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RESEARCH PAPER



# Can interactive science exhibits be used to communicate population health science concepts?

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## ABSTRACT

Engaging public audiences with population health science necessarily requires a society level perspective; however, many existing communication strategies and programs tend to focus at the individual level. This paper describes a novel approach to engaging community members with the social determinants of health outcomes using an interactive exhibit within a science centre. The exhibit was capable of supporting understanding about social determinants of health in adults and children under the age of 15 within an average three-minute interaction. The presence of a facilitator who guided and supported discussions about the exhibit and its concepts with the visitors was also key to sustaining visitor engagement. These exploratory findings suggest the use of informal learning settings, such as science centres and museums, may provide a means to communicate population health and improve discourse about public health policy.

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## KEYWORDS

Interactive; social determinants; policy; public engagement

## Introduction

Public engagement with population health science is crucial to address the myriad and complex problems the science is trying to solve (Rowbotham, McKinnon, Leach, Lamberts, & Hawe, 2017). Engagement in this sense means creating a public audience interested in and able to think critically about issues which affect society and influence policy. Crane (2018) argues the value of public engagement, including between various publics and policy makers is long-standing and necessary. Her argument focuses on the policy and practice of the National Health Service in the United Kingdom, though it applies to many health settings.

Publics have various experiences, information, and needs which can be employed to create best practice (Crane, 2018). This paper explores how the concepts of population health science might be best communicated to audiences via a novel means, an interactive exhibit within a science centre. The aim of the exhibit was to present the influence of social determinants on health outcomes to facilitate greater engagement in discourse about, and demand for, public health.

## Communicating population health science

'Improving' the quality of public discourse around population health science necessarily implies publics require a basic health literacy. Health literacy refers to the ability of an individual to find, understand, and use information about health and health services, and the personal, social, and environmental factors which influence these abilities (Batterham, Hawkins, Collins, Buchbinder, &

Osborne, 2016). For the purpose of this paper, we are focusing on the capacity of an individual to recognise and understand these broader social and environmental factors; the ability to discuss and apply health knowledge beyond the individual.

Chinn (2011) describes how the concept of critical health literacy 'straddles two paradigms' (p. 65); the individualist, via the ability to find and use information to manage personal health, and the collectivist describing social action for the attainment of public good/health goals. The World Health Organisation (2016) asserts there is a mandate for health literacy, and that achieving a health literate population has wider societal benefits, including empowering citizens to address environmental, social, and economic determinants of health. This notion of public empowerment earlier created a conceptualisation of health literacy as an asset (Nutbeam, 2008). When health literacy is considered an asset, Nutbeam argues health education can have a 'broader application outside of health care settings, for example, into schools, adult learning, and community development programs' (2008, p. 2077).

In attempting to develop health literacy and empower populations, the focus has tended to shy away from the broader societal, economic, and environmental influences on health, and return to an individualistic focus and notion of responsibility (Harrison & Leahy, 2006). For example, personal choice, eating the right foods, and exercising more are more recognisable influencers of health than social determinants such as the socio-economic status (SES) of a neighbourhood, or whether there are footpaths, parks, and fresh food stores nearby. Lundell, Niederdeppe, and Clarke (2013) found people viewed individual behaviour and responsibility as a counterargument to the influence of social determinants. This is a return to Crawford's (1980) concern of the increasing focus on individual responsibility, which still seems to be endemic in the way population health science is portrayed, and at odds with the desired critical view of health (Macdonald, 2014).

The other effect this individual focus has is removing the social determinants of health from public discussion, which was described over a decade ago as 'significantly constrained' (Nutbeam, 2008, p. 2073), despite the potential for health education to 'raise awareness of the social determinants ... and be directed towards the promotions of actions which may lead to modification of these determinants' (p. 2075). There now seems to be a growing appreciation of how poorly understood social determinants of health are within society. Although firmly established within academia, at a community level and for those working within the field it is less clear (Robert Wood Johnson Foundation, 2010), including within the context of policy development aiming to address these social determinants (Baum & Friel, 2017). If those attempting to address social determinants do not fully understand them, how can we equip publics to demand policies to address the inequalities in health outcomes these social determinants create? Previous work has found many people have limited awareness of the range of policies that could be employed to address inequalities (Lundell et al., 2013). Baum and Fisher (2014) argue public health 'has a clear role to ... promote the evidence that supports the value of action of the social economic determinants of health...' (p. 221). This paper offers new insight into how such evidence may be promoted.

