

## LIFE COURSE CENTRE WORKING PAPER SERIES

### How to Increase the Relevance and Use of Social and Behavioral Science: Lessons for Policy-Makers, Researchers and Others

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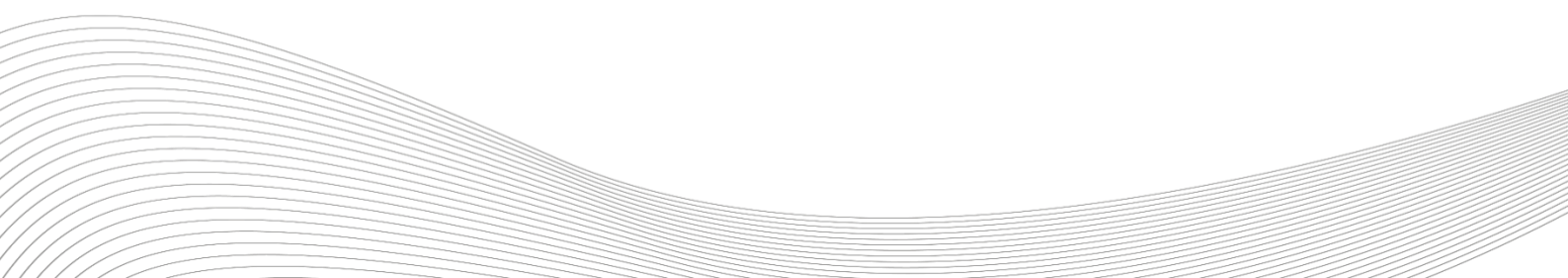
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## NON-TECHNICAL SUMMARY

For at least 40 years social and behavioral scientists have argued that their disciplines need to do more to help solve real world practical problems. But doing this has proved difficult. In this Essay, I describe three success stories where social and behavioral sciences have contributed important solutions and draw out evidence-based lessons for policy-makers, practitioners, university researchers and others who want to promote social and behavioral science informed actionable solutions to real world problems.

Researchers and policy makers are sometimes described as operating in ‘two communities’ or ‘parallel universes’ with different objectives, institutional logics, cultures, incentives and timeframes. However, these communities are not completely separate; within them policy-makers and researchers interact but often in comparatively unstructured ways. The same is true of university researchers and businesses, not-for-profits and civil society associations. For social and behavioral science contributions to policy, practice and other social and economic outcomes to be more than accidental, purposeful linkages across organisations and sectors need to be created. The mature form of such a linkage is an effective partnership between researchers and others, oriented to solving a practical problem, and characterised by a durable relationship between organisations, with common, synergistic and mutually beneficial objectives and outcomes.

Constructing scientific objectives as problems needing solutions or challenges to be overcome and embedding research within appropriate institutions and frameworks has driven innovation in computing, jet propulsion, lasers, satellites, cell phones, the Internet, GPS, digital imaging, nuclear and solar power and sequencing the human genome. Social and behavioral science based on solving real world problems and partnering deeply within and outside universities has substantial promise for improving policy and practice, enhancing relevance and impact and generating innovative breakthrough research.



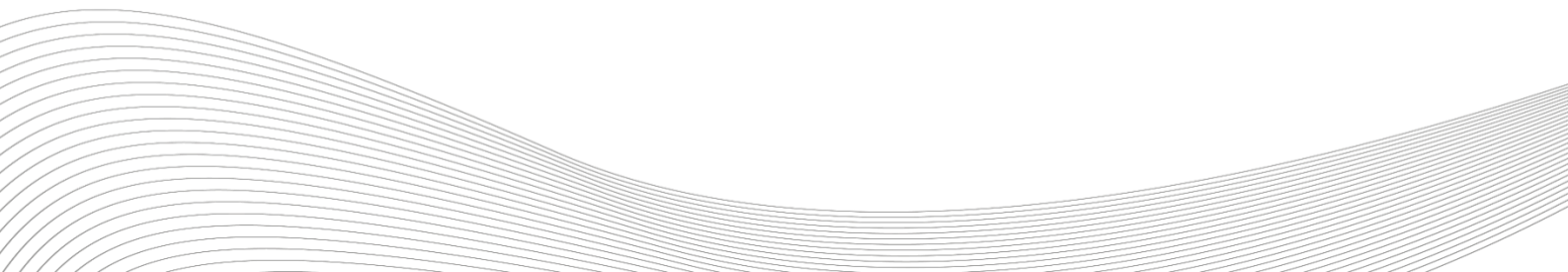
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## ABSTRACT

For at least 40 years social and behavioral scientists have argued that their disciplines need to do more to help solve real world practical problems. But doing this has proved difficult. In this Essay, I describe three success stories where social and behavioral sciences have contributed important solutions and draw out evidence-based lessons for policy-makers, practitioners, university researchers and others who want to promote social and behavioral science informed actionable solutions to real world problems.

