Integrating theory in co-design: An abductive approach

Abstract

Co-design empowers people, giving them a voice in social marketing program design, however approaches have mostly excluded expert knowledge. An abductive approach to co-design allows for inclusion of expert knowledge, providing theoretical guidance while simultaneously investigating user views and ideas extending understanding beyond known effective approaches. We use the seven-step co-design framework and outline how an abductive inference can be applied to co-design. Social Cognitive Theory constructs were integrated into the seven-step co-design process. The abductive approach to co-design was tested in two co-design sessions involving 40 participants. Findings demonstrate that theory can be successfully integrated into the seven-step co-design process using theory-mapped activity cards. This paper provides guidance on how theory can help with ideation, user insight evaluation and subsequent program design.

Keywords: co-design, abductive reasoning, insights, formative research, social marketing

1. Introduction

With a focus on collaboration and co-creation, user driven innovation is a catalyst for behaviour change (Trischler et al., 2019). From a participatory design perspective, co-design is a method that facilitates user involvement during program design in order to develop more user orientated design solutions (Sanders and Stappers, 2008). However, exclusive inductive or ‘bottom up’ approaches may be limiting program effects by excluding or limiting expert knowledge. Expert knowledge in the form of theory use may offer the potential to further extend co-design successes and thus improve program outcomes through the identification and examination of key variables that are known to have the greatest impact on influencing behaviour change (David and Rundle-Thiele, 2018).

Deductive or ‘top down’ approaches place the focus on expert knowledge (e.g. theoretical frameworks) when developing programs (Dubois and Gadde, 2002). Deductive approaches that exclude users in processes limit the ability to design programs that people prefer (Müller and Thoring, 2012) and run the risk of expert bias (Holmgren et al., 2018). Abductive approaches merge inductive and deductive approaches (i.e. expert and user views). The application of an abductive approach has received limited attention in co-design and social marketing research. Similar to deduction, abduction requires a theoretical lens, encouraging the identification and investigation of new ideas that fall outside of the initial theoretical framework (Meyer and Lunnay, 2013). Therefore, an abductive approach permits the inclusion of theory in user centred design. However, guidance on how to integrate expert evidence into user centred design processes is lacking. In addition, while inductive and deductive approaches are commonly referenced in social science literature (Bryman, 2012), the value of an abductive approach remains the least discussed.

Given the importance and benefits of applying a customer orientated approach to social marketing, integrating theory into an existing co-design process may extend co-design success, allowing for the build of more theoretically robust programs which in turn are more effective. A method outlining how a theory based program can be co-designed utilising an abductive approach is needed. Thus, this study aims to understand how theory can be incorporated into the fuzzy front and back end of an existing co-design process (see Trischler et al., 2019). This paper aims to provide guidance on how theory can help with ideation, user insight evaluation and subsequent program design.

2. Literature Review

2.1. Empowering participants through co-design

Originating from the field of participatory design (Ehn, 2008) co-design refers to the collective creativity of various stakeholders who are users and beneficiaries of programs targeting adolescents (e.g. parents, teachers, health care workers) during the design process (Hurley et al., 2018). In line with the notion of participatory design, co-design recognises that those who are affected by the design should ultimately have an influence during the design process (Ehn, 2008). Users are as recognised as valuable sources of knowledge, that can be used to develop and improve the design of behaviour change programs (Dietrich et al., 2016). Thereby, co-design empowers participants' to contribute as active and equal contributors to design ideas (Trischler et al., 2019).

To date co-design has proved successful in many contexts (David et al., 2019, Palmer et al., 2019, Hurley et al., in review), and differences between user generated ideas and expert generated ideas have been observed (Hurley et al., 2018, Dietrich et al., 2016). Benefits of co-design have been observed for researchers, users and society at large (Slattery et al., 2020). Co-design fosters the establishment of community links that enable researchers easier access to participants, including improved accessibility to vulnerable user groups, and greater response rates (Brett et al., 2010). In addition, active user involvement through co-design empowers users through increased knowledge, skills and confidence in their daily lives (Slattery et al., 2020). Benefits of co-design can also extend to wider society, strengthening community engagement (David et al., 2019), and democratising public services (Voorberg et al., 2015). However, co-design approaches may be limited by their lack of theory integration. In behavioural change fields, theories are used in the development of programs to effect better outcome change (David and Rundle-Thiele, 2018), through influencing constructs that are known to cause specific behaviour (Hardeman et al., 2005).

