An Energy Experiment: Tests, Trials and ElectroTrumps

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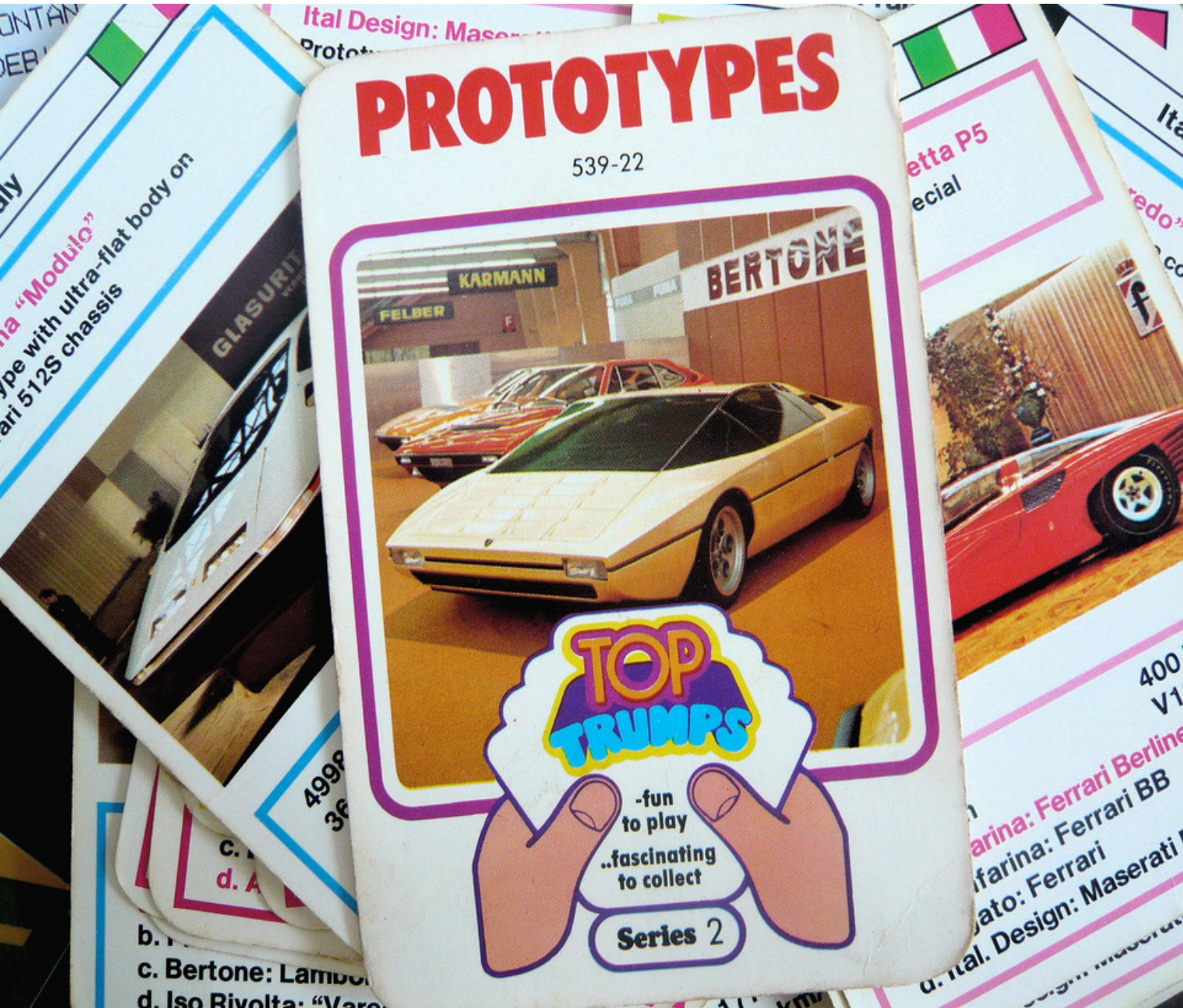

Accounts of energy often take the form of historical narratives or contemporary dilemmas. Within popular narratives our energy technologies are either presented as the inevitable outcome of heroic endeavours or as things in the world that cause or solve problems. The many films and biographies of energy's 'great men', such as Thomas Edison or Guglielmo Marconi, for example, suggest that the development of many energy technologies we know today were either awaiting the ingenuity of the canny, financially-skilled entrepreneur or their appropriate application.

