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OPTIMISING POST-DISASTER RECOVERY INTERVENTIONS IN AUSTRALIA

ANNUAL PROJECT REPORT: 2017-2018

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	**3**
BACKGROUND	**4**
PROJECT OVERVIEW	**6**
What Is the Problem?	6
Why is this Project Important?	7
Project objectives	8
Project scope and methodology	8
Expected Outcomes	10
Limitations	11
PROJECT TEAM MEMBERS	**12**
Researchers	12
End users	12
WHAT THE PROJECT HAS BEEN UP TO	**13**
End user workshop	13
Project rescoping activities	14
Queensland Floods 2010-11 case study activities	15
Victorian Black Saturday Bushfires 2009 case study activities	16
Conference Presentations	16
OTHER activities	17
PROJECT PAPERS AND PUBLICATIONS	**18**
REFERENCES	**20**

EXECUTIVE SUMMARY

Natural disasters in Australia are very costly, and often have devastating socio-economic effects on impacted communities.

Despite this, the economic impacts of natural disasters in Australia have often been overlooked in disaster management planning. A substantial problem is the inability to estimate the full economic impact – both primary and secondary – of natural disasters, considering all the affected sections of the economy.

The project aims to assist the Australian federal and state policymakers in building a more sustainable natural disaster recovery model. It investigates the sector-disaggregated economic effects of a number of natural disasters on affected individuals. Through these real-life case studies, the project helps illustrate how these event—of different types and scales—impact and ripple through communities and the broader economy over time.

By considering impacts on individuals, our research can help design post-disaster recovery government interventions that directly support individuals and communities most vulnerable to disasters and in need of assistance; and be tailored to assist sectors keep their workforce employed. Investigation of the vulnerability dimension is expected to help policy-makers better understand the socioeconomics of natural disasters and formulate public policies in a way that will tangibly minimise the disaster risks.

This year has seen significant progress on the Queensland 2010-11 case study, which is expected to be finalised within the first half of the 2018-19 year. The project also completed the preliminary individual analysis for the Victorian Black Saturday Bushfires 2009 case study. In May 2018, following extensive end-user discussions, the project was rescoped to focus solely on individual level analysis, incorporate medium term effects, and include more case studies from other states. This new scope offers exciting opportunities to maximise the research's utilisation by end-users and enhance linkages with other BNHCRC projects[1].

[1] Please refer to the section: Project rescoping activities.

END USER STATEMENT

***Ed Pikusa**, Manager Policy and Reporting, Fire and Flood Management Unit, Regional Programs Branch, Department of Environment, Water and Natural Resources, SA*

This project continues to analyse national accounts and census data to improve our understanding of the costs and benefits of natural disasters through all sectors of the economy. This is a specialised and unique piece of analysis which can provide insights for planning future mitigation and recovery efforts. These activities, especially recovery programs, are some of the most expensive emergency management activities undertaken in Australia. New insights that can assist in better targeting those investments has the potential to assist communities in preventing disasters, or reducing the economic impacts during recovery.

The specialised nature of the work has led to a strategy of engaging a small number of key end users, including the Commonwealth, Queensland Reconstruction Authority, and other state agencies. These agencies have offered to supplement the analysis with state-based data, improving the results for their needs.

In response to end user feedback during 2017-18, and an unexpected result with the data need to assess impacts on firms (as opposed to households), the researchers have worked to rescope and reframe the project to accommodate these changes over the remaining years of the CRC.

BACKGROUND

In Australia, natural disasters are estimated to cost an average AU$1.14 billion annually (BTE, 2001), and often have devastating impacts on local communities.

The 2009 Victorian Black Saturday Bushfires were the worst bushfire weather condition ever recorded globally; equivalent to 1500 Hiroshima style atom bombs going off (SMH, 2009). 173 people died; over 2,100 houses and 3,500 structures were destroyed, with thousands more suffering damage (Parliament of Victoria, 2010). The total area destroyed was around 400,000 square kilometres (Victorian Government DELWP, 2012), an area slightly larger than Japan.

The more recent 2010-2011 Queensland floods, one of the most devastating floods in Australian history, caused an estimated $6.7 billion in damage, with an overall cost of $14.1 billion (Deloitte Access Economics, 2016). The impact on the population was also substantial: more than 78 percent of the state was declared a disaster zone, with some 29,000 homes and businesses suffering inundation (Queensland Floods Commission of Inquiry, 2012).