Given the importance and benefits of applying a customer orientated approach to program design, and to support academics and practitioners in applying behavioural change theories in program design (Firestone et al., 2017) this research aims to understand how theory can be applied within a co-design process. One method for integrating theory with user insights is an abductive approach, which is discussed next.

2.2. Abductive reasoning

Arising from the works of Charles Sanders Peirce (Peirce, 1980), all types of logical reasoning can be classified into three distinctly unique categories including abductive, deductive, and inductive reasoning. Each type of reasoning is responsible for distinctly different ways of producing knowledge.

Deductive reasoning or “top down” approaches begin with a theory and the development of hypotheses, which are tested to confirm or refute the original theory (Dubois and Gadde, 2002). Alternatively, inductive or “bottom-up” approaches offer generalised conclusions from available data to formulate hypotheses (Hurley et al., 2018). Therefore, evidence based programs rely on the logic of deductive reasoning (Mason et al., 2018), however this method is inadequate to provide a full understanding of user needs and preferences. Alternatively, data-driven (user orientated) programs involve inductive reasoning methods (Fischer et al., 2012), but lack theoretical relevance.

Inductive and abductive inferences are similar in that they do not provide deductively derived guaranteed truths. However, each are uniquely distinct as induction uses evidence to support conclusions (that do not have the certainty of deductive conclusions), while abduction offers speculative but plausible explanations to explain some surprising phenomena (Folger and Stein, 2017). Some authors frame abductive reasoning as ‘induction plus an explanation’ (Lipton, 2004, Harman, 1965). That is, abduction attempts to provide meaningful explanations or “educated guesses” to explain surprising phenomena, offering more solid evidence than inductively derived conclusions (Green et al., 2007). Therefore, an abductive approach has the potential to yield more than inductive approaches as we are permitted to capture the character of both theoretical concepts and the empirical world (Dubois and Gadde, 2002), improving the quality of outputs.

In summary, inductive or ‘bottom up’ approaches may be limiting the potential for behaviour change by excluding expert knowledge. Alternatively, deductive or ‘top down’ approaches place the focus on expert knowledge (e.g. theoretical frameworks) when developing programs (Dubois and Gadde, 2002). Unfortunately, deductive approaches lack the ability to capture user preferences (Müller and Thoring, 2012). Therefore, it can be argued that inductive and deductive methods of program design are limited in their scope and in their capabilities to cater to both theory and practice. Abduction allows us to break out of the limitations of induction and deduction to be creative and innovative, examining ideas that fall

outside of the existing knowledge base. Given the benefits of an abductive approach, the following section discusses the relevance of abduction to co-design.

2.3. An abductive approach to co-design

Of the three types of reasoning, abduction is the best suited to uncover novel insights (Kolko, 2010), playing an important role in assisting social researchers to make new discoveries (Reichertz, 2004). Abductive reasoning involves the conceptualization and reimagination of existing knowledge to envision and explain a new concept (Roozenburg, 1993). Abduction's innovative and creative nature makes it synonymous with co-design (Steen, 2013) which aims to introduce new ideas and envision alternative solutions to program design (Dorst, 2011), that will ultimately influence behaviour. In contrast, neither deductive nor inductive reasoning approaches can propose new ideas as they rely on available data to draw conclusions (Kolko, 2010). Therefore, the creative and innovative nature of abductive reasoning makes it the ideal logical reasoning process to produce novel ideas (Dorst, 2011).

