Developing and Researching the Economics and Mathematics of Selection: the DREAMS Network

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Welcome to York!

DREAMing big…

- Funded via The Worldwide Universities Network (WUN) Research Development with matched funding from participating WUN-affiliated universities

- University of Cape Town, University of Western Australia, University of Sydney, University of Leeds, University of York

- Non-WUN universities- Ghent, Aberdeen and Erasmus

The DREAMS network: Aims

- To develop and extend quantitative approaches to understanding personnel selection
- Statistical, mathematical and economic approaches
- To apply and evaluate these methods via collaborative research
- Medical selection as the main motivating example
- Generalise learning to other professions

Programme for DREAMS workshop 1: Widening Access to the Professions

13th-14th February 2017, University of York

Day 1: Monday 13th February

The Boardroom, Seebohm Rowntree Building, Campus West

09.30: Tea and Coffee available (Boardroom, Seebohm Rowntree Building)

10.00: **'DREAMing big…': Welcome and introduction** Paul Tiffin, University of York

10.20: **Widening access to the professions: potential benefits and challenges** Paul Tiffin, University of York

10.50: **Markers of Widening Access status and undergraduate performance in UK medical students** Jen Cleland, University of Aberdeen

11.35: Break

11.50: **The potential benefits of Widening Access to medicine- the Australian experience** Annette Mercer, University of Western Australia

12.35: Lunch (served in ARRC Auditorium Foyer)

Note: After lunch we are in 'Focus Group 2 Room' (A/RC/112 Floor 1, ARRC building)

13.15: **Situational Judgment Testing and the Human Development Index** Anton Botha, United Nations

14.00: **Widening Access: Perspectives from the Teaching Profession** Rob Klassen, University of York

14.45: Break

15.00: Panel discussion, summing up and close of day 1

15.30: Visit to York Minster for interested parties*

18.30: Dinner- ASK Italian, Blake St, York YO1 8QG

*Entry fee £10 adults, £15 if tower access and tour requested

The DREAMS network: Activities

- A series of 3 workshops
- I- 'Widening access' (York)
- II- Situational Judgement Testing (Sydney)
- III- The economics of selection (York)
- A series of exchange visits ('mini-fellowships') for Early Careers Researchers

The DREAMS network: Activities

- We have a website https://www.york.ac.uk/healthsciences/research/mental-health/projects/dreams-network/
- Short link: http://bit.ly/2ivbkuu
- Linked to INReSH (International Network for Researchers in Selection into Healthcare)
- http://www.medschools.ac.uk/AboutUs/Projects/INReSH/Pages/INReSH.aspx
- Twitter @DocTiffin #selectionscience

Developing and Researching the Economics and Mathematics of Selection: the DREAMS Network

This project is funded by the Worldwide Universities Network (WUN) Research Development Fund (RDF) with matched funding from participating WUN universities (University of York, University of Leeds, University of Western Australia, University of Sydney and University of Cape Town).

The DREAMS project brings together a network of international experts from health economics, education, the mathematical sciences and organisational psychology via a series of workshops and networking initiatives.

The DREAMS network is an international collaboration focussed on developing new approaches to understanding the selection of individuals into the professions.

The models and methodologies we plan to create will help predict the potential costs, risks and benefits of differing selection approaches, as they apply across a number of global settings. Clear frameworks for understanding and communicating the clinical and cost effectiveness of health interventions have already been developed as part of the 'evidence-based medicine' movement (e.g. 'Number Needed to Treat' as index of treatment effectiveness). We are creating a similar language around the science of selection. Whilst the initial focus

- Papers

- Funding proposals

- Long term collaborations

The DREAMS network: Reasons to be cheerful!

- 2017 is a great time to be interested in selection!