**Keywords:** social and behavioral science; evidence-based solutions; linkages

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## Partner engaged, solution-oriented research: three success stories

For at least 40 years social and behavioral scientists have argued that their disciplines need to do more to help solve real world practical problems<sup>1-7</sup>. But doing this has proved difficult. In this Essay, I describe three success stories where social and behavioral sciences have contributed important solutions and draw out evidence-based lessons for policy-makers, practitioners, university researchers and others who want to promote social and behavioral science informed actionable solutions to real world problems.

*Using Third-Party Policing to improve School attendance.* Academic school achievement depends heavily on school attendance with little evidence of any safe threshold of school absence<sup>8</sup>. Third-party policing<sup>9</sup> attempts to control crime using non-offending third-party actors. Third-party policing strategies can be coercive as when police use landlords to discourage tenants in poor neighbourhoods from making what are perceived to be 911 nuisance calls<sup>10</sup>. But third-party policing strategies can also support rather than punish. In Queensland, Australia, parents or guardians of students with high levels of unauthorised school absences face an escalating series of government responses culminating in prosecution and fines. Children from poor families are disproportionately at risk.

The Ability School Engagement Program (ASEP)<sup>11</sup> is a partnership between researchers, Queensland Police Service and the Queensland Education Department to co-design and implement an intervention that ‘explained the legal escalation framework to the truants and their parents in a way that would raise awareness of the truancy laws, foster perceptions of the legitimacy of the laws, empower participants to willingly re-engage with school, and thereby, increase their school attendance’<sup>11, p.470</sup>.

The intervention, implemented via family conferencing, was examined using a randomised field trial, in Brisbane, Australia. The control condition was business-as-usual response. Trial results showed that the program reduced official and self-reported truancy, assisted students to attend school and improved school attendance perceptions and behavior<sup>11</sup>.

ASEP also contributed to the knowledge base for third-party policing by showing when police can forge productive partnerships with third parties. Productive partnerships occur when police collaborate with partners rather coercing them. Since third-party partners are often agencies with objectives like social welfare, police-third-party partnerships targeting different partners’ goals likely yield more effective and less punitive approaches to crime control<sup>12</sup>.

*Building commercial applications and new industries to support Indigenous people in remote regions.*

Spinifex is 69 species of native Australian grasses (genus *Triodia*) found in regional and remote Australia over one quarter of the Australian continent. Spinifex currently has no significant commercial use. In 2008 a research team including an architect-anthropologist, an architectural scientist, a nano-bio-engineer/material scientist, a botanist, a botanist-ecologist and an Aboriginal partner started a project using Western science and Indigenous knowledge to identify the properties and technology potential of spinifex grass<sup>13</sup>.

The project has yielded new information about the anthropology of traditional Indigenous spinifex uses<sup>14,15</sup>, the biology, genetics and ecology of *Triodia*, and optimal harvesting and land-management techniques<sup>16</sup>. Spinifex nanocellulose fibrils have properties<sup>17</sup> that make them suitable for commercial applications, including condoms, surgical gloves, compounded rubber<sup>18</sup>, paper and packaging<sup>19</sup>, ultrafine filtration and renewable carbon fibres<sup>20,21</sup>. They are easily and economically processed<sup>22</sup>.

An agreement between the University and the Aboriginal Corporation informed by principles in Australian native title legislation (Australian law's recognition that Indigenous people have rights to their land based on traditional laws and customs) provides for joint commercialisation of intellectual property. This agreement creates an institutional framework for spinifex commercialisation that may help establish viable Aboriginal-owned industries in remote Australia where none currently exists. The research agreement also shows how to build effective research and commercial partnerships between Australian Aboriginal people and western organisations like universities.

*Addressing Antisocial Behaviour among Public Housing Tenants.* In 2013 the Australian state of Queensland introduced a three strikes antisocial behavior policy for tenants living in state-owned housing. Tenants could receive strikes for behaviors such as excessive noise, loud music and parties, not keeping a property clean and tidy, or deliberate and minor damage. Households receiving three strikes in 12 months could be evicted. Tenants could also be evicted for 'dangerous and severe actions' such as seriously damaging the property or being charged by police for injuring a neighbor.