While previous research has integrated expert knowledge into co-design research, understanding how an abductive methodology can be applied is yet to be reported. For example, O'Brien et al. (2016) details a method to integrate expert knowledge into co-design sessions in the design of a health intervention. A summary of the evidence is communicated in the form of "evidence statements" which are presented during co-design session to inform the aims and content of the session (O'Brien et al., 2016). Alternatively, Villalba et al. (2019) and Dietrich et al. (2017) used activity cards to communicate insights from the literature into co-design sessions in order to sensitise participants and trigger discussions. However, while studies attempt to integrate existing expert knowledge into the co-design process, insights derived from the literature are not specifically mapped to a behaviour change theory and consequently abductive reasoning processes remain under-examined.

It has been suggested that the theory-practice gap is widening (Nenonen et al., 2017). While arguments are commonly made as to whether or not this gap can be bridged, solutions as to 'how' this is achieved is an underexplored area of research (Nenonen et al., 2017). This study responds by offering a detailed description of one possible solution to bridge the theory-practice gap. Examining co-design through an abduction lens allows us to explore the link between theory and practice in the design of behaviour change programs. Unlike its deductive and inductive counterparts, abduction is rarely mentioned in social science literature (Meyer

and Ward, 2014). As an underutilised methodology, an abductive reasoning approach may provide a novel approach to the design of behaviour change programs. However, limited studies have attempted to understand or formalise the abductive reasoning process occurring during co-design, which may limit the potential to maximise abductive co-design outputs.

The purpose of this study is to understand how theory can be incorporated into an existing co-design process to design a social marketing program. Specifically, the study critically examines the role of theory in an abductive co-design process. In doing so we aim to propose a co-design process that will provide practitioners and researchers with the necessary tools required to integrate and bridge theoretical and user insights to develop more efficient and effective programs.

3. Method

3.1. Recruitment and participants

A purposive sampling method was used to recruit participants for this study. Thereby, participants were recruited through an established relationship with the owner of a local restaurant. A Facebook ad was placed on the business Facebook page, advertising the co-design sessions. The site has over 10,000 followers. As an incentive for assisting in recruiting participants, the owner was given \$AUD 50 per participant. As a result, food and drinks were provided to participants during the co-design session, and a \$25 voucher to spend at a later date at the business for each participant completing the co-design session was offered. A total of 40 participants were recruited to participate in two co-design sessions. The average age of participants was 45 and 89% of participants were female.

Participants were invited to join a co-design session with the aim of designing a parent based alcohol program. Underage drinking is an issue of concern in Australia (Australian Institute of Health and Welfare, 2017) and as key influencers in the adolescent lives, parent based program have been identified as important to reduce underage drinking (Newton et al., 2017).

3.2. Approach – Application of the seven-step co-design framework

This study applied theory to the existing seven step co-design process outlined by (Trischler et al., 2019) (see Table 2). This framework has been organised into seven steps, including 1) resourcing, 2) planning, 3) recruitment, 4) sensitisation, 5) facilitation, 6) reflecting, and 7) building for change.

Table 1: Application of seven-step co-design framework.

Process stage	Application to an abductive co-design approach
1. Resourcing	<ul style="list-style-type: none"> - Relevant input sourced from peer reviewed literature. - Previous parent alcohol programs identified and assessed. - Expert judging process utilised to match existing parent alcohol program activities to Social Cognitive Theory constructs to allow for the creation of theory-mapped activity cards which were used during the co-design session (see Figure 1).
2. Planning	<ul style="list-style-type: none"> - Regular meetings held with the research team to coordinate the planning of the co-design sessions.
3. Recruitment	<ul style="list-style-type: none"> - Suitable participants identified and recruited through existing relationship with local restaurant owner.
4. Sensitization	<ul style="list-style-type: none"> - Sensitisation process implemented during facilitation stage
5. Facilitation	<p>The co-design session was split into four stages:</p> <p><i>Introduction:</i> Participants were introduced to the topic and the purpose of the co-design session.</p> <p><i>Sensitisation:</i> Participants provided with theory-mapped activity cards and ‘most/least liked’ template. Participants’ asked to read through each card individually and then record and provide reasons for their three most liked and three least liked activities on the template provided.</p> <p><i>Ideation:</i> Participants provided with ‘make tools’ and asked to design their ideal parent alcohol program. Participants encouraged to improve and/or develop ideas based on the provided theory-mapped activity cards, and/or generate completely new ideas.</p> <p><i>Pitch presentation:</i> Each group presented their design ideas to the larger group.</p>
6. Reflecting	<p>Qualitative data analysed using five-phase cycle Yin (2015) to identify and code overarching themes.</p> <p>Critical evaluation and interpretation of design ideas and co-design themes against SCT constructs in consultation with other design experts.</p>
7. Building for change	<p>Integrating and bridging SCT and user insights to design a social marketing program.</p>

