle, repeated parental instructions were well received:

We’re still going through the process of reminding her [his daughter] to turn her stereo off [...]. Some mornings [...] I just turn it off [...] because I don’t want to stress her out [...], we’ll get there (Grace’s father).

Grace’s response was positive: “My Dad always reminds me, so I’m glad he does”. All of the children in this situation considered saving electricity to be important, albeit more out of a desire to help their families than because of financial or environmental concerns [13]: “I’m helping with it, because it helps all of us [the family]. It’s helping all of us, and it’s saving money too” (Paula). Once the children were making a personal effort to save power, they tended to regard reminders as helpful, rather than as an imposition, thereby turning them into a positive way to achieve a common goal [46]. Such gentle reminders were always accompanied by frequent conversations about electricity consumption, reflecting an effective overall approach to family communication.

Recent research has shown that instructions and reminders can have positive effects both ways. Thus, children giving instructions and reminders can significantly reduce household energy consumption, provided that they have specific guidance [47]. The children in this study were not being specifically encouraged to alter energy consumption patterns within their families, e.g. via energy efficiency campaigns [13]. Nevertheless, many of the children still gave reminders to their parents and siblings, as seen in some previous analyses [46,48]. In doing so, they normally reflected reminders they had themselves received from their parents, making them part of the family dynamic. Those children who didn’t give reminders, or gave them rarely, seemingly felt that their parents “usually don’t [forget]” (Alice). In addition, it seems likely that they did not want to challenge the family hierarchy, which may also explain why younger siblings found it difficult to remind older ones.

Reminders by the children were not always given out of a genuine will to save power. Several of the participants mentioned a range of other motivations, which included imitating the parents’ example, trying to help the family in general, challenging authority, and antagonising siblings. These reasons may have been as important as saving energy, if not more so (see also [19,46]). Nevertheless, the sheer existence of reminders demonstrates that the children were aware of the electricity saving behaviours that the whole family was meant engage in, and provided them with an active role in achieving that goal [13]. Overall, this role appears to have been constructive, with parents always receiving reminders from their children positively: “It is good to help each other out” (Kaila’s mother); however, reminders by the children also created conflict in about half of the families where they were given to siblings.

3.4.4. Rules

Over a third of the families, and several of the children from the focus groups, mentioned at least one rule¹⁶ aimed at reducing energy consumption. The children and their parents mostly agreed on the existence of particular rules and their underlying reasons, confirming that they were explicit and clearly understood by both parties. Interestingly, the most widespread rules were related to the major sources of household energy consumption (water and space heating [49]), indicating that the parents were the most concerned, and therefore strictest, about those behaviours using the largest amount of power. Alternatively, or in addition, they may have viewed controlling heaters and timing showers as somewhat complex behaviours, and thus in need of clear guidelines. Finally, the existence of rules likely compensated for the fact that the more private nature of activities like showering hindered modelling, and made it difficult for parents to monitor their offspring.

In contrast to other direct socialisation methods, rules were clearly effective at controlling the children’s actions, and their presence correlated with a significantly greater number of energy saving behaviours (Mann-Whitney exact test, $p = 0.003$; see also [46]). All of the parents setting rules provided an explanation for them to their children, and usually abided by them themselves (see also [50]). For instance, Amanda was distraught that everyone in her family “used to take really long in the shower” and she would “get the cold water”. Thus, her mother set up a rule for a five minute shower, which fits well with her concerns about using “too much gas”. Children “have quite fun with that” because they can “turn off the water” when their parents are in the shower for “too long”. The rule was working well, and applied to everyone in the family.

3.4.5. Punishments

In the majority of cases, the children were not punished for not following instructions, except for being made to switch off a light, or occasionally having the hot water turned off on them while still showering. Both of these actions were seen by parents as an important part of the learning process. Stricter punishments, such as being confined to the bedroom for an hour for leaving several appliances on, and withdrawing pocket money for leaving lights on regularly, were only mentioned by two of the children, who subsequently corrected their behaviour. Possible reasons for this rarity of punishments might be that (i) parents did not consider energy efficiency important enough; (ii) the children usually obeyed rules, anyway; and (iii) a perception that the children were making an effort, which needed to be encouraged. Whatever the underlying reason, the low level of punishments likely prevented children from developing a negative attitude towards saving energy, and put more emphasis on alternative strategies based on reasoning.

4. Discussion

4.1. Importance and potential of socialisation during childhood

Children become involved in energy consumption, and thus also conservation, gradually, as the ability to reach and use appliances develops. Nine and ten-year-old-children are becoming involved in many new and more complex household chores other than switching off appliances (e.g. heating, closing curtains, laundry, cooking, deciding shower times, and charging mobile phones; see also [7,34]). Influencing newly acquired behaviours is arguably easier than trying to change a particular practice later in life [51]. Thus, as expressed by Paula’s father, when children start using electricity directly, “that’s the time that

¹⁶ Precise and explicit command given by the parents, which must be always followed by their children; often indicated by words such as “not allowed”, “limit”, “have to” or “mandatory”.

we should tell them how to take care of it and how to use it more efficiently". However, as shown here, it is impossible for this learning process to occur if children completely lack control over electrical devices.