- Increasing quantity and quality of routinely arising ('Big') data related to higher education (e.g. UKMED)

- A wealth of 'conventional' [frequentist] statistical modelling methods to use

- Structural Equation Modelling

- -Item Response Theory (IRT)

- -Latent Growth Curve modelling
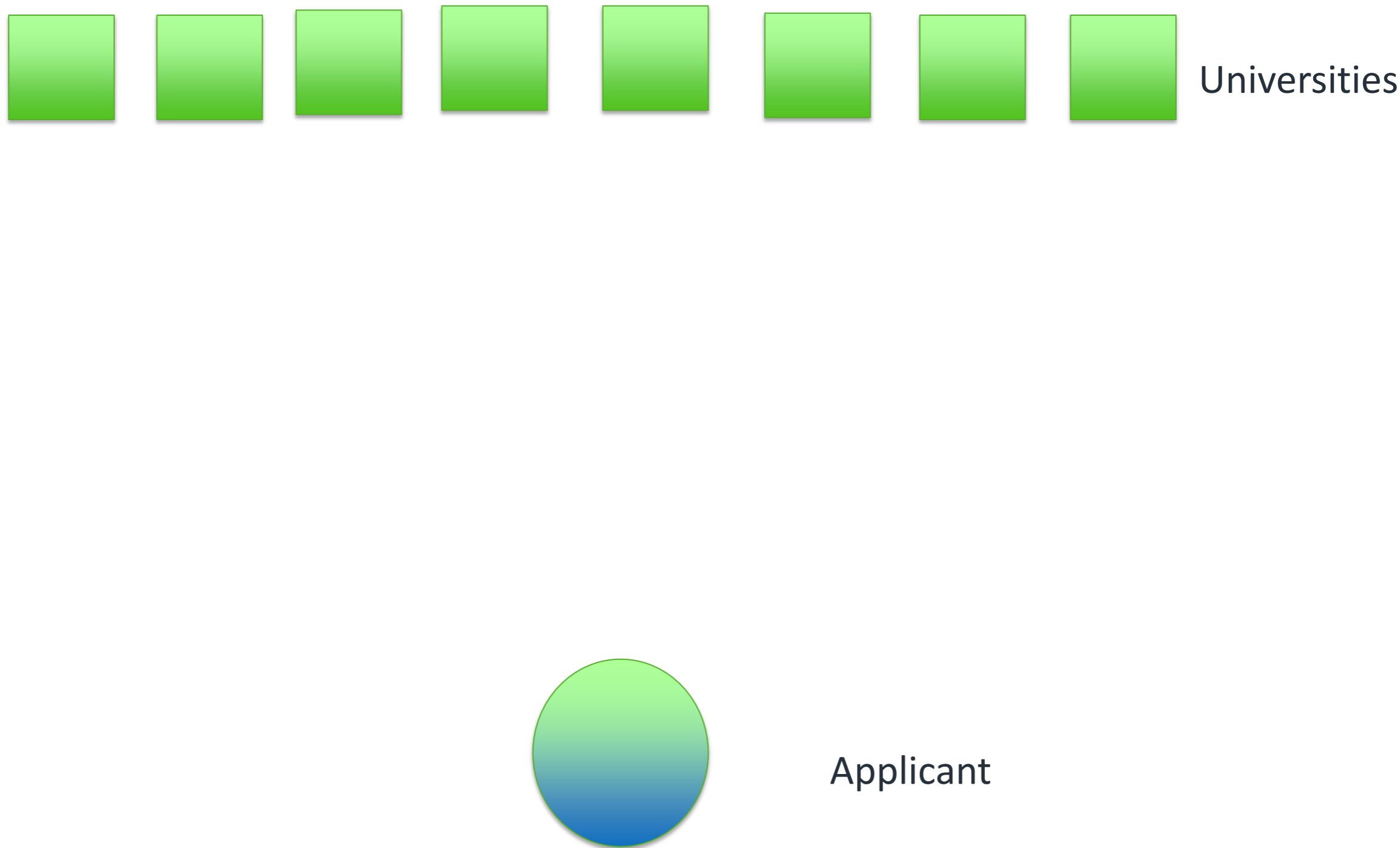
- -'Causal' modelling
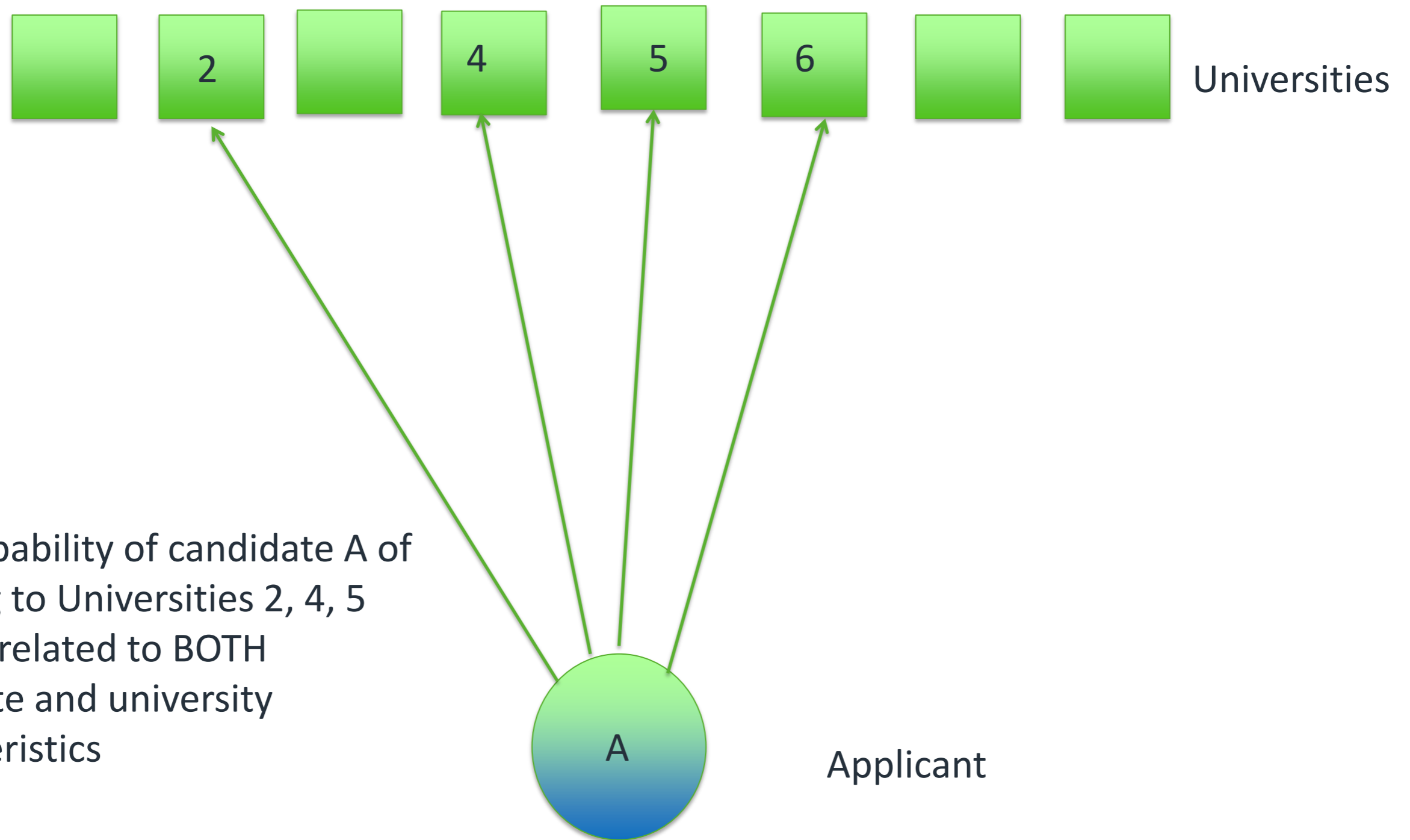
The DREAMS network: Reasons to be cheerful!