Specifically, the co-design activity cards (i.e. cards detailing existing program activities) to be used during the sensitisation and facilitation stages of the co-design sessions were theoretically mapped using key Social Cognitive Theory (SCT) constructs (Bandura,

1998). SCT explains how individuals and the environment interact and influence each other in a process known as “reciprocal determinism” (Bandura, 2004). The core constructs of SCT are intended to predict behavior and are used to guide program development (Bandura, 1998). Individual determinants of behaviour include knowledge of health risks and benefits, observational learning and self-regulation (Glanz et al., 2008). Knowledge of health risks and benefits create a precondition for change, an essential element for influencing behaviour (Bandura, 2004). Observational learning exposes individuals to others modelling the desired behaviour (Bandura, 2004), and is an established method for influencing behaviour (Glanz et al., 2008). Self-regulation encompasses certain skills that individuals must learn in order to exercise self-influence over behaviour (Bandura, 1991). Self-regulation is achieved through; (1) the identification and adoption of proximal and distal goals; (2) feedback received on the quality of performance and areas for improvement; and (3) finding social support in people who encourage their efforts (Glanz et al., 2008). Finally, environmental determinants of behaviour include the provision of enabling factors to support behaviour, known as ‘environmental facilitators’ (Bandura, 1998).

3.3. Expert judging

To ensure that each activity offered to users during the co-design session accurately represented the selected SCT construct, expert judging was utilised (Hardesty and Bearden, 2004). The expert panel was sent to 27 experts in the Marketing Department at a large Australian University. The judging panel were asked to match a list of 30 unique activities to six identified constructs of SCT. The key constructs of SCT included in the expert panel were the following: (1) knowledge of health risks and benefits; (2) observational learning; (3) health goal setting; (4) feedback; (5) social support; and (6) environmental facilitators. Each activity was judged as to whether it was representative of any of the identified SCT constructs. Eight out of the 27 experts (26%) returned completed expert panels. The literature suggests that the response rate is acceptable (Criscione-Schreiber et al., 2015) with good results obtainable through small panels of homogenous experts in a field of study (Akins et al., 2005). An activity was deemed representative of a SCT construct if an 85% agreement rate was achieved among the judges (Saxe and Weitz, 1982). In total, 22 activities were aligned to SCT constructs. Of these, two activities were selected to represent each of the six SCT constructs to create a total of 12 theory-mapped activity cards (see Figure 1)

Figure 1: Theory-mapped activity cards.

Peer to peer support
<p>Format: Phone</p> <p>A peer-to-peer program where parents are paired with a parent coach who has had similar experiences and can offer compassion, guidance and support.</p>

Parent-child contract	Skills demonstrations
<p>Format: n/a</p> <p>Parents form a contract between themselves and their adolescent that outlines their agreed upon attitudes.</p>	<p>Format: Workshop</p> <p>Series of workshops that involve skills demonstrations, role play and homework tasks which require parents to implement the practical strategies they learnt during the previous workshop.</p>

3.4. Data collection and analysis

Data was collected in two ways. First, qualitative data was collected from the ‘most/least liked’ templates provided to parents during the sensitisation stage. Second, the pitch presentations delivered at the end of the co-design session were recorded and photographs taken of each design idea. Thematic analysis was used to identify and analyse patterns of meaning in the qualitative data gathered from the ‘most/least liked’ templates. Specifically, data were analysed by following the five-phase cycle recommended by Yin (2015). This involved an open coding process, whereby codes were assigned to the transcribed data with a focus on identifying key aspects that parents placed value on in parent alcohol programs (e.g. content, format, features). In an iterative process, codes were critically re-examined to identify themes that further refined and focused the data. In addition, a total of 12 program ideas were generated by participants as a result of the two co-design sessions and were analysed in terms of their application of the theoretically mapped activities. A cross rater process was used whereby, two independent researches assessed user generated ideas in relation to key SCT constructs to ensure reliability, with a high-level of agreement (95%) reached. For and discrepancies, a third independent researcher acting as an arbitrator was consulted. Specifically, each idea was assessed in terms of 1) its direct use of the theory based activities,

2) adaptive reuse of the theory based activities, and 3) generation of novel ideas that fell outside of the theoretically mapped activities presented.