In Australia, state and territory governments are primarily responsible for financing and executing disaster relief and recovery interventions. However, severe natural disasters impose intense financial stress on the state or territory budgets. To alleviate such pressure, the Emergency Management Australia (EMA) under the Commonwealth Attorney-General's Department (AGD) provides relief and recovery assistance in three schemes:

1. the Natural Disaster Relief and Recovery Arrangements (NDRRA) that facilitate the early provision of assistance to disaster affected communities,
2. Disaster Recovery Payment (DRP) that assists eligible adults and children, and
3. Disaster Recovery Allowance (DRA) that provides short-term income support payment to individuals.

The efficacy of all these funding arrangements lies in identifying and reaching out the 'adversely affected' individuals and business enterprises.

PROJECT OVERVIEW

With the financial assistance and overall guidance of the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC), Deakin University has conducted this economic research project titled "Optimising post-disaster recovery interventions in Australia".

WHAT IS THE PROBLEM?

> **"It would be a mistake to treat Black Saturday as a 'one-off' event. With populations at the rural–urban interface growing and the impact of climate change, the risks associated with bushfire are likely to increase"** (Parliament of Victoria, 2010)

With the severity and frequency from natural disasters set to increase (Intergovernmental Panel on Climate Change, 2014), there is a need—now more than ever—for Australia to have a sustainable disaster recovery model that:

- incorporates an evidence-based and disaster-specific assessment of potential damages and impacts of natural disasters on Australian communities, and
- helps build resilience within Australian communities to such disasters.

An important dimension of resilience to natural disasters is economic resilience (Rose, 2007). As income stream represents the economic resilience of individuals to external shocks, it is important to understand how natural disasters influence the income trajectory of individuals. Thus at an individual level, economic resilience can be defined as the ability to return to the pre-disaster income trajectory. This can happen if the individual has the necessary labour market skills, education and/or experience; the economy is sufficiently diverse to withstand firm/industry-specific losses; or if the government assists the individuals during the recovery and assistance period.

A major research gap is a lack of estimates of the full economic impact of natural disasters covering all the affected sectors and households of the economy. Without understanding both the primary and secondary effects of the natural

disasters, we cannot determine the economic resilience of individuals and communities to such disasters. Consequently, persistent losses throughout the economy emanating from various sectors are not adequately accounted for in the disaster recovery model.

Secondly, a framework needs to be established to estimate the indirect economic losses. With the identification of the disaster-specific potential damage and losses, policymakers at different levels can formulate disaster risk reduction-inclusive development policies to mainstream disaster resilience practices. Hence, estimating the impacts of previous natural disasters remains highly critical towards designing more informed national economic policies.

WHY IS THIS PROJECT IMPORTANT?

The research program is a pioneering effort that combines confidential ABS Longitudinal Census data on disaster affected areas, advanced disaster mapping, and empirical economic modelling to provide policy makers with a unique evidence-based estimation of the economic impacts of some of the worst recent natural disasters in Australia's history. It also provides a more granular level of analysis than otherwise available, thus complementing other major Australian research disaster resilience endeavours (e.g. the BNHCRC Australian Disaster Resilience Index project).

The project aims to assist the Australian federal and state policymakers in building a more sustainable natural disaster recovery model by investigating both the sector-disaggregated and demographic-specific economic effects of natural disasters of different types and scales. Through real-life case studies, the project helps illustrate how these events impact and ripple through communities and the broader economy over time.

By focusing on individuals, our research can help design post-disaster recovery government interventions that direct funding to individuals and communities most vulnerable to disasters and in need of assistance, thus enhancing their economic resilience. Investigation of the vulnerability dimension is expected to also help policy-makers better understand the socioeconomics of natural

disasters and formulate public policies in a way that will tangibly minimise the disaster risks.

