

Human Powered LED Vest
(Technical Paper)

Mobile Devices Distract Children from Social Interaction
(STS Paper)

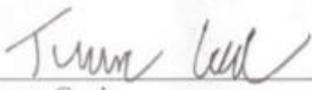
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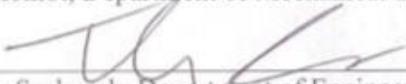
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On my honor as a University Student, I have neither given nor received
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Introduction

Technology is ever increasing in modern society and children are exposed to technology at a much younger age than in the past. Specifically, mobile smart technology like iPhones, iPads, or Androids is present in practically every household in developed countries. The problem is that media technologies such as these have grown exponentially while the research on their effects have somewhat lagged behind (Radesky, 2015). In particular, research on their effect on child development is lacking as of yet. In the *Journal of Applied Developmental Psychology*, Kristen Darling-Churchill, a research scientist with Child Trends' Education, studies children in the zero to five year old age range (Darling-Churchill, 2016). She quotes Tweety Yates, who defines early social and emotional development as the emerging ability of young children to “form close and secure adult and peer relationships; experience, regulate, and express emotions in socially and culturally appropriate ways; and explore the environment and learn – all in the context of family, community, and culture” (Yates et al., 2008). Darling-Churchill stresses that emotional and social development in young children can affect their success and well-being for the rest of their lives and therefore, factors that affect that development should be studied intensively. I will study the effects of mobile smart technology on the social development of children, focusing on decreased social interactions with peers, parents, and other adults.

From 2011 to 2013, the number of families in the United States with a child under the age of eight who own an iPad or similar tablet has increased from eight percent to 40 percent, and 75 percent of those families had some kind of smartphone or tablet under their roof (Rideout, 2013). A more recent study in 2017 found that almost all (98 percent) children under eight years old live in a home with some kind of mobile device and 42 percent have their own tablet device (Rideout, 2017). While media use overall has not changed significantly in recent years, the proportion of

media consumed on mobile devices has increased almost tenfold from 2011 to 2017. Because of their increasing presence, I will only consider mobile devices and their effects on social development in young children. Mobile devices also differ from other media sources, such as television or video games, in the fact that they are almost solely an independent activity.

The outcome of my research will also affect the societal consequences of my capstone project. The goal of my project is to build a vest that generates enough electricity through the motion of running to power lights on the front and back of the vest. If my vest comes to fruition, it could potentially be utilized by children to power their mobile smart devices for longer periods of time and therefore increase the effect those devices have on their development. The mental, social, cognitive, and physical development of children aged zero to five may be adversely affected by the increased use of mobile devices.

Human Powered LED Vest

The goal of my capstone project is to generate electricity from some sort of human movement in order to power some device or to be stored in a battery. My team is made up of six fourth year mechanical engineers, including myself, Clay Tondreau, Kat Catallo, Garrett Hanrahan, Jacob Fishman, and Kyle Peter. Our idea is to build a vest that generates electricity through linear generators to power lights on the front and back of the vest. The vest will not store any long term energy. The generators will route current to a capacitor which will be discharged to the LEDs on the vest. The linear generators create electricity by pushing a permanent magnet through a fixed area coil of wire. As the magnetic field through the coil of wire changes, an induced EMF is generated through the wire in the coil (Scanlon, 1969). In our design, the coil is wrapped around a barrel, which is fixed vertically to the vest. A cylindrical permanent magnet is

free to move inside the barrel, so as the user runs, the up and down motion will cause the magnet to move through the coil and generate a current through the wire.

Our project seeks to increase the visibility of runners or walkers on the road at night and hikers who need to see the trail at night. Running on the road at night is dangerous, because drivers have much less visibility even with headlights and so runners take the risk of being hit by a car. The National Highway Traffic Safety Administration reported 5,977 pedestrian deaths in car accidents in 2017 with 75 percent of those occurring at night (National Center for Statistics and Analysis, 2019). A combination of lower visibility and decreased driver awareness has shown a much higher likelihood of pedestrian related accidents at night. Hikers typically use headlamps when hiking at night, because they need some way to see the path ahead and to be seen by other hikers. Our vest provides the same benefits, while also lighting a broader area and being more comfortable than a headlamp.