In the year after the policy was introduced, 2.5% of households received a strike, with nearly two-thirds for disruptive behavior. In the two years after the policy's introduction the annual eviction rate more than tripled<sup>23</sup>. In response, the state government commissioned a study of the policy's, rationale and implementation, its impact on tenants, and the evidence of the effectiveness of such approaches particularly in relation to tenants with substance abuse and mental health problems. <sup>23</sup>

The study involved theoretical reviews, case studies and policy and administrative data analyses, showed that the policy did not appropriately account for the circumstances of public housing tenants with mental health and substance misuse problems and was therefore likely ineffective in

reducing antisocial behavior. The research also suggested how to improve the policy and recommended a further review that explicitly recognised public housing's role in supporting tenants with complex needs.<sup>23</sup>

The research sponsor, the Queensland Mental Health Commission, subsequently prepared a report to state Parliament (i.e. the state legislature), recommending specific changes to the three strikes policy, broader changes to public housing policy and closer integration with other policy agencies such as the state health department<sup>24</sup>. The state accepted and supported all recommendations and sought appropriate funding through the government budget process.

The Mental Health Commission also funded an independent evaluation of how it was able to secure effective policy and practice change in this instance. This evaluation identified three key drivers of successful research translation to policy and practice: the quality of the research evidence in the original commissioned project; the collaboration model among the Queensland Mental Health Commission, researchers, other government agencies and other public housing stakeholders; and the leadership of the Commission in scoping the original research, preparing the Parliamentary report and presenting a balanced, comprehensive view of the policy issues relating to public housing for tenants with mental health and substance abuse issues to the state legislature.<sup>25</sup>

### Lessons for encouraging more solution-oriented social and behavioral science

These three examples are successful applications of solution-oriented social and behavioral science. They are solution-oriented because they attempt to solve 'real world' practical problems<sup>2,3,5,6</sup>. They are successful because they achieve outcomes – new research findings, policy and practice changes, commercialisation and economic opportunities, better understandings of research-policy linkages – that would not have occurred otherwise. They are also distinctive because they were explicitly designed to realise practical, 'extra-academic' outcomes as well as standard research outcomes and outputs.

Researchers and policy makers are sometimes described as operating in 'two communities'<sup>26</sup> or 'parallel universes'<sup>27</sup> with different objectives, institutional logics, cultures, incentives and timeframes. However, these communities are not completely separate; within them policy-makers and researchers interact but often in comparatively unstructured ways<sup>28</sup>. The same is true of university researchers and businesses, not-for-profits and civil society associations<sup>29</sup>. For social and behavioral science contributions to policy, practice and other social and economic outcomes to be more than accidental, purposeful linkages across organisations and sectors need to be created<sup>29</sup>. The mature form of such a linkage is an effective partnership between researchers and others,

oriented to solving a practical problem, and characterised by a durable relationship between organisations, with common, synergistic and mutually beneficial objectives and outcomes<sup>29-32</sup>. Effective partnerships between university and non-university actors undergird the examples at the beginning of this Essay.

Successful partnerships come from different forms of engagement between university researchers, policy makers and others. Research suggests that the most common ways university researchers engage with governments, policy makers, businesses and not-for-profits include:

- academic service on external boards and committees
- episodic or spot contracting of university research for short term needs
- strategic commissioning of research projects within an organisation's larger research and development portfolio
- longer term research partnerships that transcend individual projects
- interactions for knowledge dissemination and transfer across sectors
- other forms of engagement that are focused on commercialising intellectual property such as technology transfer and the establishment of startups and spinouts<sup>29</sup>

Partnerships where university researchers work directly on a non-university actor's practical problem increase the likelihood that research solutions will be adopted<sup>4,33</sup> over more passive strategies that assume that if researchers produce relevant research other actors will take that research up. One critical challenge is therefore to get researchers to work on partners' practical problems. The second challenge is to design elements of the research ecosystem to produce outcomes that all participants (policy-makers, service deliverers, researchers, other stakeholders) value.

Partner-engaged, solution-oriented research can be initiated by research sponsors outside universities or by university researchers. Governments, businesses, and other organisations who initiate projects tend to rely on activities like episodic and spot contracting, strategic commissioning and longer term partnerships.<sup>29</sup> Here the government or other organisation defines the problem to be solved and provides funding along with appropriate accountabilities to ensure progress towards the solution. This approach to research investment is a mission-driven 'connected science' model that specifically links funding to an end product and funds what is required for delivery.<sup>34</sup> It contrasts with an approach that supports investigator-initiated basic science and assumes that research findings will then be applied to practical problems and translated to policy and practice.

US examples of the connected model include the funding programs associated with the Defence Advanced Research Projects Agency (DARPA)<sup>34,35</sup>, related Department of Defense coordination of



research and technology development linked to the Cold War<sup>36</sup>, the social science research procurements for Johnson's Great Society programs in the 1960s<sup>37</sup>, the Advanced Research Projects Agency – Energy<sup>38</sup>, and the contemporary commissioning of sponsored projects. Other funding programs based on the connected model include the Grand Challenges program of the Gates Foundation<sup>39</sup>, the European Commission's Horizon 2020 Program<sup>40</sup> and the programs of the Chan Zuckerberg Initiative<sup>41</sup>.