PROJECT OBJECTIVES

1. **Research objective** – estimate the economic impact of natural disasters on individuals' income levels in Australia:
    - 1.1 estimate the sector-disaggregated economic impact of natural disasters on individuals' income levels in Australia
    - 1.2 estimate the demographic-specific economic impact of natural disasters on individuals' income levels in Australia

2. **Policy objective** – use research outcomes as evidence to optimise and inform a sustainable Australian disaster recovery model:
    - 2.1 Identify pathways for research outcomes to optimise disaster recovery expenditure for individuals affected by natural disasters in Australia
    - 2.2 Identify pathways for research outcomes to inform an evidence-based sustainable disaster recovery model in Australia.

PROJECT SCOPE AND METHODOLOGY

The project aims to determine how the "shock" of a natural disaster affects economic activity, specifically its disruptive effects at the individual level on:

- income,
- employment status (employed, unemployed),
- employment type (full-time, part-time),
- employment sector, and
- the number of working hours;

all investigated with respect to the social status of individuals (i.e., gender, age, income-level, employment status and type, education level) and considering the economic diversity of the area they live in.

This analysis will be followed by identifying the optimum economic policy options to inform disaster recovery budget allocation decisions.

Case studies

- The Victorian Black Saturday Bushfires 2009 (fire, large scale)
- The Queensland Floods 2010-11 (flood, large scale)
- The Western Australian Bushfires 2011 (fire, medium scale)
- Cyclone Oswald 2013 (cyclone, small scale)

Methodology

The project adopts a difference-in-difference model[2] to analyse each natural disaster case study's medium-term effects on affected individuals' income:

i. the treatment groups are individuals within SA2 areas[3] affected by the natural disaster events (i.e. in-scope case studies)
ii. the control group (i.e. comparator group) are individuals in neighbouring or similar SA2s, chosen based on statistical considerations and stakeholder consultation to ensure comparability with treatment group
iii. the natural disaster event is the "shock" that treats the disaster-affected individuals within a population (i.e. the treatment group), while the carefully chosen comparator group remains unaffected.

Using difference-in-difference modelling, the project determines the difference between the incomes of affected groups before and after the disaster, do the same for comparator groups, and see if there is any difference between the two differences (hence, the name "difference-in-difference"). This model enables observation of the net effect on individual income, post the disaster and any subsequent injections (from government).

By incorporating a disaster severity measure, the model considers the effect of the magnitude of this shock on these affected groups. The vulnerability dimension also allows consideration of the possible differences in the effect of the natural disaster on different subsets within affected groups.

The project performs the necessary robustness checks, sensitivity analysis and additional analysis recommended by end-users, so that the reported results are

[2] A model that mimics experimental research design used to study causal relationships where – as is the case with our research question (natural disasters) – actual experimental trials are infeasible or unethical.

[3] As defined by the Australian Bureau of Statistics, Statistical Areas Level 2 (SA2) are medium-sized general purpose areas built up from whole Statistical Areas Level 1. Their purpose is to represent a community that interacts together socially and economically (ABS, 2016)

statistically significant and robust, and provide policymakers with the necessary level of confidence in any subsequent project policy proposals.

Data

Income data

The research team exploits individual level economic information as retrieved from the 2006, 2011 and 2016 Australian Census Longitudinal Dataset. This dataset brings together a nationally representative 5% sample from the 2006 Census with records from the 2011 and 2016 Censuses. The availability of such data provides a unique opportunity to explore changes to the individual incomes of the disaster affected victims as compared with the unaffected cohort, by economic sector.

Economic sectors

Economic sectors are categorised according to the National Accounting System of Australia (ABS, 2015).

Disaster severity measure

The construction of the disaster measure is case-study specific and may include other information (e.g. topography data). Apart from Bureau of Meteorology data, the project capitalises on the BNHCRC end-user framework to obtain state level information on disaster impact and affected regions from the project's participating end-user state representatives[4].

EXPECTED OUTCOMES

The immediate project outcomes as relevant to the objectives are:

1. A robust economic model capable of estimating the economic impact of natural disasters, of varying types and severities, on the income levels of individuals, from various socio-economic demographical backgrounds.
2. Estimates of sector-disaggregated and demographic-specific economic impacts of real-life natural disasters on individuals' income levels in Australia

[4] Please refer to the section: "Current team members".

3. Identification of individuals, and their sectors of employment, most in need of disaster recovery assistance
4. Publications, including journal articles, conference papers, media articles, and guidance notes to disseminate and expand economic research on natural disasters in Australia
5. Policy briefs and other documentation for end-users that inform the budget allocation decisions in both pre-disaster mitigation as well as post-disaster recovery phases.