Researchers acknowledge health information can now be obtained from multiple sources external to health practitioners, such as the internet and the media, which requires health services to work more closely with these other outlets to ensure information is communicated accurately (Rowlands, Shaw, Jaswal, Smith, & Harpham, 2017). Internet, books, television, and other media can all be considered sources of informal education (Bucchi & Trench, 2008). Engagement with informal education sources further allows public health researchers to discuss research-based evidence with publics at a grass-root level; a key means of developing public support and, by extension, political will (Baum & Fisher, 2014). Informal education settings, such as science centres, zoos, aquariums, and museums, may provide additional means of engaging publics with population health science and fostering awareness of the role of social determinants in determining health. They may also provide a means of potentially overcoming some of the existing difficulties in highlighting social determinants as discussed in the preceding paragraphs.

## ***A potential role for informal education settings***

We preface this section by acknowledging that the definitions of formal, informal, and non-formal learning have become increasingly contested with complex interrelationships (Greenhow & Lewin, 2016). The definitions provided here are based on foundational work in the science centre sector, the contextual focus of this paper, and most representative of the ethos of the science centre involved in this project.

Informal education refers to learning which occurs outside the realm of formal (school based) learning (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003). It is unstructured, learner-led, unassessed, and free choice social activity which can lead to unintended – and often unmeasurable – outcomes (Harington, 2001). Falk and Dierking (2000) describe a contextual learning model for informal learning, which has three interrelated contexts: personal, sociocultural, and physical. Personal refers to the motivations, interests, and expectations of the individual, which affects what they do and learn in an informal setting. Sociocultural factors refer to the culture and society within the informal environment, including peers, family, and any facilitators, which may influence learning. Physical context refers to someone knowing where to go and what to do, but also their comfort levels, influenced by design and architecture. Crucially, ‘experiences occurring after the visit frequently play an important role in determining, in the long term, what is actually “learned” in the [informal setting]’ (Falk & Storksdieck, 2005, p. 746). Therefore, one interaction with a concept forms the basis for further understanding upon a later exposure to the same concept. This exemplifies constructivism, a learning theory which describes how individuals construct their own schema or understanding over time based on knowledge and experiences (Hein, 1995). Informal education settings may offer a fruitful means of engaging people with population health science, an avenue rarely explored.

A previous study by Ward, Howdle, and Hamer (2008) explored different ways of providing information to publics through a series of different events and talks, such as posters and interactive exhibits. They found that providing people with the opportunities to ask good questions was beneficial, but by far the most important factor was the informal nature of the interactions. Participants specifically mentioned the relaxed style, easy-to-understand language, and the informal approach of the researchers (Ward, Howdle, & Hamer, 2008).

Visitors to science centres and museums can be described as heterogeneous with a range of common motives for attending; principally education, entertainment, experience, or time with family (Schwan, Grajal, & Lewalter, 2014). An informal approach to providing information, through conversation, interaction, and participation is common in science centres and museums. Bandelli and Konijn (2012) refer to science centres and museums as becoming increasingly positioned as ‘interfaces between science and society’ (p. 421). Given the ‘interface’ position of science centres, there is potential for them to be used in public health communication.

A previous study by the Centre for Disease Control (Redwood, Provost, Asay, Ferguson, & Muller, 2013) found that using a giant inflatable colon, which members of the public could walk through and read information on, was a promising means to encourage screening for colorectal cancer. An evaluation of an interactive exhibition within a museum of infectious disease found museum-based education and design could help foster content knowledge recall, motivation, and positive beliefs about health practices (Martin, Durksen, Williamson, Kiss, & Ginns, 2016). Through interactive activities and active visitor engagement (So & Watkins, 2005) science centres can highlight the relevance of science to everyday life (Holstermann, Grube, & Bögeholz, 2010). Could science centres highlight the relevance of population health science to publics?