Where control exists, the extent to which energy saving practices are adopted is dependent on the degree of socialisation. At ten years or younger, children are mainly focused on their home and the information they acquire from their families [52], thus providing the perfect opportunity for developing household energy saving practices which they may then carry with them into adulthood. Previous research suggests that, if taught and encouraged, children of this age have the potential to engage in a greater variety of energy saving behaviours than observed in this study. They can, for instance, persuade their parents to buy energy efficient light bulbs, dry clothes on the line, close the fridge quickly, and turn off appliances at the wall [53,54].

By the age of ten, children are reaching the final phase of the main family socialisation process into energy use, and start to make most of their daily energy decisions autonomously [7]. In this light, the small number of voluntary and habitual energy saving behaviours the participants of this study tend to engage in is concerning, especially when considering their extensive use of electrical appliances. Adolescents generally seem to lose interest in energy topics [7,55], and are characterised by a particularly high level of electricity use [8,14,45,56]. Nonetheless, energy saving practices acquired during childhood remain crucial, because they re-emerge once teenagers grow into independent adults needing to manage their own household energy consumption and finances [7,10,16]. This highlights the importance of socialising children into saving energy at an early age.

4.2. Effectiveness of socialisation methods

With the exception of nagging and, possibly, strict punishments, all of the socialisation methods emerging from this study are complementary and reinforce each other. Which method is employed seems to be influenced by the visibility of the behaviour. For instance, the children disagreed the least with their parents when talking about turning off lights, TVs and computers. During all of these activities, family members can observe each other, leading to a family norm and learning through modelling. Conversely, less visible behaviours, namely, showers and heating, are associated with the highest percentage of disagreement between parents and children, indicating that implicit norms may not be sufficient. This creates a need for direct socialisation, as evident in the frequent existence of rules relating to both heating and showers.

Rules are widely recognized as an important and beneficial component of child rearing when accompanied by explanations (as in this study) [40,57]. In the context of this research, they provide clear, explicit and strict guidelines which (i) are easy to follow; (ii) are independent of the visibility of particular behaviours; (iii) contain an implicit message that saving energy is important; and (iv) prevent misunderstandings and constant negotiations, thus reducing conflict. Rules are thus very effective in raising the number of energy saving behaviours children engage in, as was also found by Garabuau-Moussaoui [58] and Kleinschafer and Morrison [50,58].

Because rules represent an external constraint, their eventual withdrawal may cause the behaviours they enforce to be abandoned – a reaction associated with forceful control or a child's reactive temperament [59]. Conversely, if a rule is internalised, it may become habit and foster self-control [60,61]. The chances of rule internalisation increase with a child's compliance, which is aided by a cooperative attitude and a strong parent-child bond [59]. In the context of electricity consumption, rule internalisation is likely to occur, as shown by most of the children in the study complying and agreeing with the rules set by their parents without conflict or the need for punishments. Actual evidence for rule internalisation with regards to electricity consumption has previously been reported by Kleinschafer and Morrison [50].

A more common direct socialisation method than rules are instructions and reminders. Reminders were used by all of the parents, suggesting that they are a necessary component of the socialisation process (see also [7,58]). Reminders are important, because they help to maintain particular behaviours through simple repetition, in a way similar to advertisements or classical conditioning [62]. This is consistent with comments by many of the participants, who reported that they had developed habits following a period of frequent reminders. Nevertheless, the low number of children's habitual energy saving behaviours suggests that reminders on their own are not particularly effective. Reminders are also not always positive: although they can help to create a cooperative attitude in the family with the aim of achieving a common goal (see also [46,63]), they can also lead to frustration and conflict [44,58]. In the context of this study, such conflict was evident in form of a vicious circle of nagging and ignoring.

Indirect socialisation – specifically, the extremely common process of modelling – is the most peaceful and organic learning method [15]. In line with previous research [7,9,14,32], modelling was one of the primary socialisation processes identified in this study. The example set by parents is therefore particularly important: when parental behaviours are obscure or inconsistent, children struggle to adopt them, regardless of any instructions, reminders, or explanations (see also [9]). Because modelling is not related to explanations, it was one of the main processes giving rise to seemingly meaningless behaviours, which first need to be rationalised before they can lead to a conscious effort. Similar observations were reported by Garabuau-Moussaoui [7].

4.3. Consciousness

Behaviours, including energy saving ones, can be formed without a conscious effort, relevant knowledge, or a specific goal [12,64,65]. Thus, it is not surprising that many of the children engaged in several electricity saving behaviours without realising their purpose. The fact that mere exposure can lead children to save energy is encouraging, but the unconscious behaviours thus created are likely to be randomly abandoned, are more difficult to influence than conscious ones, and cannot become the subject of agency [64,65]. For instance, habits, though relatively stable, depend on the context [39], which tends to change as children grow up and leave home. As a result, they are at risk of disappearing, unless there is an underlying positive attitude that maintains them. Similarly, rules, instructions and reminders are extrinsic motivations [66], and the behaviours they enforce liable to reversal when parents are absent or lose influence (e.g. teenagers' rebellious attitude) [59].