LIMITATIONS

As with any study, there are multiple limitations that policymakers should take into account when interpreting, replicating, or applying our results:

1. This project is focused on income, which while a very important indicator of economic activity, should be considered holistically with other indicators when formulating disaster recovery policies
2. There is a general gap in data that has historically affected determination of the severity and impact on natural disasters. Related to this is data accessibility: information useful to constructing measures such as disaster severity and estimating effects of government assistance on income, is not readily available and/or requires significant consultation lead time before being made available
3. It is acknowledged that it is not possible to account for the effects of all possible shocks that might have hit the affected state between the ABS Census years (2006, 2011 and 2016). However, to the best of our ability, and noting above limitations, we pin down the disaster effect by:
    i. incorporating the disaster severity measure in the disaster-hit areas into the model
    ii. only reporting results that are consistent across disaster severity measures
    iii. using multiple comparator groups constructed in consultation with stakeholders.

PROJECT TEAM MEMBERS

The project team consists of many stakeholders from a range of organisations. As a BNHCRC project, these stakeholders are categorised into the two groups: researchers, and end user state government agencies responsible or involved in natural disaster policy-making.

RESEARCHERS

This year has seen a number of changes to the project team. The project team thanks Dr Md Habibur Rahman for his valuable contributions and insights into the foundations and direction of the project. The team also welcomes Ms Farah Beaini, who will oversee the stakeholder management and end-user engagement as the project matures and develops policy briefs.

Professor Mehmet Ulubasoglu	Deakin University	Lead Researcher
Dr Md Habibur Rahman	Deakin University	Research Fellow (end: Mar 18)
Ms Farah Beaini	Deakin University	Research Fellow (start: Mar 18)

In addition to the core research team, there are a number of casual members who contribute valuably to the project by working on the ArcGIS, statistical programming, and performing regressions as part of the ABS visits.

END USERS

This project currently has a total of 6 end users across government. The end users extend their support to the research team in delivering the assigned outcomes of the project.

- Emergency Management Australia, Attorney General's Department
- Department of Environment, Land, Water & Planning, Victoria
- Department of Environment, Water and Natural Resources, South Australia
- Queensland Reconstruction Authority
- Department of Treasury and Finance Victoria

This year, we also welcome the Western Australian Office of Bushfire Risk Management (Department of Fire and Emergency Services).

WHAT THE PROJECT HAS BEEN UP TO

With the project ramping up its result output, the research team has increased its efforts in stakeholder engagement and consultation to ensure that the research produced continues to meet the needs of our end-users and can also be utilised by other interested stakeholders. As of now, the research project has accomplished several milestones that are described below.

END USER WORKSHOP

On 11 April 2018, an end-user workshop was held between the project team, the BNHCRC, and end-user representatives from the Commonwealth, South Australian and Queensland governments. The project team disseminated research findings and conducted focus group interviews with the end-users to assist in developing a proof of concept for research utilisation.

The workshop was very productive, with broad support for the project's potential utilisation as an element in disaster recovery intervention policy decision making. Lead end-user representative from SA considered the use of ABS Census data as

novel and exciting. Emergency Management Australia considered the research to be very valuable in aiding with the National Impact Assessment Model, given its economic assessment dimension. The Queensland Reconstruction Authority (QRA) suggested a number of refinements to the Queensland case study methodology, discussed in the next section, to increase the capacity of the research to be utilised by policymakers.

All parties agreed to the need for further refinements to project scope and modelling prior to developing a proof of concept, including:

- engagement of other states would be extremely beneficial, given that each state has different disaster recovery frameworks and policies
- refining the project scope, increased stakeholder collaboration during methodology development, more comparator groups where possible, as well as extending the analysis timeframe to incorporate medium-term effects, would strengthen the utilisation of this research by policymakers.

These suggestions propelled the rescope of the project, discussed below.

PROJECT RESCOPING ACTIVITIES

On 26 June 2018, a proposal to revise the project scope was approved. The rescoping:

- provides a more focused research that explores and incorporates stakeholder suggestions and emerging research questions
- offers links with other BNHCRC projects such as the Australia Natural Disaster Resilience Index[5]
- provides medium-term effects of disasters on individual income
- enables other states (e.g. WA), with different disaster recovery arrangements, to utilise our research
- while excludes firm level analysis, still allows for likely sectors impacted by disasters to be identified via information on individuals' sector of employment.

