Experimental Methods in Health Psychology in Australia: Implications for Applied
Research

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Abstract

The purpose of this article is to explore the importance of laboratory-based experimental research within health psychology in Australia in bridging the gap between correlational research and large-scale population interventions. While correlational research is useful in the early stages of investigation design, it does not necessarily provide clear information on the causal mechanisms of behaviour change. On the other hand, conducting population interventions with insufficient experimental and pilot testing can lead to ineffective interventions or a lack of understanding of why the intervention was effective. We argue that a systematic multi-method approach that incorporates laboratory-based experimental methods can lead to more effective and resource-efficient interventions through the identification of key behaviour-change mechanisms and causal relationships. A systematic multi-method approach also has the advantage of overcoming limitations of single-method approaches within applied fields of research. We discuss recent experimental work conducted in Australia to illustrate the virtues of experimental research.

Key words: health psychology; methodology; laboratory research; experimental research; behaviour change; Australia

Word count: 3357

Introduction

In his introductory address to the American Psychological Association in 1957 Cronbach argued that psychology was heading in two directions; in one direction experimental design and, in the polar opposite, correlational design (Cronbach, 1957). To a certain extent this position still holds true in psychology in general with, for example, learning and perception research relying primarily on laboratory based experimental studies, and applied fields tending to favour correlational designs. This distinction has particular implications for health psychology, as although there is a preponderance of predictive correlational studies (Collins & Mullan, 2011; Juraskova et al., 2012; Kor & Mullan, 2011) that make an important contribution to theory development and testing, such research only provides one part of the procedure needed for converging evidence for psychological effects and processes in health behaviour and outcomes. In addition to correlational research, research that provides a detailed exploration of the causal factors or mechanisms of behaviour change is needed¹.

Unfortunately, however, it is not uncommon for interventions aimed at promoting health-related behaviour to be designed and conducted with insufficient understanding of these mechanisms, resulting in the adoption of interventions targeting components that may not be responsive to change. Further, although often necessary from a practical point of view, the utilisation of multiple techniques in one intervention arm also makes it difficult to determine the ‘active ingredients’ of interventions. In other words, optimal intervention design needs to be based on evidence that examines the effectiveness intervention techniques based on psychological theory using factorial designs that permit the isolation of the elements

¹ There is a body of research that argues for the value of observational and correlational studies in providing causal information. However, many of the studies conducted in this area do not make use of methodological and analytic procedures that could maximize the causal inferences drawn, and thus can only provide very limited causal information. For further information on causality in observational studies, see Winship and Morgan (1999).

of each technique on primary behavioural outcomes. In contrast, laboratory-based experimental research is often condemned for not being readily generalisable or translatable to chronic populations, while many of the benefits of this research method are ignored or downplayed. The purpose of this commentary is therefore to emphasise the importance of formative experimental work in controlled environments as a testing ground for the processes and mechanisms of interventions that are later rolled out in public health contexts.

Laboratory-Based Experimental Research

Many interventions do not allow for an understanding of the mechanisms of behaviour change, or the ‘active ingredients’ of what makes a successful intervention (Abraham & Michie, 2008; Michie & Abraham, 2008; Michie, Johnston, Abraham, Francis, & Eccles, 2013). For example, Michie and colleagues have noted that although interventions may be effective in bringing about desired change in a primary behavioural dependent variable, a lack of evidence on the factors that drive the change may cause problems when it comes to future replication and generalizability of the intervention in other contexts, and leaves little room for further intervention development. Moreover, if brief low cost interventions are needed, the question of which linear or interactive combination of behaviour-change components are effective and should be retained, and which are redundant and could be removed, needs to be addressed (Abraham & Michie, 2008; Hagger, 2010). Reverse-engineering such interventions to determine the effective components can prove difficult, particularly based on what has been reported in publications, as what could turn out to be crucial details for the success of the intervention may be missed or sidestepped (Michie & Abraham, 2008). Therefore, research into the components that may be effective in changing specific aspects or behaviour is needed.

We turn to recent examples in an Australian context to illustrate the imperative for experimental research that identifies mechanisms prior to intervention design. A recent

Australian intervention targeting breakfast consumption utilised theory of planned behaviour-relevant behaviour change techniques to alter the cognitive determinants of intention and breakfast eating. Perceived behavioural control was targeted using a print-delivered message to bolster self-efficacy and attitudes were targeted by providing information on affective consequences (Kothe, Mullan, & Amaratunga, 2011). Intervention mapping was used to link particular behaviour change techniques to be contained in the intervention to the psychological variables proposed to be associated with intentions and behaviour from the theory of planned behaviour (Abraham, Kok, Schaalma, & Luszczynska, 2010). As predicted, results demonstrated that the effects of the intervention on behaviour change were mediated by changes in the key social cognitive variables that were mapped a priori on to the intervention techniques. Other examples of Australian research that is currently ongoing uses a similar method of targeting social-cognition model variables using behaviour-change techniques and intervention mapping to develop the content of the intervention (Hawkes, Hamilton, White, & Young, 2012).