4. Findings

4.1. An abductive approach to co-design

The application of theoretically mapped co-design activity cards to an existing co-design process was critically examined to understand the role and relevance of theory in co-design. First, the utilisation of theory-mapped activity cards during the sensitisation and facilitation stages are examined. Second, user insights are evaluated against the SCT framework to inform subsequent program design.

4.1.1. Sensitisation

In line with the abduction approach, during the sensitisation stage, participants were provided with the 12 theory-mapped activity cards detailing previous parent alcohol program activities theoretically mapped to key SCT constructs (2 cards per construct). Participants were given time to read and reflect upon each card. Next, participants were provided with a template asking them to identify and provide reasons for their three most liked and least liked activities. This sensitisation activity is important as it familiarises participants with the underlying topic while beginning the process of idea generation (Hurley et al., 2018). Thereby, providing theoretically mapped activity cards influences participants to begin interpreting and considering the activities alongside their own needs and wants. Sensitising participants using theory-mapped activity cards allows them to call upon prior knowledge of theoretically based constructs which otherwise would not be present in the interpretations, adaptations and creative outputs during the co-design session.

4.1.2. Facilitation

Following the card sorting activity, participants were randomly allocated into groups of three to four and the remaining design tools were distributed (butcher paper, pens, post-it notes, colored markers, sticky tape, scissors). The facilitators encouraged participants to improve and/or develop ideas based on the provided activity cards and/or the generation of completely

new activities to design their ideal parent alcohol program. In doing so participants were provided with the freedom to introduce program ideas beyond the initial theoretical framework.

4.1.3. Reflecting

On average, four (33%) of the theory-mapped activity cards were directly utilised in the final design ideas generated by participants. In addition, 11 of the 12 design ideas (92%) adapted the existing activities to better align with their user needs. Given participants use of activity cards to articulate final design outcomes, the inclusion of theoretically mapped activities offers the potential to yield more theoretically derived outcomes than traditional co-design approaches. Finally and importantly, while program design was guided by SCT, the process still allowed for many novel insights to emerge, featuring nine (75%) of the final design concepts introducing novel program design ideas.

Analysing the collected data from the co-design sessions led to the identification of five key themes including a preference towards three Social Cognitive Theory constructs, namely 1) social support, 2) goal setting and, 3) knowledge of health risks and benefits and two additional converging themes, namely 4) communication and, 5) flexibility, which are discussed hereafter.

Social support

Social support, a key Social Cognitive Theory construct, was a key theme for parents. Eleven (92%) of the final design ideas implemented at least one element of social support, indicating that parents wanted other people to encourage their efforts. Specifically, participants noted that program components that included collaborations and interactions with other parents would be beneficial in not only fostering the creation of peer to peer support systems but allowing for idea sharing and feedback amongst participants.

*“To have somebody who has already experienced what you’re going through and to help give ideas on new ways to try and help your relationship with your child.”
(Female participant, Session 1)*

In addition, while parents recognised the need for content tailored specifically to parents, they also expressed the desire to include their teenagers in some program strategies, such as in an online quiz or dedicated parent/teen workshop session.

“I actually like the idea of doing something with our teens involved. Let’s share ideas, thoughts, experiences of our past and work together (Female participant, Session 2)”

Goal setting

The next prominent theme was the SCT construct goal setting, including the identification and communication of family expectations. In total, eight (67%) of the final design ideas implemented a program component focused on parents setting alcohol specific family goals. While participants suggested novel ideas such as a peer to peer contract for parents to agree on parameters, and a family assessment quiz for families to track and rate their own progress, the ‘family contract’ provided on the theory-mapped activities was the most favoured. Participants felt that a family contract would set clear rules and guidance on what is acceptable behaviour and provide accountability once expectations were set.