## ***Research aim***

The aim of this project was to determine whether the use of a hands-on, interactive science centre exhibit could be developed to effectively communicate a population health science concept – in this case social determinants of health. To measure effectiveness of communication, two key concepts were developed for the exhibit to convey. These were:

- Being healthy is much harder for some people;
- Environment and public policies have a major impact on health.

Evaluations with exhibit users explored how clearly these concepts were conveyed and understood, and if different levels of facilitation enhanced or hindered this understanding.

## Method

### *Defining 'interactive'*

Before describing the exhibit development, the context of what is meant by an interactive exhibit will be provided. At its simplest, an interactive exhibit has a reciprocal nature whereas the visitor does something and the exhibit provides some form of response (Allen, 2014). This can range from what Heath, Lehn, and Osborne (2005) term 'low-tech' – very simple inputs from the visitor such as pushing a button or lifting a flap – through to 'sophisticated information systems which prescribe complex forms of interaction between the user and the exhibit' (p. 98). The different natures of the interactions can similarly range from single user through to collaborative participation which entails social interaction, which Heath et al. (2005) argue is core to visitor experience and understanding of science. This is discussed further in the section on prototype design. The nature of the interaction and how 'entertaining' or enjoyable it is can influence the educational success of the exhibit (Hakverdi Can, 2013) with studies showing those exhibits exploring life sciences related to the 'everyday' 'stimulated visitors' interest in knowing more' (Afonso & Gilbert, 2007, p. 985). The interaction of the exhibit developed in this project would be based on a topic related to the 'everyday' and, as a prototype, would be at the 'low-tech' end of interaction. A challenge with this, and indeed all interactive exhibits, is ensuring that the design of the exhibit allows science centre visitors the freedom to 'play' to develop their own meaning from their interaction while still leaving with the intended learning outcome (Achiam, 2013).

### *Setting*

The exhibit was designed and tested within Questacon – The National Science and Technology Centre of Australia. Built in Canberra's Parliamentary Triangle in 1988, Questacon has become a popular tourist attraction, known for its hands-on, experiential learning (Gore & Stocklmayer, 2011). The foundation of experiential learning is the educational theory of constructivism, which recognises people learn based on their own experiences and knowledge is not merely gleaned from teaching or books (Yager, 1991). The exhibit was placed in one of the galleries, Q-Lab, which is 'a dynamic and experimental environment that encourages enquiry and aims to keep up-to-date with the scientific world' (Commonwealth of Australia, 2018, para 1).

### *Prototype exhibit design*

Two interns and Questacon's exhibition design team developed the prototype. The exhibit aims, as described, were used as a foundation for the design. The physical design of the prototype used easy to obtain materials from local hardware stores. The prototype itself cost less than \$200AUD to build, with the emphasis on testing the idea rather than the finer aesthetics of the design. This cost represents the material expenses only and does not include the labour costs; Questacon staff donated their time. If labour costs were included then the prototype would have cost several thousand dollars to develop. The exhibition design team at Questacon worked with the interns to develop a simple exhibit, without attempting to influence or change the key messages in any form. There was a reciprocal respect for the knowledge and expertise – the designers were concerned only with the design and effectiveness of the exhibit as a communication tool; the interns with the

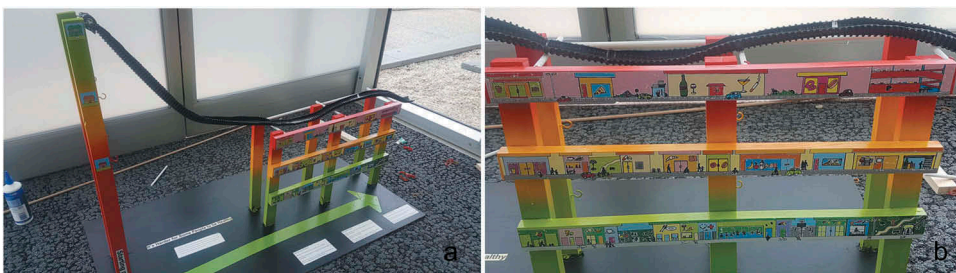
accuracy of the message conveyed. This approach is a small, basic model of co-production between researchers and exhibition designers; a particularly suitable approach as it allows for rapid planning, testing, and evaluating of exhibit design ideas (Rudman et al., 2018).