Laboratory-based experiments have the advantage of providing a stepping-stone between correlational or predictive research and large-scale interventions (Hagger & Chatzisarantis, 2009). Experiments can provide crucial information on the mechanisms underpinning behaviour change and are not only important in maximising the efficiency of the interventions but may assist in reducing resources wasted on implementing ineffective population-based interventions. One way to optimise the effectiveness of different research methods in the development of interventions is to combine them in a multi-method approach. For example, after conducting an initial correlational study aimed at examining the key theory-based psychological factors linked to behaviour, an experiment may be conducted using a factorial design, including each technique identified in the correlational research as a separate independent variable, to examine the experimental effects on the behavioural

outcome in a convenient sample. The experiment may help identify the specific techniques likely to have efficacy in the intervention. The final intervention would then incorporate the techniques identified in the experimental research applied using a randomised controlled design on the population of interest. This could be followed up by further testing of intervention effectiveness in other populations of interest such as illness groups, and, importantly, by also looking at the acceptability, adoption and likely use over time of such interventions (Kippax, Reis, & de Wit, 2011). The multi-method approach demonstrates how systematic progression beginning with correlational research, concluding with full intervention trials with, laboratory-based experiments as an important bridge can lead to efficient and effective intervention design.

Research conducted by Sharpe and colleagues (Boston & Sharpe, 2005; McGowan, Sharpe, Refshauge, & Nicholas, 2009; Sharpe et al., 2012) provides an excellent illustrative example. The researchers developed an attention-bias modification procedure based on the dot-probe paradigm that had been previously used for anxiety treatment, and applied it to pain management. First, preliminary research was conducted in university students to determine the best stimuli to use, whether threat appraisal of pain affects attentional biases, and whether attentional biases are associated with pain outcomes (Boston & Sharpe, 2005). They then conducted a laboratory-based attention-bias modification experiment in university students, and found that individuals who were trained to direct their attention away from pain words experienced less pain in a laboratory-based pain task than those who were trained to direct their attention towards pain (McGowan et al., 2009). They then applied a similar attention-bias modification procedure to two clinical pain (acute and chronic) populations using randomised controlled designs and found that for the acute pain sample, the attentional bias modification intervention improved pain outcomes (Sharpe et al., 2012). Furthermore, for those with chronic pain, the addition of attentional bias modification training to an eight-

week cognitive-behaviour therapy program improved anxiety sensitivity and disability up to six months later.

Experimental research can also help to provide key information not only about the theoretical mechanisms for change, but also about the influence of the actual methodological design. Being able to control possible extraneous factors that may influence findings other than the intervention or manipulation of interest is important for good intervention design. For example, experimental research into the placebo effect has found that explaining the purpose of the study, a common practice in interventions adopting randomized-controlled designs, can undermine double-blind procedures, as it is possible for participants infer their group allocation based on this information and their experience in the study (Colagiuri & Boakes, 2010). A further experimental study explored the role of the placebo on undergraduate sleep behaviours. Researchers found that warning about side effects increased the number of side effects reported, again suggesting that fully informing participants about the experimental procedure may not always be advisable (Colagiuri, McGuinness, Boakes, & Butow, 2012). Laboratory-based experiments may therefore provide essential additional detail to interventionists in terms of including procedures to better control for factors and variables that may dampen or interfere with the desired effect. Careful attention to these factors will ensure that interventions developed in health psychology settings maximise the effects on the health outcome of interest.

Of course we do not intend to claim that experimental methods do not have limitations. In experimental designs, randomisation of participants to groups provides an estimation of treatment effects that is unaffected by extraneous variables. Randomisation implies that participants allocated to experimental and control conditions will be similar in most (if not all) variables that are not targeted by the experimenter. That said, randomisation results in balanced experimental and control groups as the sample size of the experiment

increases (Sen & Singer, 1993). Therefore it may be important to couple experimental and non-experimental (e.g., correlational) study designs with other techniques, such as propensity score matching, that aim to balance treatment and control groups on a large number of covariates (Rosenbaum & Rubin, 1983). In addition, exploring trends across experimental studies, for example using meta-analytic techniques, may provide more robust information.