### Lessons for policy makers and other representatives of non-university organizations

The connected model of research investment is a starting point for policy-makers and others who want to directly engage university researchers on actionable solutions to real-world problems. But there are other ways to help build engagement and effective partnering.

1. Understand what researchers value and incorporate these factors into research investment frameworks and project scopes. Researchers value being able to address scientifically important research questions with the potential for new knowledge<sup>42</sup> that lead to outputs like academic publications. Allowing or requiring researchers to publish findings and providing access to resources like data and policy expertise can be highly attractive to university researchers.
2. Recognise and communicate the value of solving practical problems. Many researchers want to produce work that is relevant beyond the academy but university reward systems can work against this interest (see below). Partners who can align project outputs with researchers' incentives and help researchers see and realise other concrete benefits will find it easier to enlist researchers in their projects. Drivers and incentive systems that foster researcher engagement with non-university partners include the following. Government funding agencies such as the National Science Foundation, Research Councils UK and the Australian Research Council, incorporate broader social and economic impacts into their program assessment criteria<sup>43</sup>. Working with non-university partners allows researchers to show engagement and impact that will help make funding proposals more competitive. Many countries also undertake system-wide assessments of the real-world impact of university research such as the UK's Research Evaluation Framework<sup>44</sup> or Australia's Engagement and Impact Assessment<sup>45</sup> that create favourable environmental conditions for partner-engaged research. Solving practical problems also potentially advances social and behavioral science because solutions need to work in the real world. This requirement can discipline researchers to make replicable breakthroughs<sup>5</sup>, that is breakthroughs that will

work repeatedly. Working to solve real problems does not guarantee replicability, but focusing on solutions that will be used in real settings and contexts directs researchers to solutions that work repeatedly and robustly including in contexts that may differ from those in which they were developed.<sup>2</sup> Understanding what works and when can drive social and behavioral science breakthroughs that researchers value highly.

3. Use appropriate program models. The connected model of research investment links funding to desired practical outcomes. Funding programs for connected research differ in the extent to which they allow researchers to initiate projects. For discrete projects, the required outcome is usually set by the project sponsor, but larger connected funding programs often allow researchers to initiate projects. In the United States, for instance, the Advanced Research Projects Agency – Energy (ARPA-E) supports research into new energy technologies through a combination of directed programs and open funding calls<sup>38</sup>. In Australia the Try Test and Learn Fund of the Federal Department of Social Services (Social Security) supports rapid development, piloting and evaluation of innovative solutions to long-term welfare dependence. Projects can be proposed by university researchers, the private sector, not-for-profits, the Department of Social Services itself, other state and federal agencies, and consortia of these groups. Successful projects are co-designed with the Department but undertaken by project teams with access to departmental resources, such as administrative data on welfare recipients.<sup>46</sup>
4. Use effective agreements. Research projects sponsored by government, business and not-for-profits will usually be covered under agreements that address different parties' accountabilities, milestones and deliverables. Effective agreements cover issues such as the research plan and relevant responsibilities, intellectual property ownership, data requirements, ownership and sharing, publication rights, commercialisation, dispute resolution and partnership termination.<sup>30,32</sup>

### Lessons for university researchers and administrators

University researchers and administrators can also encourage partner-engaged, solution-oriented research.

1. Work on problems that matter to sponsors and research end-users. Under the connected model, non-university partners typically set project objectives. But university researchers who want to engage non-university partners also benefit from initiating real-world focused projects partners value. Working on real-world problems creates a strong incentive for end-

users to engage with the research and researchers.<sup>2,3</sup> Aside from increasing relevance, working on real problems also creates conditions for research innovation and scientific breakthroughs, as I note below.

2. Approach research using models incorporating new insights to solutions, partnering, collaboration and teamwork. Putting partnerships at the centre of research frequently broadens it to include team members beyond social science and beyond universities. It also enables researchers to work in realistic settings on real questions with real data and takes advantage of complementary incentives among partners to solve problems and produce high quality research outputs<sup>31,pp 173-178</sup>. Solution-oriented social and behavioral science also leads to an expanded view of the full project lifecycle, from co-identifying and co-developing a shared awareness of the problem or functional requirement, determining an approach, prototyping and testing a solution, moving to scaled up implementation, and then looking to 'scale out' to new (real) contexts, settings and problems<sup>31</sup>. This type of understanding parallels and extends the movement from 'bench to bedside' in medical and public health research<sup>47,48</sup>, which is sometimes seen as moving from basic lab-based science to clinical practice and public health intervention in real settings.