- Advances in computing power

- Novel, rarely or never applied approaches to data analysis and modelling

- Bayesian approaches (use of prior knowledge, estimate intractable models)

- Numerical simulation (imputation etc)

- Agent based modelling

- Machine Learning ('artificial intelligence')

- Economic modelling

Conceptualising selection as a complex system:
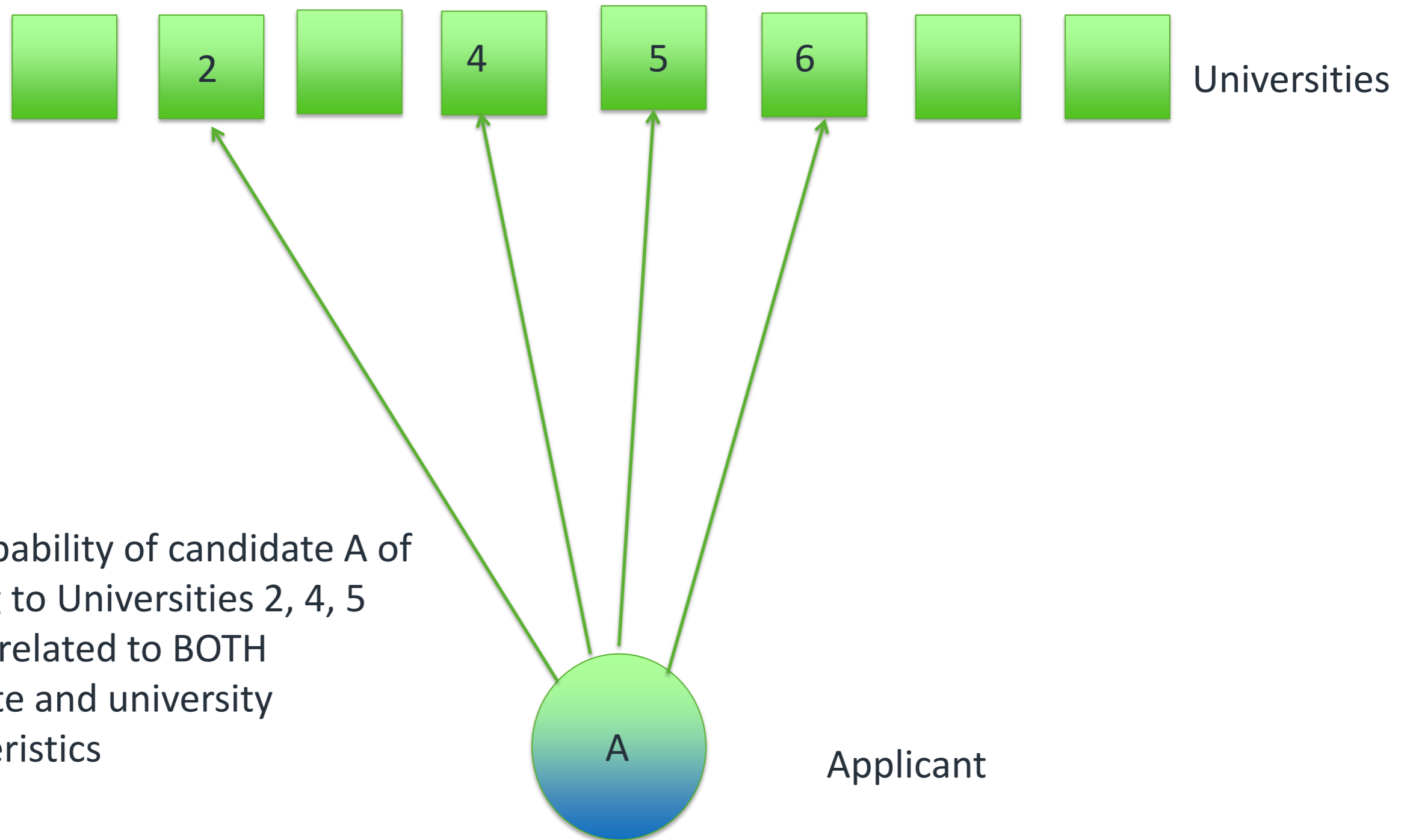

Universities

Applicant

Conceptualising selection as a complex system:

Universities

The probability of candidate A of applying to Universities 2, 4, 5 and 6 is related to BOTH candidate and university characteristics