The design of science centre exhibits has systematically aimed to prompt visitor engagement (Skydsgaard, Møller Andersen, & King, 2016). Perry (1992) developed a model for designing exhibits which intend to motivate an audience, incorporating six design principles: curiosity, confidence, challenge, control, play, and communication. Borun, Chambers, Dritsas, and Johnson (1997) also identified design principles required to enhance learning in groups, such as families, which include being multi-sided (a group can surround it), multi-user, and multi-outcome. The ability to present different outcomes may promote discussion, which could foster understanding and appreciation of the influence of social determinants on health outcomes. Pedretti (2004) supports this, arguing exhibits should create dialogue and debate, especially about contentious issues. Aside from the physical design, how to best communicate social determinants of health was also a key consideration. Using the Canadian Council on Social Determinants of Health's Guidelines for Common Messaging (2013), the exhibit also needed to make social determinants tangible, grounded in context, memorable and clear. All of these design principles were taken into consideration in the planning of the exhibit, leading to an initial list of suggested elements as follows:

- A point-based game, where people had different starting positions and made changes to an environment to improve their health/life expectancy;
- A model house/diorama where people examined the surrounds for parameters that could improve the health of the occupants;
- A model where changes to very specific parameters would result in measurable changes to health or life expectancy.

Through a process of refinement and discussion, the use of a track was suggested, with length of track completed as an analogy for length of life. The 'vehicle' to move along the track was a marble, mimicking popular marble run construction toys. By using a marble run design (Figure 1(a)), the exhibit incorporates each of Perry's (1992) design principles. The marble run format is familiar, which potentially creates user confidence, as they know what to do. It allows the user to control what happens, provides a challenge and creates curiosity about the potential outcome. Users can also play around with different settings to explore 'what happens if...'. This style of play is integral to generating discussion between users. The exhibit also offers the multi-outcomes supported by Borun et al. (1997) as different starting points or decisions along the way will change the incline of the track.

Visitors could change the pitch and height of the track depending upon various starting conditions and modifications. SES determined the starting point. A higher starting position – indicating higher SES – meant the ball almost invariably completed the course, regardless of the



**Figure 1.** (a) Marble run exhibit prototype – top view. (b) Marble run exhibit prototype – side view showing.

shape of the rest of the track. When visitors started the ball from a lower SES point, the second half of the track had to be modified to make it to the end.

The second half of the track consisted of three different levels representing three different streets within fictional neighbourhoods, all with varying levels of public health policy intervention (Figure 1(b)). The lowest street had many factors aimed at improving public health, while the highest street had very few. This suggested that the fewer health policies implemented in your neighbourhood, the more difficult it is to achieve good health outcomes, irrespective of starting point. The health policy intervention variables included:

- Location: walkability (shared zones, zebra crossings) and presence of public spaces (such as parks, sporting fields);
- Amenities: services which assist in maintaining health such as doctors, pharmacies, or gymnasiums;
- Diet: prevalence of fast food outlets, grocery stores, restaurants and cafes, and specialty food stores (e.g. butcher, bakery, delicatessen);
- Exercise: prevalence of infrastructure facilitating an active lifestyle such as transport options (e.g. car or bicycle lanes), footpaths or walking/running tracks, and fitness facilities;
- Alcohol and smoking: availability and affordability of these products, and social attitudes towards them (e.g. binge drinking vs social drinking).