The full project lifecycle corresponds to a Science, Engineering and Design (SED) approach to research<sup>31</sup>.

- Science, including social and behavioral science provides understanding, description and explanation.
- Engineering helps develop solutions for known problems.
- Design brings different stakeholders together to identify requirements that help clarify new problems and new possibilities<sup>31</sup>.

Approaching research like this influences how researchers choose problems, build teams and select methods, tools and techniques. Solution-oriented social and behavioral science also blurs the distinction between basic and applied social science because in producing solutions researchers also produce new knowledge and advance theory<sup>2,30,31,49</sup>.

3. Use theories and research methods that fit the project life-cycle. SED principles have two direct implications for research practice. Projects that follow the full life-cycle from co-designing questions and problems, to developing, testing and implementing scaled solutions, will use many theories, methods, data and research designs. No approach adequately covers the full project life-cycle because research objectives and contexts differ across the life-cycle and between subprojects<sup>2</sup>. At some parts of the research process, for example, researchers may need to assess if a solution works. Depending on context and problem this may require

a causal analysis, but it may also be enough to know if a solution predicts an outcome<sup>50</sup>. For causal analysis, an experimental approach like a randomised controlled trial or a lab experiment may be appropriate. But if a solution has to work in highly variable complex contexts, if institutional or policy constraints prohibit randomisation<sup>2,27</sup>, or researchers are moving from prototyping to real world implementation, other approaches such as non-experimental econometric evaluation methods<sup>51</sup>, meta-analyses, systematic reviews, causal Bayes nets, process tracing<sup>52</sup>, detailed ethnographic case-studies<sup>53,54</sup> or computer simulations<sup>48</sup> may be required.

4. Build teams appropriately. Research teams trying to solve real world problems will frequently be multidisciplinary as well as involving university and non-university partners. For policy and practice research and research with business and not-for-profits, stakeholder communities and end-users may be a core part of project teams or key project participants. But other team members who bring expert policy, practical or professional knowledge, data experts, and so on can also be critical. Teams may also be multidisciplinary because of the different expertise and functional capabilities needed for a solution. The examples at the beginning of this Essay included researchers from social and behavioral science, humanities, life sciences, physical sciences, engineering, and design and practice professions, as well as policy-makers, enduser groups and relevant communities.

Solution-oriented social and behavioral science also requires functionally differentiated teams; interdependent team members, working on problem design, conceptualisation, data collection and analysis, prototyping, resourcing, business development, implementation, knowledge transfer and so on. Whereas multidisciplinary research frequently involves disciplines bringing different lenses to a common research question, solution-oriented research across a project lifecycle involves bringing different functional specialists together to address aspects of solution development, validation and refinement for different contexts.

5. Listen to Partners. This is one of the most important lessons for university researchers. Partnering with non-researchers on their problems requires an important cultural shift by university researchers. As substantive and research experts, university researchers often want to start partnerships by 'telling' rather than listening. Telling involves researchers putting their definition of the situation on a partner's problem. It may, for instance, involve researchers redefining or defining a partner's problem in a way that enables a straightforward social and behavioral science solution, proposing a solution before properly understanding a problem, or trying to impose an approach that reflects scientific best

practice but is not commercially, practically or politically implementable.<sup>27</sup> University researchers who want genuine partnerships working on partners' problems, need to listen rather than tell to properly understand a problem as partners define it, and to understand partners' needs and constraints. University researchers also need to recognise, respect and take advantage of the different types of policy, practical, and technical expertise that non-university partners bring to a research team.

6. Build fit-for-purpose university research institutions. Universities can support researchers to build effective partnerships by creating research institutions that are fit-for-purpose. Partnerships require specialist professional support in areas like research development, legal review, intellectual property, contract management and research ethics. Moreover, even extensive partnerships often depend on strong personal relationships between a few individuals with mutual trust and shared knowledge of each other's organisations and objectives. These conditions make effective partnering difficult and may disincentivize it for university researchers in mainstream academic departments. Fit-for-purpose research institutions like appropriately configured university research institutes and centres help solve this problem. In my experience, fit-for-purpose implies the following characteristics:
  - An explicit solution-oriented social and behavioral science mission
  - An accompanying explicit organisational narrative of the value and benefits of solution-oriented research to wider society, to partners and stakeholders, and to researchers
  - A critical mass of high quality researchers in core capability areas
  - Research leaders who can model effective non-university partnering and engagement
  - Professional services support in areas such as research development, legal, contract and intellectual property management, finance and human resources
  - Physical and technical infrastructure and facilities
  - Policies and procedures establishing transparent and fair terms and conditions for collaboration within the organisation and with outside partners
  - Institutional reward and recognition systems that at the very least do not disadvantage researchers undertaking solution-oriented social science.