“A contract is a great way to lay on the table what parents’ expectations are and what the child’s expectations are. Then everyone knows where they stand.” (Female participant, Session 1)

In addition, participants favoured the implementation of goals as they can be personalised, taking into account the individual needs and values of the teenager, dynamic of the family household and parent-child relationships.

“Can cater it to the particular personality of the child and what would benefit them individually” (Female participant, Session 1)

Knowledge of health risks and benefits

Participants felt that evidence based knowledge (e.g. alcohol and the teenage brain) and practical tips (e.g. how to have conversations with teens) were valuable content. For example, participants indicated that the evidence base has changed since they received alcohol education in school and as such they felt they are not aware of the latest research on alcohol and the developing teenage brain.

“Parents need to learn how alcohol affects the teenage brain. Students learn this at school, but parents do not know this as it is new research.” (Female participant, Session 2)

“There is a lot of information we can access when seeking parental guidance, but it usually/typically lacks the practical implementation of strategies.” (Female participant, Session 1)

The final two themes were not aligned to SCT constructs and these related to program delivery preferences.

Communication

Participants valued program components that fostered positive parent-child communication, such as discussing concerns, the harms associated with underage drinking and family expectations. In addition, practical tips on how to communicate, when to communicate and what topics to discuss were considered important.

“Opportunity to openly discuss concerns, impact of drinking, what is acceptable and unacceptable. Starts a direct line of communication.” (Female participant, Session 2)

Flexibility

As parents are time poor, online was considered a convenient platform as it would allow parents to access the information at times that suited them, from their own home and in times when they actually needed it. However, online components were considered as essential supporting components for face to face sessions.

“I like something that is easily accessible , can do in my own time - a way of learning new information.” (Female participant, Session 2)

4.1.4. Building for change

Co-design sessions were theory informed via 12 activity cards mapped to six SCT constructs delivering an abductive approach to co-design. Participants indicated a clear preference towards three SCT constructs (i.e. goal setting, social support and knowledge). These SCT themes are ‘parent focused’ demonstrating how three SCT constructs, namely social support, goal setting and knowledge were considered as valuable mechanisms within a program seeking to improve parent child communications to reduce adolescent alcohol drinking. While some SCT constructs were identified as core program mechanisms by co-design participants, other SCT constructs were not considered to be essential elements for program design (i.e. observational learning, feedback and environmental facilitators). Alternatively, participants identified two additional themes (i.e. communication and flexibility) which are mechanisms that are ‘program features’. Program features are elements related to

program build and delivery aims. When considered together, the ‘program feature’ themes converge on the SCT themes to provide a clear starting point for program build (see Figure 2).

Figure 2: Key program features and mechanisms identified in co-design

The development of these themes in consideration with SCT led to the creation of four key program activities and a series of online resources which are detailed in Table 3.

Table 2: Contribution of theory and user insights in program design.

Element of program design	Relevant Social Cognitive Theory construct	Relevant co-design theme
<i>Myth busters Quiz</i>		
Knowledge of 1) the risks associated with underage drinking, and 2) parents influence in underage drinking	Knowledge of health risks and benefits	Knowledge of health risks and benefits
<i>Consider the conversation</i>		
Video clip of parent-teen conversation regarding alcohol	Observational learning	Communication
Conversation scenarios	Feedback	
<i>The family agreement</i>		
‘Family agreement’ template	Goal setting	Goal setting
Group discussion surrounding house rules	Social support	Social support Communication Flexibility

Element of program design	Relevant Social Cognitive Theory construct	Relevant co-design theme
<i>SMS Conversation starters</i>		
Weekly conversation cues sent via mobile phone	Environmental facilitators	Communication Flexibility
<i>Program website</i>		
- The teenage brain and alcohol	Knowledge of health risks and benefits	Knowledge of health risks and benefits
- Consider the conversation	Goal setting	Goal setting
- Family expectations	Social support	Social support
- Family agreement template		Communication
- Frequently asked questions		Flexibility
- Evidence based facts		
- Help line contact numbers		
- Alcohol trivia game		

5. Discussion

We introduced abduction as a novel method of reasoning and applied it to the seven-step co-design process (Trischler et al., 2019). The aim of this study was to understand how theory may be incorporated into an existing co-design process in order to provide guidance on how theory can help with ideation, user insight evaluation and subsequent program design. Each of the contributions are discussed in turn.