A Systematic Multi-Method Approach

When using only large-scale interventions targeting multiple change variables, it can be difficult to determine not only which factors are responsible for change, but also whether these changes are additive or multiplicative. Research adopting both correlational and experimental designs can assist in determining the behaviour change mechanisms at work. One of the most effective means for testing interactive effects of theory-based behaviour-change techniques in the context of experimental research is the adoption of a factorial design in which individual behaviour-change techniques are manipulated independently and the unique and interactive effects examined on behavioural outcomes in health contexts. For example, in a recent field experiment, Hagger et al. (2012) examined the effects of an intervention comprising of pen-and-paper manipulations of motivation, using mental simulations, and planning, using implementation intentions, and examined the individual and interactive effects of these manipulations on alcohol consumption in three national samples. Results revealed that implementation intentions were effective in reducing alcohol consumption in two of the three samples, but the robust test for the interaction between the motivational and planning techniques led to a rejection of the hypothesis of an interaction between the techniques.

Similarly, approaches that combine correlational and manipulation methods are also extremely useful to examine how the effects of changing a variable through experimental manipulation can affect other variables in a network of relations proposed in a model or

theory. Specifically, key variables targeted based on previous correlational research could be identified as targets for intervention, manipulated using key intervention techniques mapped on to the variables, and then the effects tested in the context of the model with the other constructs measured using self-report and relations among them specified by correlation or regression analyses. An example from our work is a field experiment in which we administered an intervention to change attitudes toward physical activity from the theory of planned behaviour in children, using a print communication, and examined the effects on the key variables from the theory and actual physical activity behaviour (Chatzisarantis & Hagger, 2005). The experimental manipulation was included as a dummy-coded variable in a path analysis in which the manipulation of attitudes, part behaviour, attitude and the other theory variables of intention and behaviour were included as observed constructs. Results demonstrated that the manipulation predicted physical activity intentions via the mediation of attitudes, corroborating the targeted nature of the manipulation, but revealed no statistically significant effects on actual behaviour. This analysis provided essential information for the design of interventions by illustrating that changing attitudes leads to very small effects on actual behaviour, a finding corroborated in previous intervention research.

A further advantage of laboratory based experimental research is that statistical analyses can be undertaken to elucidate the pathways via which the change in outcome occurs. Mediation analyses can help to determine whether changes that occur as a result of an intervention are due to changes in the theoretically derived constructs expected (Michie & Abraham, 2004; Plotnikoff, Pickering, Rhodes, Courneya, & Spence, 2010), rather than through other, unaccounted for, mechanisms, and can also help in identifying the behaviour change mechanisms of effective interventions (Lubans, Plotnikoff, Jung, Eves, & Sigal, 2011). Mediation analyses require measurement of the direct association between two variables, which in experimental research is usually the relationship between the manipulated

variable and the outcome or behaviour, and also measurement of the indirect association between these variables via a third variable, usually the theoretical construct through which the intervention is thought to work. If the indirect pathway fully accounts for the association between the manipulated variable and the outcome, then it is assumed that the intervention is operating through the mechanisms proposed (Shrout & Bolger, 2002). Such an approach has been repeatedly called for in the literature; however, this has rarely been achieved (e.g., Hardeman et al., 2002).

There are, however, caveats worth noting in using mediation analysis. As Bullock, Green, and Ha (2010, p. 552) ~~cautioned~~: “analyses in which a mediator is experimentally manipulated will be inaccurate unless the experimental intervention affects only the mediator in question and no other mediators” (p. 552). In health psychology, it is often difficult to devise a manipulation that affects only the hypothesised mediator because mediators hypothesised by different theories often display considerable commonality in content (Hagger, 2009). For example interventions based on self-determination theory aim to promote health behaviour by promoting more self-determined or autonomous motivation by shifting individuals’ reasons for engaging in the health behaviour from external to internal (Deci & Ryan, 1985). The techniques relevant to promoting autonomous motivation are through the interpersonal style displayed by significant others, known as autonomy support. However, some studies have also shown that autonomy-supportive interventions promote persistence by increasing positive affect or attitudes (Hagger, 2010). To the extent that autonomy supportive interventions influence affect and affect mediates effects of autonomy supportive interventions on health behaviour then mediational analysis that targets perceived locus of causality as the only mediator only will provide inaccurate estimates of the process and mechanisms involved.

Of course, there are times when laboratory-based experimental research on healthy or convenience samples is of limited value, and conducting interventions on the target population that have not been empirically validated is both unfeasible and of ethical concern. In these cases, intervention efficacy comes at the cost of determining its effectiveness. The concept of efficacy in medical and health research is commonly used to designate the success of an intervention under ideal and highly controlled conditions, and is constrained by internal validity (Gartlehner, Hansen, Nissman, Lohr, & Carey, 2006). In contrast, effectiveness is generally taken to mean the success of an intervention in the real world and as applied to the target population, and is constrained by external validity (Gartlehner et al., 2006). In situations where the findings of laboratory-based studies on healthy populations are not directly transferable to the clinical or health population under investigation, a multi-method approach, where sufficient preliminary investigation and pilot testing is conducted prior to experimentation, is important and can assist in overcoming the inevitable problems and limitations associated with using just one design.