Research entities like this are fit-for-purpose because they aim to address coordination, cultural and resource barriers that impede research teams from working effectively on end-user defined problems for specific ends<sup>cf. 36</sup>.

7. Rethink graduate training. Regardless of discipline, at least 50% of doctoral graduates will not achieve long-term traditional teaching and research academic appointments in universities<sup>55,56</sup>. Using social and behavioral science to solve real problems provides a way to rethink social science graduate training to accommodate the diverse labour market opportunities doctoral graduates now face. Some elements of a reconfigured approach to doctoral training include:
  - Recognising that the primary purpose of graduate training is to produce a doctoral graduate who is well equipped for jobs inside and outside universities
  - Making available current and time series data on doctoral graduate employment outcomes to help students choose schools and programs and understand associated outcomes
  - Implementing a comprehensive researcher development framework like Vitae<sup>57</sup> that recognises multiple researcher domains or competencies such as engagement and influence, research governance, and personal effectiveness as well as disciplinary and technical knowledge and ability
  - Incorporating structured experiences of university-non-university partnering, such as co-design with government, industry and not-for-profits, of doctoral projects, workplace internships, and/or data or resource sharing
  - Providing a comprehensive vehicle like an academic portfolio of skills, experiences and outputs that enables graduates to recognise and evidence their skills and experiences to employers<sup>55</sup>
  - Supporting the development of transferrable skills, such as disciplinary knowledge, data and methods skills, communication, problem solving, project management, creativity, teamwork and working with others outside the organisation, that are relevant to university and non-university based research<sup>58</sup>
  - Building and encouraging graduates' "intellectual self confidence"<sup>59</sup> to work on problems that are set by partners rather than chosen by researchers, including working in ways that are unfamiliar and challenging with others who have different perspectives and expertise.
8. Realign cultures, norms and incentives within universities. Inside universities academic and disciplinary cultures do not always reward and recognise such partnering. But realigning university recruitment and reward systems to recognise cross-disciplinary and cross-sectoral partnering and solutions-based research outcomes is possible. New reward and incentive systems should complement existing systems as solution-oriented partner-engaged research

complements discipline-oriented research. Recognising and rewarding factors like non-university employment, non-traditional academic research outputs, or cross-disciplinary and cross-sectoral research collaboration in university hiring and promotion illustrates some potential changes<sup>60</sup>.

Constructing scientific objectives as problems needing solutions or challenges to be overcome and embedding research within appropriate institutions and frameworks has driven innovation in computing, jet propulsion, lasers, satellites, cell phones, the Internet, GPS, digital imaging, nuclear and solar power and sequencing the human genome<sup>36,61</sup>. Social and behavioral science based on solving real world problems and partnering deeply within and outside universities has substantial promise for improving policy and practice, enhancing relevance and impact and generating innovative breakthrough research.

## References

- 1 Flyvbjerg, B. *Making social science matter : why social inquiry fails and how it can succeed again* / Bent Flyvbjerg ; translated by Steven Sampson. (Oxford, U.K. ; New York : Cambridge University Press, 2001).
- 2 Fox, C. R. & Sitkin, S. B. Bridging the divide between behavioral science & policy. *Behavioral Science & Policy* **1**, 1-12 (2015).
- 3 Furman, J. Applying behavioral sciences in the service of four major economic problems. *Behavioral Science & Policy* **2**, 1-9 (2016).
- 4 Lindblom, C. E. & Cohen, D. K. *Usable knowledge : social science and social problem solving*. (Yale University Press, 1979).
- 5 Watts, D. J. Should social science be more solution-oriented? *Nature Human Behaviour* **1**, 0015 (2017).
- 6 Western, M. C. We need more solution-oriented social science: on changing our frames of reference and tackling big social problems. *LSE Impacts Blog* (<http://blogs.lse.ac.uk/impactofsocialsciences/2016/06/06/we-need-more-solution-oriented-social-science/>, 2016).
- 7 Miller, T. R. *et al.* The future of sustainability science: a solutions-oriented research agenda. *Sustainability Science* **9**, 239-246, doi:10.1007/s11625-013-0224-6 (2014).