Applicant
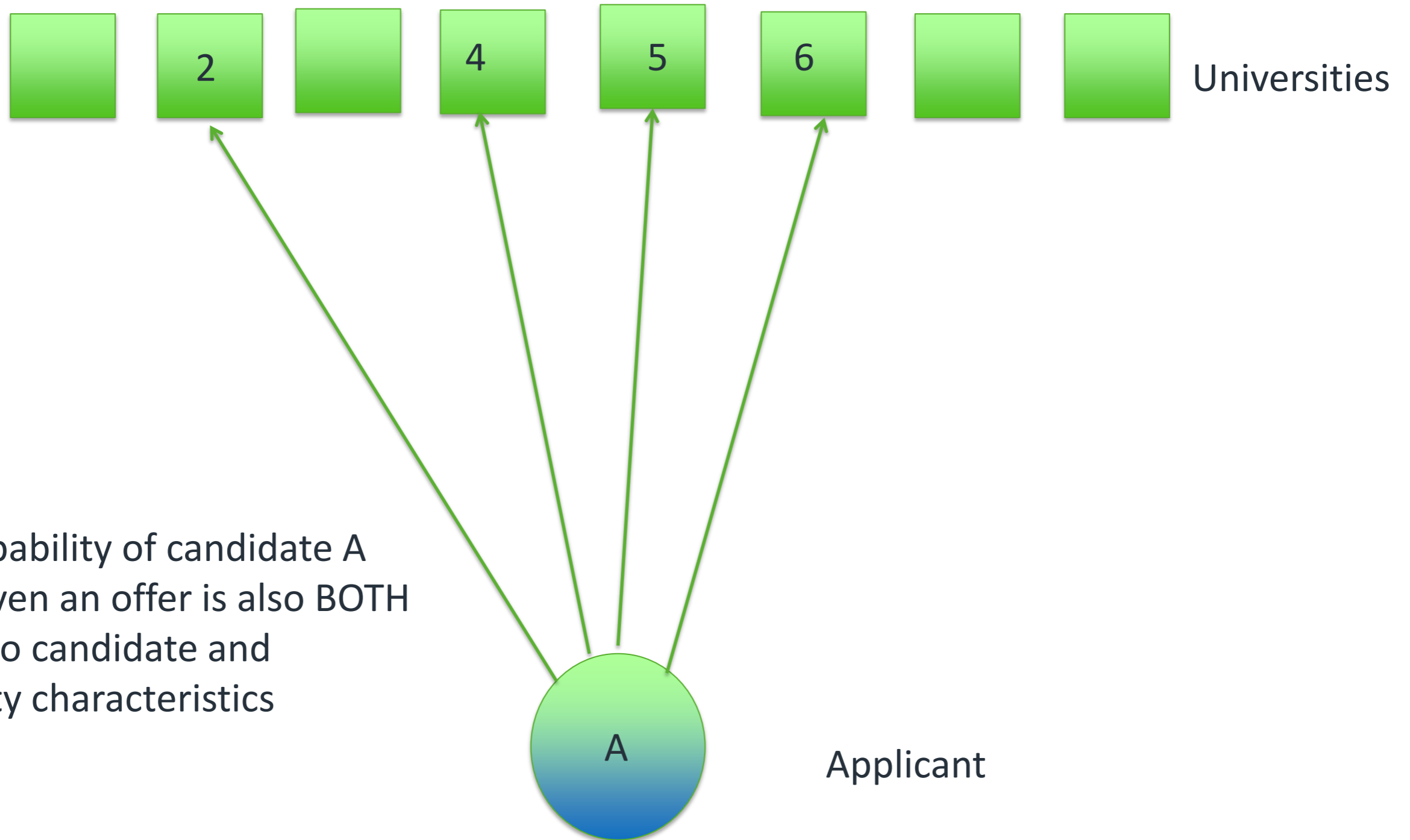
Conceptualising selection as a complex system:

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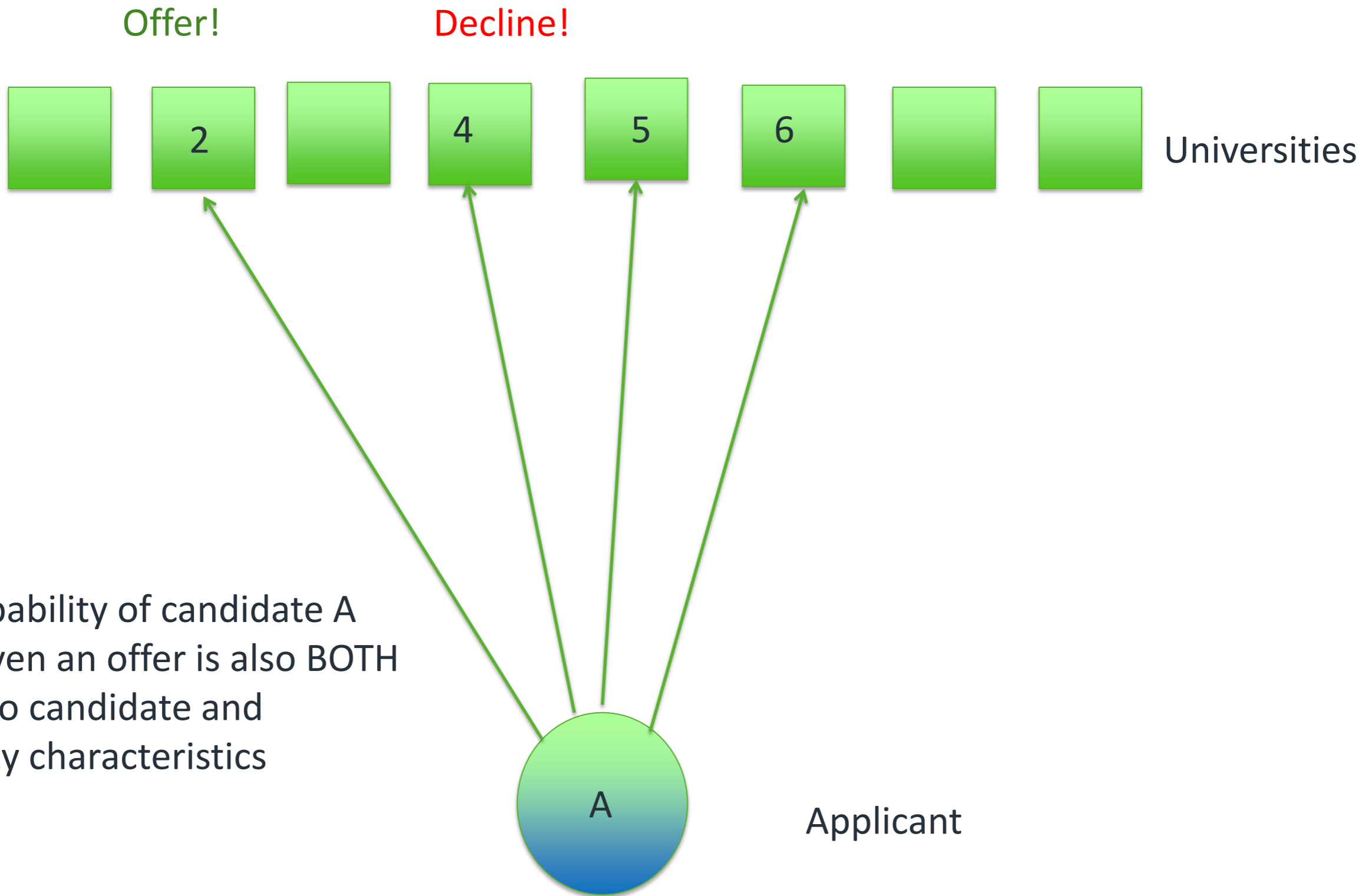
Applicant

Conceptualising selection as a complex system:

Offer!

Universities

The probability of candidate A being given an offer is also BOTH related to candidate and university characteristics

A

Applicant

Conceptualising selection as a complex system:

Offer!

Decline!

| | 2 | | 4 | 5 | 6 | | | Universities

The probability of candidate A being given an offer is also BOTH related to candidate and university characteristics

A

Applicant

Conceptualising selection as a complex system:

Offer! Decline! Offer!