The broader problem that our project addresses is the increasing effect that human society has on the environment. With a growing demand for electricity, fossil fuels and natural gas are being burned and releasing harmful substances into the atmosphere. More cars on the road and commercial planes in the sky are having similar effects on the environment. If society doesn't change and adapt, then the climate will continue to change and we will continue to kill the earth. In order to minimize human impact on the world, new technologies need to be invented and developed that are not harmful to the environment. While LEDs do not require much power, that little amount can be diminished by using our vest that powers itself.

There are some devices that use human movement to generate electricity, but most do not do so effectively. Some of the existing devices are wearable technologies, similar to our design. One patented design, as seen in Figure 1, uses the force of a human foot stepping to rotate a gear

chain and a combined generator to create electricity (Stanton et al., n.d.). The entire device is built into a shoe, so the user can use it with day to day walking. Because the device fits into a shoe and is constrained by comfort and aesthetics requirements, the rotation of the gears were not sufficient to generate a substantial amount of energy. Another inventor tried to put a generator into the sole of a shoe using a linear generator to induce EMF similar to our generator (Cherdak, n.d.). This design fails again due to the constraints of a shoe.

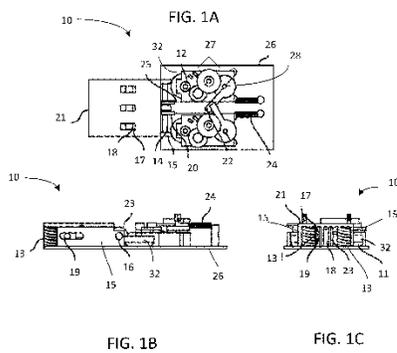


Figure 1: Foot-Powered Energy Generator

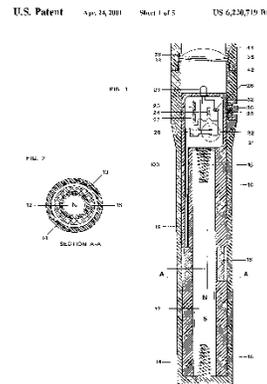


Figure 2: Renewable Energy Flashlight

The inspiration for our project was the Renewable Energy Flashlight (Vetorino et al., n.d.), shown in Figure 2. With a magnet that is free to move through a barrel, the user can shake the flashlight and generate electricity and light up the LED. Our goal is to improve on this concept by attaching the generator onto a vest, so the user does not have to do anything differently while running to light up their vest.

Technological Momentum of Mobile Devices

The theories of Technological Determinism and Social Construction of Technology (or SCOT) both fall short in describing the relationship that smart technology has had and currently

has with society. Technological Momentum, on the other hand, fully encapsulates the applications of both Technological Determinism and Social Construction of Technology.

Thomas Hughes, an American historian of technology, includes in his definition of technological momentum that “social development shapes and is shaped by technology” (Hughes, 1994). He argues that momentum is also time dependent – during some periods, technology may be more of the cause or it may be more of the effect in the technology-society equation.

The problem that I am trying to solve is the lack of knowledge surrounding the effects that may arise when children are distracted by mobile devices instead of interacting with friends, siblings, parents, or other adults. In my studies, I will introduce mobile smart devices, such as iPhones, iPads, or Androids as the main artifact. Studies of other media devices, such as television, video games, or computers, will also be considered for comparison purposes, but the goal of this research is to determine what effect mobile smart technology has on child development. Certainly these technologies also have an effect on older adolescents and adults and some studies on other age groups will also be considered, but again, the goal is to determine the effect on children, specifically of age five or younger.