A ball starting lowest on the SES ladder would not travel far along the high, 'unhealthy' track, but it would make it to the end on the lowest, 'healthy' track (if policy interventions were present). The implication here is that people with lower incomes, education, and social connections often struggle to make healthy choices, but changes to our neighbourhoods and public policy can ensure everyone leads a long and healthy life.

## Development

The early prototype was a marble run to demonstrate the impact three socio-economic 'starting points' would have on overall health. Users could then change other factors, e.g. food availability, alcohol prices, and transport options to influence the marble's trajectory. After consulting with Questacon's exhibition design team, feedback suggested the exhibit may be confusing to some users and inadvertently promote individual choices as key determinants of health, rather than broad public policies, as intended.

The design was modified to represent a whole-of-systems approach, rather than changing a single parameter. This was achieved through removing the food availability, alcohol prices, and transport images and text, and replacing them with extensive neighbourhood representations (as seen in Figure 1(b)). The representations intended to demonstrate that careful and effective urban planning, government investment, and health interventions can ensure an even playing field, particularly for those starting from lower SES. Those starting at the top rung will make it to old age no matter what the environmental conditions. Those starting at the bottom need easy access to fresh food, public amenities, and social connections to achieve the same result.

## Evaluation

The exhibit was trialled in the QLab Gallery for a period of five days. A researcher facilitated the exhibit at all times. On approaching the exhibit, all participants were informed the prototype exhibit was being tested for a university study. The Australian National University Human Research Ethics Committee (201/036) gave the study ethical approval. The researcher then performed one of three possible facilitation roles chosen on a rotating allocation basis: they either (a) explained the exhibit in full, using a variation on a script (in 'Supplementary Materials'), (b) informed participants



the exhibit was about health but did not provide further explanation, or (c) did not provide any explanation and left participants to parse the analogy for themselves. If participants asked the facilitator questions about the exhibit rather than reading the information panel, this prompted a full facilitation irrespective of whether they were allocated (a), (b), or (c) initially.

After participants had interacted with the exhibit, the researcher discussed the prototype with participants. Participants were asked what they thought of the exhibit, and what message they believed the exhibition intended to convey. Qualitative data was recorded by noting down people's responses, their age group, and the amount of time they spent interacting with the exhibit on a standardised data collection form developed specifically for this project. The total duration of time people spent interacting with the exhibit was recorded on a stopwatch, starting once they were informed the exhibit was a prototype and a facilitation path had been taken. Timing stopped once they stepped away from the exhibit.

The facilitator also recorded participant comments as they interacted with the exhibit. A participant was considered to have understood the exhibit if they made a comment which explicitly referred to the underlying concept of social determinants, for example if participants referred to a high starting point as a 'wealthy house', or a low track rung as a 'healthy street'. Likewise if participants identified environmental factors on health, for instance, 'this street makes it easier to be healthy', this was considered a successful communication. Communication was considered to be less successful if participants' comments indicated a perception that personal choice was the determining factor, for instance, 'the person on this track makes unhealthy choices'. Notes were also made if participants made an effort to extend the analogy and continue testing the exhibit as a model, rather than leaving the exhibit behind after the marble's first successful run.

## Results

Over five days of testing, 136 people interacted with the exhibit and consented to having their (and their children's) comments transcribed. Of these, 59 were students visiting with school groups (52 in Grade 6, seven in Grade 12) and the other 77 were families and members of the public visiting Questacon (58 adults, 19 children). Eleven of these children were under the age of five so were excluded from the study, leaving a total sample of 125. Several adults were also supervising children in the gallery, but they were not included in the dataset if they did not interact with the exhibit.

### *Appropriateness of exhibit as communication tool*

Participants spent an average of 3.35 minutes examining the exhibit. The exhibit was generally popular with participants, with 97 participants (78%) stating they enjoyed interacting with the exhibit. A total of 39 participants (31%) made statements indicating they agreed with the prototype's key concepts, saying that it 'made sense' or was a suitable way to represent health factors. One participant explicitly stated they disagreed with the exhibit's key concepts, citing personal stories as evidence wealth and environment do not have impact overall health.