Whilst classic portraits of the heroic, 'great men' of electrical science and technology have been challenged by anti-biographies (like David Nye's study of Edison) there has been little parallel attempt to examine stories of experimentation in the field of electricity [1]. Biographies of challenging and quixotic subjects, like Nikola Tesla, for example, with his spectacular showmanship and perhaps even more spectacular failures, present us with an account of technological development in which the experiment, the trail, test or demonstration is centre stage, whether it succeeds or not (e.g. Lomas 1999, Siefer 1996).

Yet whilst foundational scientific histories often hinge on dramatic experimental discoveries it is striking how little detail remains available of these events. An otherwise informative history of early electrical experiments, such as that provided by Torres Assis and Andre Koch (2010), for example, includes little technical detail on the scale or specificities of the experiments described. Instead, it reduces them to demonstrations of principle, perhaps highlighting the radical division between historical narratives of scientific development, and the more abstract or non-narrative academic communication of scientific findings found in journals.

Like experiments in biology and biomedicine (Latour and Woolgar 1979, Latour 1993), experiments in the field of electricity invite questions about the production of scientific knowledge, and about the changing relationship between science, technology and the public. Our aim with this text is to reclaim the specificities of electrical experiments and to develop a novel means of highlighting histories of experiment, introducing a very simple game, ElectroTrumps, that sets up new opportunities for juxtaposition, comparison and reflection.

When is an energy experiment an experiment?

What is it that qualifies a practice as an 'experiment' as opposed to backyard tinkering, for example? What kind of tests become widely recognised, and what kind of trials remain informal? What are often referred to as energy 'experiments' fall along a spectrum of practices and methods for the production of scientific and technical knowledge. At one end of the spectrum, we might say, is the 'experiment': designed to generate surprise, new knowledge and questions that could not have been asked before (Fischer 2007, Fortun 2014).

At the other end of the spectrum is the 'test', designed to confirm what is already known. In between the two lies a glossary of terms (trials, demonstrations, probes, prototypes and pilots) that have distinct conceptual significance and ideological meaning in different contexts of use. For some, the different ends of this spectrum establishes the distinction between two disciplinary traditions. As a pioneer of science and technology studies Trevor Pinch (1993) once suggested, the test is to technologists what the experiment is to scientists.

Attempts to establish a precise typology - to pin and anatomise the precise definitions of these words - would be to deflect attention from their fluidity. In the contemporary world, from arenas of global finance to arenas of public policy, we find this spectrum of experimental terms deployed for particular ends; used strategically by people and institutions to claim particular qualities (novelty or originality, rigour and reliability, reach or generalisability) for their claims to truth.

Experiments, energy and the public

What we refer to as energy 'experiments' might be said to represent a distinct genre of public engagement with the engineering and physical sciences. Over the past 250 years, experiments with the chemistry of materials and the organisation of energy systems have transformed public and private locations (from homes to museums, industrial laboratories, villages, towns, and cities) into truth spots for the production of scientific and technical knowledge. As the mode of energy experimentation has changed, so have the means by which materials, technologies, and infrastructures are accepted or

legitimised (Jasanoff 2003).

In 19th century England, for example, energy experiments were performed in private, upper class stately homes. Such austere venues had long granted experiments an authority and credibility; with vital implications for their reception by a wider public that was not present (Shapin 1988). Take Cragside in Northumbria, for instance, the home of Lord and Lady Armstrong, which was developed in the 1860s as a showpiece for hydroelectricity, with lighting, lifts and laundry services powered by the worlds first hydro-electric power station.

Today, such high profile energy experiments are just as likely to be held in public or through public media, with scientists and engineers seeking to demonstrate the applicability of new knowledge by enlisting potential users and potential contexts of use into their experiments. Across Europe, for example, journalists now undertake 'green living experiments', setting themselves the task of living with low carbon or carbon neutral energy technologies for a fixed period of time and writing about their experiences in the print or online media (Marres 2008, 2009). Meanwhile television documentaries and current affairs programmes offer 'news' on new technologies, for example, as well as highlighting the promise and dangers of particular technologies, often with a tendency towards scandal or hyperbole, or a futuristic sci-fi slant to enhance news-value.

Just as biomedical technologies are granted credibility and authority through experiments that take place outside the scientific laboratory (e.g. Kelly 2012), experiments with energy materials technologies are made credible and authoritative by being conducted in these 'field labs'. In the UK, for example, publicly funded and publicly visible trials of low carbon or energy efficient industrial processes - like the biodegradable waste treatment plants described by Joshua Reno (2010) - compel people to engage with energy science and technology in intimate and embodied ways.