In-scope

1. Four case studies of varying scales and types:

[5] i.e. income being an important dimension of disaster resilience

i. Victorian Black Saturday Bushfires 2009
ii. Queensland Floods 2010-11
iii. Western Australian Bushfires 2011 (new)
iv. Cyclone Oswald 2013

2. Profiling of the socio-economic characteristics of the affected regions pre and post disasters, to provide additional context to the results (new)
3. Short (existing) and medium-term (new) individual level analysis of income effects of in-scope natural disasters over the time period: 2006 – 2016
4. Exploration of linkages with other BNHCRC research projects, and how this research can be utilised to support and enhance existing government natural disaster recovery framework policies and procedures
5. Generation of guidance notes for end-users on conducting this research (new), as well as policy briefs identifying the optimum economic policy options that inform the budget allocation decisions in both pre-disaster mitigation as well as post-disaster recovery phases.

Out of scope

Firm level analysis has been descoped.

QUEENSLAND FLOODS 2010-11 CASE STUDY ACTIVITIES

As reported in the previous annual report, our research found *positive* income effects among affected individuals following the floods. While in line with previous economic literature, the results warranted further attention and discussion with stakeholders, given the complexity of the case study (e.g. concurrent flooding effects from Cyclone Yasi).

Throughout 2017-18, the project team held a number of discussions with QRA which yielded a number of helpful suggested changes to the comparator group and mapping. These suggestions are currently being modelled and investigated. Results are expected to be presented in the first half of 2018-19.

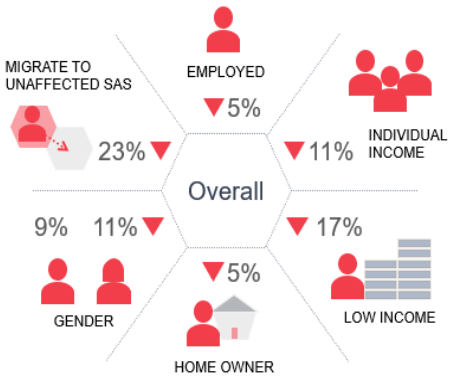
VICTORIAN BLACK SATURDAY BUSHFIRES 2009 CASE STUDY ACTIVITIES

In February 2018, the research team reported back on the previous request by Vic DELWP to investigate the mental health effects of the Black Saturday Bushfires on affected individuals. Using the HILDA dataset, the project team:

- found that the Black Saturday Bushfires reduced the life satisfaction of the affected individuals in the year following the disaster, but then people recovered from reduced life satisfaction in the second year of the disaster and onwards
- identified some negative mental health effects (though with delayed onset) following the disaster. Again, both these life satisfaction and mental health effects differ among different cohorts of population in Victoria.

In addition, the project team presented preliminary findings of the income effects of the Victorian Black Saturday Bushfire case study during the RAF end-user breakout sessions. These findings, particularly migration implications, received significant interest from Victorian IGEM, as well as Western Australia who were in attendance. Engagement with the Victorian end-users will be ramped up in the first half of 2018-19.

Some preliminary findings



- **Overall,** with an average 15% share of burnt areas, average decline in individual income following the fires was 11.25%.
- **Migration:** Huge migration to neighbouring areas (50% moved out over 5 years), normally only 5% migration per annum. There was a 22.5% decline in income for those who moved out from burnt SA2 to other areas
- **Unemployed** not statistically significant, possibly due to continued availability of income sources (e.g. Centrelink)

CONFERENCE PRESENTATIONS

The research team participated in the **AFAC Fire and Emergency Management Conference** held in Sydney in September 2017, presenting the research paper

titled: "*Unpacking the Sectoral Income Effects of Natural Disasters: Evidence from the 2010-11 Queensland Floods*".

The research team also participated in the **Research Advisory Forum (RAF)** held in Sydney on 12-13 Apr 2018. The team presented the findings for Queensland Floods 2010-11 and preliminary findings of the Victorian Bushfires 2009 case studies, and how these events affected individual's income streams.