In general, the exhibit was successful at communicating the first key concept (being healthy is harder for some people). There was more modest success with the second key concept (environment and public policies have a major impact on health). A majority of participants (87, 70%) made comments indicating they understood the exhibit's aim to communicate the effects of wealth on population health. A further 60 participants (48%) extended the model and used it to understand multiple interactions between SES, environment, and health, while 40 participants (32%) made comments explicitly suggesting they understood the exhibit's aims to communicate the effect of public policy on health. This is exemplified through this comment from an adult: 'Your socio-economic background has an impact on your health, it's not just

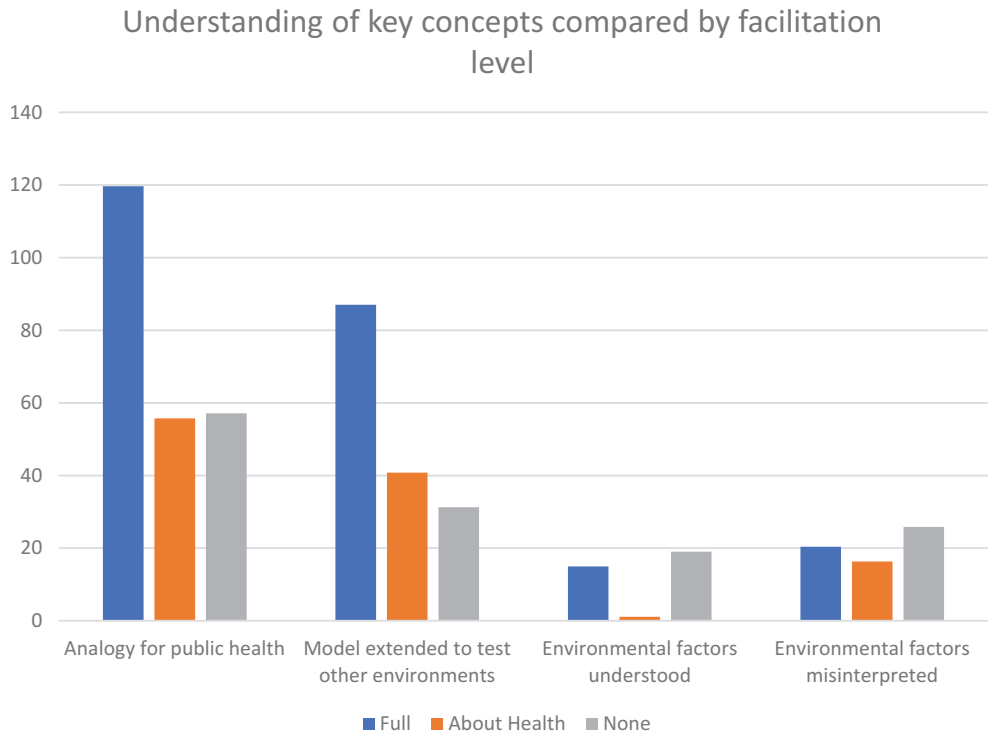


genetics’. However, this aspect of the exhibit could also be misinterpreted. A proportion of participants (20, 16%) made statements implying they thought the exhibit depicted only healthy lifestyles, rather than healthy environments, and that a secondary message of the exhibit was to make healthy choices.

The level of understanding of the key concepts varied with age group (Table 1) and with facilitation level (Figure 2). The results in Table 1 indicate that understanding environmental factors is possible even with younger audiences. This included children in the final year of primary school (around 11 years of age) who made comments such as ‘if you’re healthier and more wealthy, you’ll live longer’. Figure 2 shows full facilitation enabled greatest understanding that the exhibit was a model for public health and could be extended to other environments. There was no discernible ‘best’ facilitation level for understanding environmental factors. Participants had a tendency to ask the facilitator questions rather than read the information panel, resulting in 10 additional participants receiving full facilitation rather than the partial or no facilitation allocation made on approach. Despite this, a large proportion of participants who did not receive full facilitation were still able to understand the purpose of the exhibit as a model for health and continued to use it as such.