- 8 Hancock, K. J., Shepherd, C. C. J., Lawrence, D. & Zubrick, S. R. Student attendance and educational outcomes: Every day counts. ( Report for the Department of Education, Employment and Workplace Relations, Canberra, 2013).
- 9 Mazerolle, L. & Ransley, J. *Third party policing*. (Cambridge University Press, 2006).
- 10 Desmond, M. & Valdez, N. Unpolicing the urban poor: Consequences of third-party policing for inner-city women. *American Sociological Review* **78**, 117-141 (2013).
- 11 Mazerolle, L., Antrobus, E., Bennett, S. & Eggins, E. Reducing truancy and fostering a willingness to attend school: results from a randomized trial of a police-school partnership program. *Prevention science* **18**, 469-480 (2017).
- 12 Mazerolle, L. The power of policing partnerships: sustaining the gains. *Journal of Experimental Criminology* **10**, 341-365 (2014).
- 13 Memmott, P. *et al.* Towards Novel Biomimetic Building Materials: Evaluating Aboriginal And Western Scientific Knowledge Of Spinifex Grass. (Australian Research Council Discovery Project, DP0877161, 2009).
- 14 Memmott, P. Bio-architectural technology and the Dreamtime knowledge of Spinifex Grass *Traditional Dwellings and Settlements Review* **24**, 65-66 (2012).
- 15 Powell, O., Fensham, R. J. & Memmott, P. Indigenous Use of Spinifex Resin for Hafting in North-Eastern Australia. *Economic botany* **67**, 210-224 (2013).
- 16 Gamage, H. K., Memmott, P., Firn, J. & Schmidt, S. Harvesting as an alternative to burning for managing spinifex grasslands in Australia. *Advances in Ecology* **2014** (2014).
- 17 Amiralian, N. *et al.* Easily deconstructed, high aspect ratio cellulose nanofibres from *Triodia pungens*; an abundant grass of Australia's arid zone. *RSC Advances* **5**, 32124-32132 (2015).
- 18 Hosseinmardi, A., Annamalai, P. K., Wang, L., Martin, D. & Amiralian, N. Reinforcement of Natural Rubber Latex using Lignocellulosic Nanofibers Isolated from Spinifex Grass. *Nanoscale* **9**, 9510-9519 (2017).
- 19 Raj, P. *et al.* Gel point as a measure of cellulose nanofibre quality and feedstock development with mechanical energy. *Cellulose* **23**, 3051-3064 (2016).
- 20 Jiang, E. *et al.* Cellulose Nanofibers as Rheology Modifiers and Enhancers of Carbonization Efficiency in Polyacrylonitrile. *ACS Sustainable Chemistry & Engineering* **5**, 3296-3304 (2017).



- 21 Gaddam, R. R. *et al.* Spinifex nanocellulose derived hard carbon anodes for high-performance sodium-ion batteries. *Sustainable Energy & Fuels* **1**, 1090-1097, doi:10.1039/C7SE00169J (2017).
- 22 Amiralian, N., Annamalai, P. K., Memmott, P. & Martin, D. J. Isolation of cellulose nanofibrils from *Triodia pungens* via different mechanical methods. *Cellulose* **22**, 2483-2498 (2015).
- 23 Jones, A., Phillips, R., Parsell, C. & Dingle, G. Review of systemic issues for social housing clients with complex needs. (The University of Queensland, 2014).
- 24 Queensland Mental Health Commission. (ed Queensland Mental Health Commission) (Queensland Mental Health Commission, Brisbane, Queensland, 2015).
- 25 KPMG. Key Drivers of Policy and Practice Change in Social Housing: Queensland Mental Health Commission Final Report. (2017).
- 26 Nutley, S. & Davies, H. T. O. Getting Research into Practice: Making a Reality of Evidence-Based Practice: Some Lessons from the Diffusion of Innovations. *Public Money & Management* **20**, 35-42, doi:10.1111/1467-9302.00234 (2000).
- 27 Brownson, R. C., Royer, C., Ewing, R. & McBride, T. D. Researchers and Policymakers: Travelers in Parallel Universes. *American Journal of Preventive Medicine* **30**, 164-172, doi:10.1016/j.amepre.2005.10.004 (2006).
- 28 Newman, J., Cherney, A. & Head, B. W. Do Policy Makers Use Academic Research? Reexamining the "Two Communities" Theory of Research Utilization. *Public Administration Review* **76**, 24-32, doi:10.1111/puar.12464 (2016).
- 29 Bastow, S., Dunleavy, P., Tinkler, J. & Aguilera, N. *The impact of the social sciences : how academics and their research make a difference / Simon Bastow, Patrick Dunleavy, Jane Tinkler ; editor, Natalie Aguilera.* (Los Angeles : Sage, 2014).
- 30 Shneiderman, B. & Hendler, J. It's the Partnership, Stupid. *Issues in Science and Technology*, 37-40 (2017).
- 31 Shneiderman, B. *The new ABCs of research: Achieving breakthrough collaborations.* (Oxford University Press, 2016).
- 32 Jasny, B. R. *et al.* Fostering reproducibility in industry-academia research. *Science (New York, N.Y.)* **357**, 759, doi:10.1126/science.aan4906 (2017).