Global experiments

Rethinking moments of experimentation in the history of energy technologies also means re-distributing agency and authorship across global locations. The most important milestone in the 20th century history of solar photovoltaics is usually recorded as the date in 1954 at which Bell Laboratories publicly announced that three of its scientists - Daryl Chapin, Gerald Pearson and Calvin Fuller – had invented a silicon photovoltaic cell capable of converting enough of the sun's energy into power to run everyday electronic equipment.

On April 25th, 1954, the company held a press conference to announce the invention of the 'Bell Solar Battery', a panel of cells that could power a small toy, and the following day they presented it to the National Academy of Sciences in Washington. The New York Times heralded the invention on its front page, writing that the solar cell 'may mark the beginning of a new era, leading eventually to the realisation of one of mankind's most cherished dreams - the harnessing of the almost limitless power of the sun for the uses of civilisation'.

Yet this is a very particular account of the history of photovoltaic science and technology. It is a version of history in which agency is stabilised around three white men and one key material (silicon) rather than distributed across the complex network of humans and materials that were necessary for the solar cell to cohere as a successful technology. It is also a version of history in which agency is spatially located, with a North American scientific laboratory at the centre. Yet, as popular histories of solar energy reveal, non-western field sites and global locations have also been critical sites of research, experimentation and testing in the development of the modern solar cell (Cross 2012).

By early 1954 Bell Laboratory's trials had led to the creation of a solar cell that crossed what was considered the minimum threshold for its viability, an efficiency of 6 per cent, producing 50 watts of electricity per square yard of photovoltaic material. Yet over the second half of the 20th century, West Africa emerged as an important testing ground for photovoltaic applications in telecommunications, water pumping for drinking, livestock and irrigation, and lighting. One of the first systematically recorded 'experiments' to demonstrate a potential application for the modern, silicon solar photovoltaic cell in sub Saharan Africa, for example, took place in 1970's Mali.

As John Perlin (1999) has documented, one French missionary, Bernard Verspieren, responded to the effects of a devastating drought by installing a solar powered water

pump in a village on the edge of the Sahel. Launching the solar powered pump, Verspieren told assembled villages: 'Solar power is the answer, it will be your salvation. You've seen it touched it, listed to it. Not in a laboratory but in your own backyard' (Perlin 1999, p111).

Over the next few years his detailed technical reports provided a stimulus to discussions about the coating of solar modules, and engineers responded by developing a more rugged design and more durable moulded glass panel which more completely sealed the cells and their connections from contaminants such as dust and sand. In this way scientific and technical knowledge that was critical to the development of the silicon based solar photovoltaic module as we know it today was produced not in the laboratory spaces of Europe and North America but in field laboratories across the non-western world.

The ElectroTrumps Game

Our reflections on energy experiments and public engagement led us to develop our own experiment in research, writing and play. Inspired by Joseph Dumit's innovation with learning-games (2017) as well as Anna Tsing and Elizabeth Pollman's (2005) multi-round, 'Global Futures' game of imagination and speculation, we developed a card game about energy experiments.

Our game takes its inspiration from a popular cultural gaming phenomenon called Top Trumps. Top Trumps was first launched in the UK in 1968 and over the past fifty years hundreds of versions of the game have been produced [2]. By the 1980s the game was ubiquitous in primary schools and packs of the cards continue to be a popular staple of school playgrounds in the UK. The original cards were designed to promote basic literacy, numeracy and mnemonic skills as well as general knowledge. They also expressed a commitment to 'learning through play'.

Each pack of 52 Top Trumps cards is based on a theme or topic, from vehicles to space phenomena, from dinosaurs to wildlife, from movie stars to athletes. Each card presents a person, place or object linked to the theme and a list of between 4 and 8 vital attributes, which is given a numerical value. The aim of the game is to win all the cards, and each round is played by a player choosing one of the categories as its 'trump'. The card with the highest value in this trump category beats all others, and the player with the winning card gets all the other cards played in this round, and goes on to choose the next trump from the next card in their pile. The classic game is more complicated than 'snap' but far simpler than the multi-round imaginative story telling card game designed by Tsing and Pollman.

Our modified version of the game, which we've called ElectroTrumps, has an energy experiments theme. Our cards are intended to highlight the range and variety of energy experiments, test and trials. In developing a template for the ElectroTrumps cards we settled on five simple starting categories: 1) Name of experiment (or author of experiment); 2) Date of trial; 3) Voltage achieved in test; 4) Current used in test; 5) Significance of discovery from 1 – 10.