**Table 1.** Understanding of exhibit key concepts compared by age ( $n = 125$ ).

Age	Number in sample	Exhibit as an analogy for public health	Model extended to test other environments	Environmental factors understood
5–10	6	18%	33%	17%
11–15	54	50%	41%	17%
15–18	7	100%	100%	0%
18+	58	88%	50%	52%



**Figure 2.** Participant understanding of exhibit prototype concepts compared by the level of facilitation ( $n = 125$ ).

### ***Participant perceptions of exhibit topic***

Many participants had a strong desire to link the exhibit with their personal lives, and some were inclined to interpret the exhibit personally. After learning about the theme of the exhibit, 13 participants immediately posed a question such as ‘where would I fit in?’ and set the tracks up to correspond to their personal SES and environment. Younger users tended to be more specific, with one 11-year old pointing to the green track stating ‘I live here’. Participants generally associated themselves with middle or upper-class starting points and no-one who did this believed themselves both to be in a lower socio-economic position and a highly unregulated environment. Subsequently, they typically had a positive experience with the exhibit. Two adults, for instance, lined up the lowest socio-economic start with the ‘healthy’ street’s most regulated environment and announced ‘We can still make it’, when the marble completed the run.

Other participants supplied personal anecdotes and information to either support or disagree with the concepts presented in the exhibit. One participant, for instance, cited their mother as evidence that environment did not always affect health, saying ‘My mum is the least healthy person I know [...] she grew up in a bad neighbourhood but now she’s moved and it hasn’t changed’. Another participant compared Australian public policy with that of the USA, where they had recently visited: ‘I was amazed at the amount of junk food [...] It’s better here’.

Four participants voiced concern with the overall theme of the exhibit, suggesting that the more congenial conditions represented a faster movement towards death rather than a greater likelihood of completing the track, or longer lifespan. One participant characterised this as a ‘plummet towards death’. The presence of the middle line was a source of confusion for some participants. Six participants in total made comments that suggested they believed the medium track and starting point were intended to be ideal conditions. Three participants interpreted this to mean the exhibit was about balancing healthy and unhealthy choices.

## **Discussion**

The use of an interactive exhibit to communicate concepts related to the social determinants of health shows both promise and challenge. Overall the type of exhibit used here was capable of demonstrating that health is more difficult for some people, with the majority of participants understanding this difficulty was related in some way to economic and environmental factors. This understanding was seen in adults and in those participants aged under 15 years, and it was achieved in an average three-minute interaction. The challenges associated with communicating the social determinants of health are well documented (Baum & Friel, 2017; Robert Wood Johnson Foundation, 2010). However, the findings here suggest the use of a simple hands-on exhibit is capable of supporting that understanding in a very short period of time. Better results were seen when the interactions were fully facilitated, which echoes the findings of Ward et al. (2008). The use of something to ‘play’ with in an open and informal setting encourages people to ask questions and engage with the concepts and materials presented (Perry, 1992). The amount of time people stayed and interacted with the exhibit was also indicative of its engagement power. An earlier study of the ‘holding power’ of interactive science centre exhibits about the human body recorded visitors staying at exhibits from between, on average, 32 and 106 seconds (Boisvert & Slez, 1995). The hold time of this prototype exhibit was over 180 seconds, which is far greater than the highest average reported in Boisvert and Slez (1995). However, there are some key factors which influence this hold time. Boisvert and Slez (1995) found that the use of facilitators with exhibits increases visitor engagement, and the exhibits with the second greatest holding power were simple and highly interactive, allowing visitors to ‘experiment with the objects in several ways to understand the concepts presented’ (p. 507). This exhibit employed both of these characteristics, in that it was facilitated and was highly interactive. If future exhibits, or an entire exhibition, about population

health was to be developed then we recommend using highly interactive models to allow visitors to fully explore concepts, and ideally having facilitators for exhibits conveying more complex ideas.