The age group studied is significant, because whether a social group is affecting or being affected by the technology more depends on which social group you consider. For example, it could hardly be argued that iPhones or iPads were invented because of a problem related to young children. It is also not likely that the early stages of mobile devices affected young children in a significant way. Instead, this technology has gained momentum since its inception and has increasingly affected and been affected by this age group. One key feature of mobile devices is the ability to use apps made by developers. Developers make apps that they think will be useful for consumers in order to make money. Therefore, the technology created on mobile

devices are determined by the social needs or problems of young children. The converse is also true. Apps and capabilities on mobile devices have the ability to dictate much of a developing child's life. They are intended and may in fact work for educational value, distraction, or even cognitive development (Radesky, 2015), but there may also be unintended harmful effects on children's cognitive, social, emotional, and physical health (Cho et al., 2017). The equation is not black and white. It is not solely one affecting the other. Both children's needs and desires and mobile smart technology are interconnected and continuously shape the other. Therefore, technological momentum is valid to apply to this system and will be the main theory considered in my research.

Expert Interviews and Wicked Problem Framework

How does the distraction of mobile smart devices affect children by hindering their time for unstructured play and social development? There is not a simple answer to this question, so in order to develop my own argument, I will perform interviews of researchers in related fields of study. There are certainly good arguments for and against prolonged use of digital media by children (Paul, 2013), so I want to talk to people who have expertise in this topic on top of my own research in order to gain multiple perspectives.

There are three people in the University of Virginia community that I plan on interviewing. One is Dr. Amrisha Vaish, the Director of the Early Social Development Lab at UVA. She studies the social, emotional, and moral development of young children and the emergence of moral emotions, such as empathy, sympathy, guilt, and gratitude (Vaish, 2016) (Vaish, 2018). I first plan to discuss the importance of social interaction in child development regardless of technology. What sort of interactions help children develop empathy, gratitude and

other emotions? And if a child is on a mobile device for a large portion of the day, then how does that time away from the real world affect their development?

The other two interviews I will perform are with Dr. Angeline Lillard, the Director for the Early Development Lab at UVA, and one of her graduate students, Sierra Eisen. Dr. Lillard studies a wide range of topics in the child development field, so she will be a great resource to speak to about all the details of the field. Her recent interest has been in pretend play and Montessori Education for young children. I am interested to discuss the importance of unstructured play time and how mobile devices may take away from that. Sierra Eisen is a graduate student studying developmental psychology. Her interests and research lines up exactly with my thesis. She has done specific research on touch screen media in children's lives and using interactive media as opposed to traditional methods of learning (Eisen, 2016) (Eisen, 2018).

In order to organize the information gained from these interviews, I will integrate this system into the Wicked Problem Framework. In Horst Rittel and Melvin Webber's explanation of a wicked problem, they define 10 attributes that describe it (Rittel, 1984). One attribute is that wicked problems have "no stopping rule." In other words, there is no way to know when the "right" solution to the problem has been found. Along with that, there is more than one explanation of the problem, which varies from person to person. Both of these are characteristics of the system I am studying. The information I gain from interviews will allow me to develop my own unique viewpoint to study this wicked problem.

Conclusion

The problem being considered is the effect that mobile smart technology has on the cognitive, social, emotional, and physical development of children under five years old. The technology has developed far quicker than the research regarding the effects it may have, so it is widely unknown or unthought-of in families of developed countries. Considering most families have some sort of smart device in their home and let their children use it, it could be detrimental for future generations if they do not have fully-developed social or emotional abilities. The outcome of my research project will provide evidence to understand the potentially harmful effects that smart devices may have on developing children, so parents can raise their children in the best possible way. The final product of my capstone project will be a vest capable of generating enough energy to power four LED strips on the front and back of the vest. The result of my capstone project will determine if human powered energy is feasible and will provide speculation on the possible impact that it could have on society.

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