The precarious nature of unconscious behaviours raises questions about their long-term stability, and limits children's ability to surpass their parents' energy saving efforts. This underscores the need to employ additional socialisation pathways not entirely dependent on the parents' behaviour, such as the development of energy literacy at school and through the media. At home, energy literacy can be fostered further through relevant conversations [13], which are thus important even if they do not, by themselves, clearly increase the number of the children's electricity saving behaviours.

5. Conclusions

Our study, the first of its kind in New Zealand, investigated how children are socialised into saving electricity in the household. We found that providing children with some control over energy-consuming appliances, a visible and consistent example set by the parents, rules accompanied by explanations, daily routines, frequent and in-depth conversations, and cooperative reminders are all effective means of socialising children into using energy carefully, and ideally ought all to be employed. By contrast, nagging and inconsistent behaviour on the part of the parents are unhelpful and potentially detrimental. To ensure the stability of energy saving practice throughout life, the latter should

ideally be conscious, rationalised, and internalised [9,59] all of which can be aided by developing energy literacy. Ultimately, such literacy might inspire children to go beyond the energy saving efforts of their parents.

Our results have implications for how parents, educators, the media, product designers, and organisers of government campaigns may promote children's involvement in saving energy. Parents are the main driver behind children's energy saving behaviours, and should hence be specifically targeted by government, school and media campaigns [9,67] stressing (i) their importance as role models; (ii) the effectiveness of different socialisation methods; (iii) the significance of communicating about energy issues; (iv) the need to avoid negative associations with saving energy (e.g. by setting clear rules to diminish conflict); and (v) the need to give children some control over appliances. Positive reinforcement of children's efforts to save power currently seems to be uncommon, but could help to develop the children's self-efficacy and consistency. Similarly, helping children to become conscious of their already existing energy saving efforts may empower them, and encourage them to do more. Finally, parents should exploit their children's general curiosity to encourage their interest in energy topics.

Formal learning,¹⁷ though no substitute for family interactions, can help to develop children's energy literacy, and thus provide a conscious avenue to saving energy. In the long term, it may help to stabilise the energy saving behaviours acquired at home, and motivate children to surpass their parents' efforts. In addition, formal education has the potential to reach large numbers of households, and could disseminate the results of this and similar studies via newsletters and meetings. Likewise, it could encourage communication about the topic, both between parents (e.g. via school campaigns and community projects) and at home (e.g. via projects and relevant homework). For instance, if parents were to discuss their children's level of control over appliances, some of the more cautious adults might allow their offspring more freedom. Finally, educators, such as schools,¹⁸ have been successful in increasing the number of energy saving behaviours that families perform at home [32,47,53,54,68–71], and should suggest a broad variety of ways to save power beyond turning off appliances [32,53].¹⁹ Such suggestions might be taken up most readily when supplied in context (e.g. tips on the efficient use of kitchen appliances during cooking lessons²⁰). This recommendation is particularly important in the New Zealand context, where formal education for energy literacy currently tends to be limited: although it forms part of the guidelines for the Year 5 curriculum, it is not compulsory [72].²¹

The potential of the media to influence children's energy literacy and behaviours was not explored here. However, the media appear to have at least some impact on children's understanding of energy [13,19]. Thus, cartoons, magazines, story books, advertisements, family documentaries, and web pages, among others, could include practical advice on how children can save power.

Finally, children may also learn to save energy from novel technologies. For example, energy consumption can be made more visible through feedback devices, and savings be encouraged via video games and competitions [18,19,29,47,73,74]. Likewise, there is scope for designers to develop household and communication technology encouraging children to be energy efficient [29]. For instance, many of

the children in this study use mobile phones, which could serve as a platform to give reminders, set goals, and self-assess energy consumption [34]. Finally, electrical appliances could include child-friendly features advising on their proper use, such as visible reminders to “turn off” light switches, signs on heaters stating the recommended temperature, or automatic messages asking users to switch off and unplug computers when not in use.

Overall, the findings of this study resonate with the current literature and help to create a baseline for future and/or international comparisons. It is one of the first to study children's socialisation into energy use, and as such contributes to an emerging field that explores how children learn to use energy and their potential role in building an energy-efficient society.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.erss.2018.04.020>.

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¹⁷ Government, schools, providers of learning material, and supporting educational institutions such as the EnviroSchools Foundation.

¹⁸ And scouts [32,54].

¹⁹ E.g. by using efficient technology, limiting the temperature of heaters, line drying clothes, putting on warm clothes when cold, doing full batches of laundry, and rinsing dishes in cold water.

²⁰ Cooking lessons were provided by most of the schools included in this study.

²¹ The energy education given to the children in this study was largely limited to reminders to switch off lights and appliances in the classroom, freedom to choose energy as an assignment topic, and scientific experiments [13].

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