Our choice of categories is not entirely arbitrary but neither is it definitive. Factors such as the date of the experiment and its power may (or may not) be established. The 'significance' of an experiment is largely debatable, subject to claims and context. This is partly the point of the game – to discuss the relative significance of different experiments, potentially prompting players to seek further information or debate the relative merits of different technologies.

Rather than compiling a complete set of cards for distribution we have developed a small set of sample cards. Part of the play in this game is that players are invited to invent their own cards. Our sample cards are intended to inspire contributions from others. We propose that ElectroTrumps be played as a kind of wiki-game, where the fundaments of the game might also find new forms, or inspire new sets.

As currently envisaged, the game can encompass foundational experiments in the history of electricity – from well-known experiments like those carried out by Faraday, Edison, Swan and Tesla - to contemporary experiments with smart, digital systems, or low-tech renewable mini-grids. Our initial set of examples includes both formal historically evidenced laboratory experiments and public-science, popular tests. A set of definitions and guidelines related to the categories is provided, but is open to challenge and could be redefined in play.

The game has been designed for use as part of a classroom teaching activity and aspects

of the game were developed during seminars with undergraduate and graduate students at the University of Edinburgh and the University of Durham. In making these suggestions, and by opening the game to direct input, we also propose the game as an alternative, experimental mode of public engagement with the humanities and social sciences; one that holds out the possibility of generating new and surprising questions about the social and material politics of energy within and beyond the academy.

The game is hosted on a dedicated website that contains a downloadable pack of cards as well as resources for inventing your own cards (www.electrotrumps.xyz). ElectroTrumps invites you to co-produce a pack of Energy Experiments playing cards by adding your own examples to a collective pack. The aim is to source the material for a card game that is free, fun, playable and pedagogic.

Our guidelines for the game are not identical with the rules provided by the official, branded Top Trumps games. The materials are open to alternative uses. Could the cards be compiled to generate alternate histories of electrical technologies? Will they only highlight gender disparities in the power industries and in engineering research or will they uncover hitherto unrecognised figures? Will they demonstrate an emphasis in particular fields, or reveal a funding-driven focus on particular technologies? Could they be brought together to design new experiments, invent new technologies or bring creativity to bear on under-emphasised challenges?

Rules for Playing ElectroTrumps

ElectroTrumps is a game for two or more players. The object of ElectroTrumps is to complete a full pack of playing cards and then to win all the cards. ElectroTrumps can be played with a deck of 30, 42, 48 or 52 cards. A selection of 15 ElectroTrump cards can be cut out from this book or downloaded from www.electrotrumps.xyz. Additional cards must be designed by the players. Players can use or modify an ElectroTrumps playing card template, which can be reproduced from this book or downloaded, to invent new cards. In the process of inventing new cards players are invited to discuss or modify the theme, develop sub-sets, and review the categories.

To play, begin by shuffling a full deck of playing cards. Deal the cards until each player has an equal number, discarding any remaining cards. Agree who will begin, and decide the direction of play. The starting player chooses one of the categories or attributes on the cards as a trump. One at a time each player selects one card from their hand and reads out the value of that category or attribute. Whoever has the highest value in the trump category wins and collects all the other players' cards in this round. The winning player chooses the next trump category from another card in their pile. If a player loses all their cards they are out of the game. The rounds continue until one player has collected all the cards.

There are two alternative modes of play. In the first, 'The Electron Variation', players can view all of the cards in their hand and choose between their cards in each round. The winner can view their new cards. In the second, 'Insulator', players hold their cards face down so that they cannot be seen: in each round they must choose the first card in the stack. The winner must place any new cards at the bottom of the stack, face down.

Questions to Consider During Play

How important is it that the power-ratings are included in the experimental details? Should we include a category of test/trial/experiment, and if so, what should be their hierarchy? Should the 'author' of the experiment always be included, or any form of identification be allowable? Does an older date trump a newer one, or vice versa? Or should this be negotiated at the start of each play? How should we rate the 'significance' of the examples or should we allow for a completely arbitrary scale based on our own judgements? How do we define the electric-ness of the experiment, and should it include any experiment that involves electric current, static or voltage?

Footnotes

[1] David Nye's (1998) anti-biography of Edison which argued that there is no unitary Edison to explain or account for.

[2] Top Trumps was launched and marketed in the UK by the Dubreq games company. The game's success over the next decade saw Dubreq acquired by the multinational company Waddingtons. In the 1990s the Top Trumps brand was bought by a Winning Moves, a UK based global games company.

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