OTHER ACTIVITIES

- Submission of a paper titled "*Floods, Bushfires, and Sectoral Economic Output in Australia: 1978-2014*", to premier economics journal the Economic Record (a premier journal targeted by Australian economists)
- Submission of a paper titled "*Natural Disasters and Economic resilience: The Income Effects of the Black Saturday Bushfires in Disaster-Hit Individuals*" to the AFAC18 Conference, to be held in Perth in September 2018
- Presented a paper "*Silver Lining of the Water: The Causal Evidence on the Local Economic Effects of Queensland Floods 2010-11*" at the 4th Annual Workshop (11-12 December 2017) on Natural Experiments in History: Development, Health and Labour at Melbourne
- Produced a Commentary Report on the Monitoring and Evaluation Framework for Disaster Recovery Programs, at the request of the Attorney General's Department, following a workshop held on 13 July 2017 to identify explicit research utilisation paths for relevant stakeholders
- Presented a showcase on outcomes of post-disaster recovery interventions in Australia, as part of BNHCRC's Mini Showcase with the Attorney General's Department on 10 October 2017 in Canberra.
- Commenced engagement with WA OBRM on Western Australian case study.

PROJECT PAPERS AND PUBLICATIONS

Refereed Journal Articles

Submitted

Ulubasoglu, M., M.H. Rahman, Y.K. Onder, Y. Chen, and A. Rajabifard (2017). *Floods, Bushfires and Sectoral Economic Activity in Australia: 1978-2015*. Economic Record (Wiley), Economic Society of Australia. Invited for revised resubmission, October 2017.

Accepted

Rahman, M.H. (2018). Earthquakes don't kill, built environment does: *Evidence from cross-country data*, Economic Modelling Volume 70, April 2018, pp. 458-468.

Related Refereed Journal Articles

Rahman, M.H., N. Anbarci, P. Bhattacharya, M. Ulubasoglu (2017), "Can Extreme Rainfall Trigger Democratic Change? The Role of Flood-Induced Corruption", Public Choice, March 2017, v. 171, pp. 331-358.

Rahman, M.H., N. Anbarci, P. Bhattacharya, M. Ulubasoglu (2017), "The Shocking Origins of Political Transitions? Evidence from Earthquakes", Southern Economic Journal, January 2017, v.83, pp. 796-823.

Conference Papers

Refereed

Rahman, M.H., M. Ulubasoglu, P. Bhattacharya, K. Potts, Y. Chen, M. Kalantari and A. Rajabifard (2015). "Natural Disasters and Economic Development: Evidence from Australia", Australian Conference of Economists, 7-10 July 2015, Brisbane.

Non-Refereed Conference Papers

Ulubasoglu, M. Y.K. Onder and M.H. Rahman (2018). "Evaporative Heating: The Negative Income Effects of the Black Saturday Bushfires in Disaster-Hit Areas", The 2018 Annual Conference of the Australasian Fire and Emergency Service Authorities Council, 5-8 September 2018, Perth. Accepted.

Ulubasoglu, M., and M.H. Rahman (2017). "Unpacking the Sectoral Income Effects of Natural Disasters: Evidence from the 2010-11 Queensland Floods", The 2017 Annual Conference of the Australasian Fire and Emergency Service Authorities Council, , 3-5 September 2017, Sydney.

Rahman, M. H., Chen, Y., Potts, K., Bhattacharya, P., Rajabifard, A., Ulubasoglu, M. & Kalantari, M. (2015), "Bringing hazard and economic modellers together: A spatial platform for damage and losses visualisation", Research proceedings from the Bushfire and Natural Hazards CRC and AFAC conference, Report No. 2015.084, Adelaide.

Rajabifard, A., M. Ulubasoglu, K.Potts, M.H. Rahman, M. Kalantari, P. Bhattacharya (2014). "A pre-disaster multi-hazard damage and economic loss estimation model for Australia", The 2014 Annual Conference of the Australasian Fire and Emergency Service Authorities Council, 2-5 Sep 2014 Wellington.

Book chapters

Rahman, M. H. and Ulubasoglu, M. (2015). "Economic Growth: Measurement", In Wright, James D. (Ed.), International Encyclopaedia of the Social and Behavioral Sciences, Second Edition, pp. 45–50. Oxford: Elsevier.

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