Many participants related to the exhibit on a personal level, either matching the characteristics to suit their personal circumstances, or interpreting the outcomes through their self-experience or of family members. This has pros and cons. Allowing a participant the scope to place themselves within the scenario provides an opportunity for them to explore the issue by engaging with the social influences. This is particularly valuable for younger participants, with engagement in social issues and opportunities to think critically about social problems considered a key facet of critical health education (Macdonald, 2014). The use of complex scientific concepts, and socio-scientific dilemmas in particular, as the basis of an interactive exhibit has been found to allow for enhanced argumentation and discussions which allow visitors to make meaning and enhance learning (Ash, 2002). On the negative side, it potentially allows the participant to reject the information as it does not fit with their experience or 'world view', a common occurrence in scientific topics reliant on empirical evidence (Kahan, 2013), as one participant here did. Also telling is the tendency for visitors to identify with the middle or upper socio-economic levels of the exhibit. This is likely to reflect the typical visitor to an institution such as Questacon which has an entry fee of around \$50AUD for a family of four. This suggests that those who interacted with this exhibit were not from the low socio-economic group that would experience the greatest impact from social determinants of health. Alternatively, the exhibit could be developed to be portable and be installed in various locations like libraries or shopping centres within communities, thereby removing barriers such as admission fees or travel costs. Even so, such an exhibit would not necessarily be positive or empowering for these vulnerable groups. The exhibit potentially missed an opportunity to convey a 'call to action' for Questacon visitors; it could have been used to empower them to advocate for better public health policies which address the inequalities in health outcomes caused by social determinants.

Despite the potential gains to be made in facilitating awareness of, and dialogue about, social determinants of health, the exhibit still faced the same challenges – namely the focus on the individual as solely responsible for their health (Crawford, 1980). This was reflected in comments alluding to people not making the right choices for their health. This was despite concerted efforts made with the visual presentation of choices within a community context, rather than singular items, and reinforcement from the facilitator that the exhibit was showing a community level focus. As a prototype, this exhibit had some areas for improvement, and this representation was one. Perhaps a more three-dimensional representation of the communities using model houses, shops, and green spaces may provide a more realistic simulation of the community level and reduce the individual focus.

Other elements could be improved too, for example, the mechanism to change the path for the marble run should have been on both sides to better facilitate visitor interaction. Due to the timeframes and experimental nature of the co-design approach employed here, opportunities may not have been pursued to their maximum. A more refined and sophisticated prototype could have been developed for example, embracing a more participatory-action-research oriented approach (Rudman et al., 2018).

Nutbeam challenged health educators 'to communicate in ways that draw upon personal experience, invite interaction, participation and critical analysis' (2008, p. 2073). The use of an interactive exhibit within a science museum does represent a means of communication which invites interaction, participation, and critical analysis (Pedretti, 2004) and from participant comments in this study, they also appear to bring their personal experience along. The use of personal experience is a key component of constructivism (Hein, 1995), and a core facet of informal learning. It is possible that through the creation of population health based interactive exhibits, users may be able to construct greater meaning about the role population health science plays in their life. Further research to explore the potential of exhibits is required and encouraged.

The findings of Redwood et al. (2013) similarly demonstrate that novel approaches to engaging the community in health topics can be a means of changing awareness about health issues or potentially influencing behaviours. They note the limited data available to evaluate the efficacy of such approaches, which this paper has added to, but far more research remains to be done. This paper is only a snapshot, drawing upon one exhibit within one science centre. We echo Baum and Friel (2017) in encouraging public health researchers to promote the evidence which supports action on social determinants of health, and to be creative and experimental in how they do so. We encourage researchers to partner with institutions like science centres and museums to further explore the utility of research practice partnerships, long-term collaborations designed to apply research to address problems, typically in education however also in other areas including public health (Coburn & Penuel, 2016). Greater understanding of the impacts of an exhibit that had been through greater refinement may provide insights into the potential outcomes which may be gleaned from such a communication and engagement approach. Here we propose a place to start, by developing additional interactive exhibits and experiences, partnering with museums and other 'interactive' specialists to develop new ways of engaging with communities to create the groundswell needed to shift political will.

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