- 33 Cherney, A., Head, B., Boreham, P., Povey, J. & Ferguson, M. Research Utilization in the Social Sciences. *Science Communication* **35**, 780-809, doi:10.1177/1075547013491398 (2013).
- 34 National Academies of Sciences, Engineering, and Medicine. *Returns to Federal Investments in the Innovation System: Proceedings of a Workshop—in Brief*. (The National Academies Press).
- 35 Defense Advanced Research Projects Agency. *Defense Advanced Research Projects Agency*, <<https://www.darpa.mil/about-us/about-darpa>> (
- 36 Sarewitz, D. Saving science. *The New Atlantis* **49**, 4-40 (2016).
- 37 Prewitt, K. in *Items Insights from the Social Sciences* Vol. 2017 (The Social Science Research Council, 2016).
- 38 Advanced Research Projects Agency - Energy. *ARPA-E*, <<https://arpa-e.energy.gov/?q=program-listing>> (
- 39 Grand Challenges. *Grand Challenges*, <<https://grandchallenges.org/#/map>> (
- 40 European Commission.
- 41 Chan Zuckerberg Foundation. *Chan Zukerberg Initiative*, <<https://chanzuckerberg.com/>> (2018).
- 42 Hemsley-Brown, J. Facilitating research utilisation: A cross-sector review of research evidence. *International Journal of Public Sector Management* **17**, 534-552, doi:10.1108/09513550410554805 (2004).
- 43 National Science Foundation. (National Science Foundation, 2015).
- 44 REF. *REF 2014 Research Excellence Framework*, <<http://www.ref.ac.uk/>> (2014).
- 45 Australian Research Council. *Engagement and Impact Assessment*, <<http://www.arc.gov.au/engagement-and-impact-assessment>> (2015).
- 46 Australian Department of Social Services. *Try, Test and Learn Fund*, <<https://www.dss.gov.au/review-of-australias-welfare-system/australian-priority-investment-approach-to-welfare/try-test-and-learn-fund>> (2017).
- 47 Szilagyi, P. G. Translational Research and Pediatrics. *Academic Pediatrics* **9**, 71-80, doi:<https://doi.org/10.1016/j.acap.2008.11.002> (2009).

- 48 Mazerolle, L. *et al.* From Bench to Curbside. *Criminology & Public Policy* **16**, 501-510, doi:10.1111/1745-9133.12287 (2017).
- 49 Haskins, R. & Margolis, G. *Show me the evidence : Obama's fight for rigor and evidence in social policy.* (Brookings Institution Press, 2015).
- 50 Kleinberg, J., Ludwig, J., Mullainathan, S. & Obermeyer, Z. Prediction Policy Problems †. *American Economic Review* **105**, 491-495, doi:10.1257/aer.p20151023 (2015).
- 51 Khandker, S., Koolwal, G. B. & Samad, H. A. *Handbook on Impact Evaluation Quantitative Methods and Practices.* (Washington : World Bank Publications, 2009).
- 52 Cartwright, N. & Hardie, J. *Evidence-based policy: a practical guide to doing it better.* (Oxford University Press, 2012).
- 53 Moran, M. *Serious whitefella stuff : when solutions became the problem in Indigenous affairs* (Carlton, Victoria : Melbourne University Press, 2016).
- 54 Shneiderman, B. & Plaisant, C. 1-7 (2006).
- 55 McGagh, J. *et al.* *Review of Australia's Research Training System: Report for the Australian Council of Learned Academies.* (Australian Council of Learned Academies, 2016).
- 56 National Academies of Sciences, Engineering and Medicine. Graduate Training in the Social and Behavioral Sciences: Proceedings of a Workshop--in Brief. (Washington DC, 2017).
- 57 Vitae. (ed Vitae Careers Research Advisory Centre Limited) (Vitae, <https://www.vitae.ac.uk/vitae-publications/rdf-related/introducing-the-vitae-researcher-development-framework-rdf-to-employers-2011.pdf/view>, 2010).
- 58 Sinche, M. *et al.* An evidence-based evaluation of transferrable skills and job satisfaction for science PhDs.(Research Article)(Report). *PloS one* **12**, e0185023, doi:10.1371/journal.pone.0185023 (2017).
- 59 American Historical Association. *Intellectual Self Confidence*, <<https://www.historians.org/jobs-and-professional-development/career-diversity-for-historians/career-diversity-resources/five-skills/intellectual-self-confidence>> (2017).
- 60 Klein, J. T. & Falk-Krzesinski, H. J. Interdisciplinary and collaborative work: Framing promotion and tenure practices and policies. *Research Policy* **46**, 1055-1061, doi:<https://doi.org/10.1016/j.respol.2017.03.001> (2017).
- 61 DeLisi, C. Santa Fe 1986: Human genome baby-steps. *Nature* **455**, 876-877 (2008).