Theory's role in the fuzzy front end co-design process

This study provides guidance on how theory can be integrated into co-design sessions with users following an abductive approach. The findings demonstrate that theory can be successfully integrated into co-design through the use of theory-mapped activity cards. The integration of theory-mapped activity cards resulted in a co-design process that differed from the earlier applications (Trischler et al., 2019) (see Table 4).

Table 3. Theory-mapped versus traditional co-design approach

Co-design stage	Theory-mapped co-design	Traditional co-design
Resourcing	- Literature review conducted to identify previous parent alcohol programs.	- Literature review conducted to identify previous parent alcohol programs.
	- Expert panel process to map SCT constructs to existing parent alcohol program activities.	- Activity cards clustered based on alcohol specific parenting behaviours.
	- 85%+ expert agreement for theory mapped constructs utilised in the co-design process.	

Co-design stage	Theory-mapped co-design	Traditional co-design
	- Two theoretically mapped cards per key SCT constructs.	
Sensitisation	- SCT-based activity cards used. - Participants begin to interpret their own needs and wants within a theoretical framework (in a process they are unaware of).	Parenting behaviour based activity cards. - Participants equipped with no knowledge of existing behaviour change theories.
Facilitation	- Focus on SCT activities. - Able to call upon knowledge of SCT obtained during sensitisation stage. - Iteration between SCT and prior knowledge to arrive at final design ideas.	- Focus on alcohol specific parenting behaviours without theory guidance. - Final design ideas grounded in user insights.
Reflecting and building for change	- Abductive analysis. - Cross rating process to assess user insights in relation to SCT constructs.	- Inductive analysis. - User insight driven.
Building for change	- Final design grounded in SCT and user insights. - Program evaluation criteria guided by SCT constructs.	- Final design grounded in user insights - Program evaluation criteria guided by user insights.

Specifically, during the fuzzy front end of the co-design process, utilisation of an expert panel allows for the creation of theory-mapped activity cards. Attempts have been made to integrate prior expert knowledge into co-design sessions through the use of activity cards (for example see Dietrich et al., 2017, Villalba et al., 2019), however these have not previously been mapped to specific theoretical constructs. Clearly mapping prior knowledge and insights to behaviour change theory provides theoretical guidance that can then clearly inform subsequent program design..

The sensitisation phase of co-design is important in building a trusting environment, consequently improving participants' reflections and insights (Dietrich et al., 2016). Sensitising participants' using theory-mapped activity cards allowed participants' minds to be prepped with theoretical knowledge to build from. Therefore, and unlike the traditional co-design approach, participants were able to unconsciously gain a level of appreciation for the theoretical base prior to program development. Abduction requires participants to consider new ideas and envision new design solutions through the critical examination of their current

knowledge against new data (Reichert, 2004). Workshop discussions were framed within the theoretical framework, enabling participants to relate theoretical constructs to their real life experiences. During the facilitation stage participants' made assumptions about what they believed a program should look like based on their existing knowledge and prior experience while also interpreting their existing knowledge against the new theoretically mapped information they were provided. The utilisation of the theory-mapped activity cards allowed participants to expand their repertoire, thus improving their capacity to examine different perspectives in order to unleash new ideas and insights (Kolko, 2010). This process led to the adaptive reuse of the theory-mapped activity cards while also providing innovative ideas permitting a stronger reliance on theory than the traditional approach to co-design.