For example, interventions targeting improvements in gluten-free diet adherence in individuals with coeliac disease are lacking in the literature; however, attempting to test such an intervention in a population without coeliac disease may not provide data that informs how intervention manipulations may affect behaviour in the specific, clinical population. As an alternative, Sainsbury and colleagues (Sainsbury & Mullan, 2011; Sainsbury, Mullan, & Sharpe, 2013a) conducted in-depth formative research, including theory-based elicitation interviews and predictive studies, aimed at identifying the factors associated with poor gluten free diet adherence in people with coeliac disease, so that these could be targeted in a population-specific intervention. The theoretical and psychological determinants of adherence were then targeted through relevant behaviour change techniques identified in the literature (Abraham, Kok, Schaalma, & Luszczynska, 2010; Sainsbury, Mullan, & Sharpe,

2013b). The experimental intervention resulted in improvements in gluten free diet adherence and knowledge, and thus was considered successful within the target population (Sainsbury et al., 2013b), whilst minimising the chance of an ineffective intervention within the clinical population. The researchers are currently in the process of conducting a larger scale intervention based on the findings of this preliminary research.

It is important to note that research methods other than randomised controlled trials can be used assess causality, which can be particularly useful when experimental designs are unfeasible or inappropriate. Such methods have received extensive attention more recently. For example, *regression discontinuity* designs can provide a method for assessing causation where randomisation is not possible or unfeasible by exploring cases around which a natural cut-off or point-of-reference occurs, such as those who just ‘miss out’ on a particular intervention reference point (Hahn, Todd, & Van der Klaauw, 2001). Non-experimental observational studies can also provide some information on causality, particularly when conducted longitudinally (Winship & Morgan, 1999). For the sake of brevity, these methods have not been fully explored here; for good resources that provide more information see Morgan and Winship (2007); Rubin (2005) and Pearl (2000).

The multi-method approach incorporating laboratory based experimental studies that we advocate does not come without challenges. Using laboratory-based experimental research as an extra step between predictive or correlational research and larger scale interventions can add extra time and monetary costs to research budgets that may already be stretched. Whilst it is important to acknowledge that these costs sometimes make this step impractical, we argue that, on the whole, the inclusion of laboratory-based experimental research can save resources. For example, experimental research may suggest that the proposed intervention strategies are ineffective in changing the key outcomes, or that changes that do occur cannot be attributed to the proposed mechanisms. In these cases, adding

experimental research as an extra step can prevent resources being used on a larger scale intervention that may not be effective, and can help to streamline time and money into behaviour change tools that are both efficient and effective.

Researchers in health psychology in Australia and internationally are leading the way in developing systematic approaches to intervention design, using mixed methods including experimental work alongside correlational designs, pilot testing, and initial interviews that elicit questionnaire content. Leading researchers in intervention design recognise the importance of establishing the need for pilot work (Sainsbury & Mullan, 2011), correlational studies across multiple behavioural contexts (Hagger, Anderson, Kyriakaki, & Darkings, 2007), and experimental designs (Chatzisarantis & Hagger, 2005; Kothe, Mullan, & Amaratunga, 2011) that focus on mechanisms as antecedents of the design and implementation of full, large-scale interventions using randomised controlled designs (Bartholomew, Parcel, Kok, & Gottlieb, 2001; Glanz, Rimer, & Viswanath, 2008). This approach is intended to provide a clear rationale for intervention development including information on the techniques that should be adopted and their likely effectiveness in changing behaviour prior to the full implementation of interventions. We hope that a multi-method approach would improve effectiveness of interventions and create conditions for discovering potential mediators and processes (Bartholomew et al., 2001).

Recommendations

Two primary recommendations are made for researchers in health psychology for the use of experimental methods in informing behaviour-change intervention research. First, we strongly recommend the inclusion of laboratory-based experimental research as standard part of a research protocol in the lead up to intervention development. Instead of relying solely on correlational data or pilot feasibility trials of the intervention itself, experimental work will give a researcher a clear view of the mechanisms involved, help identify potential mediators

to evaluate the intervention, and provide a more robust evaluation of the causal nature of the effects. Although not always relevant, in most instances laboratory research offers a cost effective way to develop effective interventions.

Second, we advocate a systematic multi-method approach to help overcome the limitations that individual research methods present on their own. Researchers in health psychology need to develop and conduct appropriately designed experiments to test the proposed mechanisms of their intervention before they go ahead and conduct their intervention. As such, there is a call for more innovative and rigorous pilot testing that is relevant to the research question. Such research would include testing of mechanisms using appropriate methods such as correlational studies and pilot experiments prior to the design of interventions to change health behaviour.

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