Bridging user insights and theory

Next, during the fuzzy back end of the co-design process, abduction allowed for a more nuanced understanding of co-design ideas than an inductive approach to analysis. Co-design insights were reflected upon in conjunction with the research teams existing knowledge of SCT. That is, user insights were critically examined against SCT constructs to identify any theoretical links. Therefore, program design was grounded in both user insights and SCT. Clear preferences for key SCT constructs emerged through the co-design process with parents identifying the importance of social support, goal-setting and knowledge as key mechanisms for inclusion in a program. SCT constructs that were neglected included observational learning, feedback and environmental facilitators. In addition, parents identified program delivery preferences; key insights that are often lacking from behaviour change theories which focus on predictors and influencers of behaviour (Bandura, 2004). Through clear mapping and subsequent program testing the social marketing theory base can be challenged and new theories can emerge (Belk et al., 2019).

The user generated insights provided a strong starting point for program build, identifying SCT constructs favoured by parents, as well as program build considerations (i.e. delivering program components that are accessible to parents at any time). During this stage it was important to make sure the program feature themes converging on the SCT themes were clearly aligned to a SCT construct, ensuring a balanced approach to the preferred constructs (e.g. online formats to deliver goal setting tools or foster social support through online

communities). Theoretically grounded insights on user behaviour and user generated program feature insights allows us to not only measure program success in relation to achieving desired change in parents (i.e. parent specific outcomes measures), but offers performance indicators to evaluate program implementation.

Enriching the co-design process through abductive inference

Finally, this study provides a process to design practically useful and theoretically guided behaviour change programs. There is a need for the development of actionable strategies which guide researchers and practitioners to integrate theory in new program development (Levit and Cismaru, 2020). New approaches are needed that effectively combine two important ends of the design spectrum namely, tapping users as a unique source of knowledge and experience and converting these insights into feasible and useful concepts. Particularly the latter must come from a team of experts (e.g. designers, researchers, and marketers). Nenonen et al. (2017) suggest that abductive methodologies may improve the quality of research outputs through the generation of concepts that are more accessible and understandable in practice than those that arise from theory. Our approach adds to the growing body of literature, providing an explicit and replicable description of how to apply an abductive approach to program co-design, using an example of the development of a parent alcohol program. An abductive co-design method is a promising approach that can identify clear program strategies that are grounded in both user insights and theoretical constructs to improve program efficacy and usability.

Limitations and future research directions

This study must be viewed in light of limitations. We have demonstrated that an abductive approach to co-design can be applied to the development of a parent alcohol program aiming to influence alcohol specific parenting behaviours. There is opportunity for this approach to be further developed and explored in other contexts. This in turn would allow for the refinement of the abductive co-design process and build evidence surrounding its acceptability.

In addition, while SCT has been shown to be effective in alcohol prevention efforts (Tebb et al., 2016), it does bring with it some limitations. SCT is broad and seeks to provide explanations for a multitude of human phenomena (Bandura, 1998), thus, it is difficult to

operate in its entirety. In addition, with the focus largely on individual and environmental factors which are known to influence health behaviours, SCT is less focussed on emotional factors and unconscious thought processes. Future research may seek to explore the application and usefulness of alternative behaviour change theories to the abductive co-design approach.

Next, this work involved co-design sessions with parents only. In the future, the theory-mapped cards could be used with other key stakeholders or a combination of key stakeholders (e.g. school teachers, health care professionals). Involving key stakeholders in co-design activities is important for gaining support and acceptance for program implementation (Trischler et al., 2019). Thereby, the inclusion of school teachers and principals during co-design may aid to improve the uptake and adoption of program strategies within school communities.

Next, to further assist researchers in implementing an abductive approach and to allow for replicability, more detailed reporting on methodologies used to transform user generated insights into viable program ideas are needed. Finally, the efficacy of implementing an abductive approach to co-design needs to be tested. These insights can be used to inform the design of a pilot program to evaluate effectiveness.

Conclusion

This study advances understanding of the role and relevance of theory use in co-design research. Researchers and practitioners are provided with practical guidance on how theory can be incorporated into co-design sessions with users following an abductive approach. Given the importance and benefits of applying a customer orientated approach to program design, integrating theory into an existing co-design process may further extend program effectiveness.

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