2   4   5   6   Universities

The probability of candidate A being given an offer is also BOTH related to candidate and university characteristics

A   Applicant

Conceptualising selection as a complex system:

Offer!   Decline! Offer!   Decline!
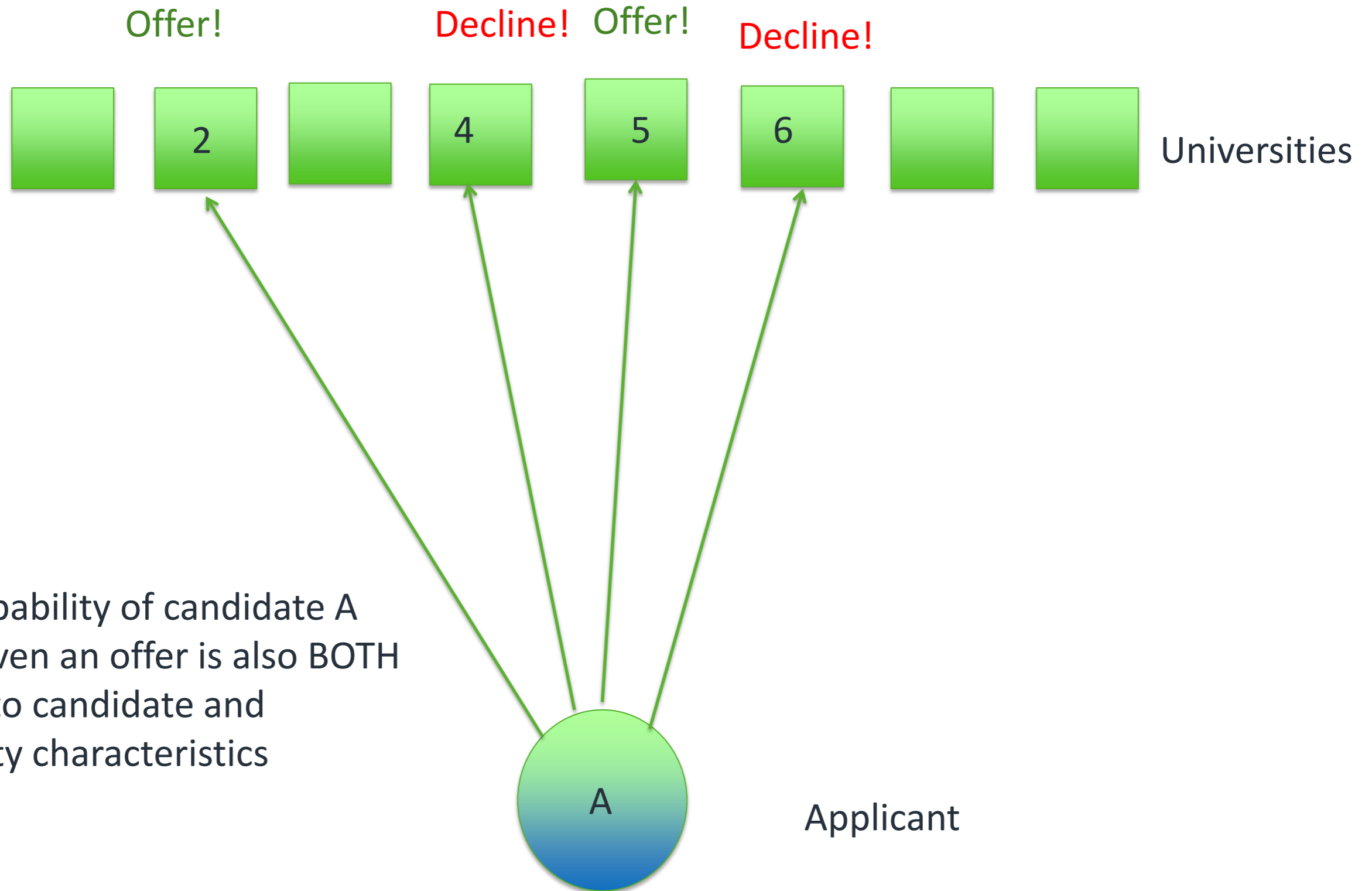
2   4   5   6   Universities

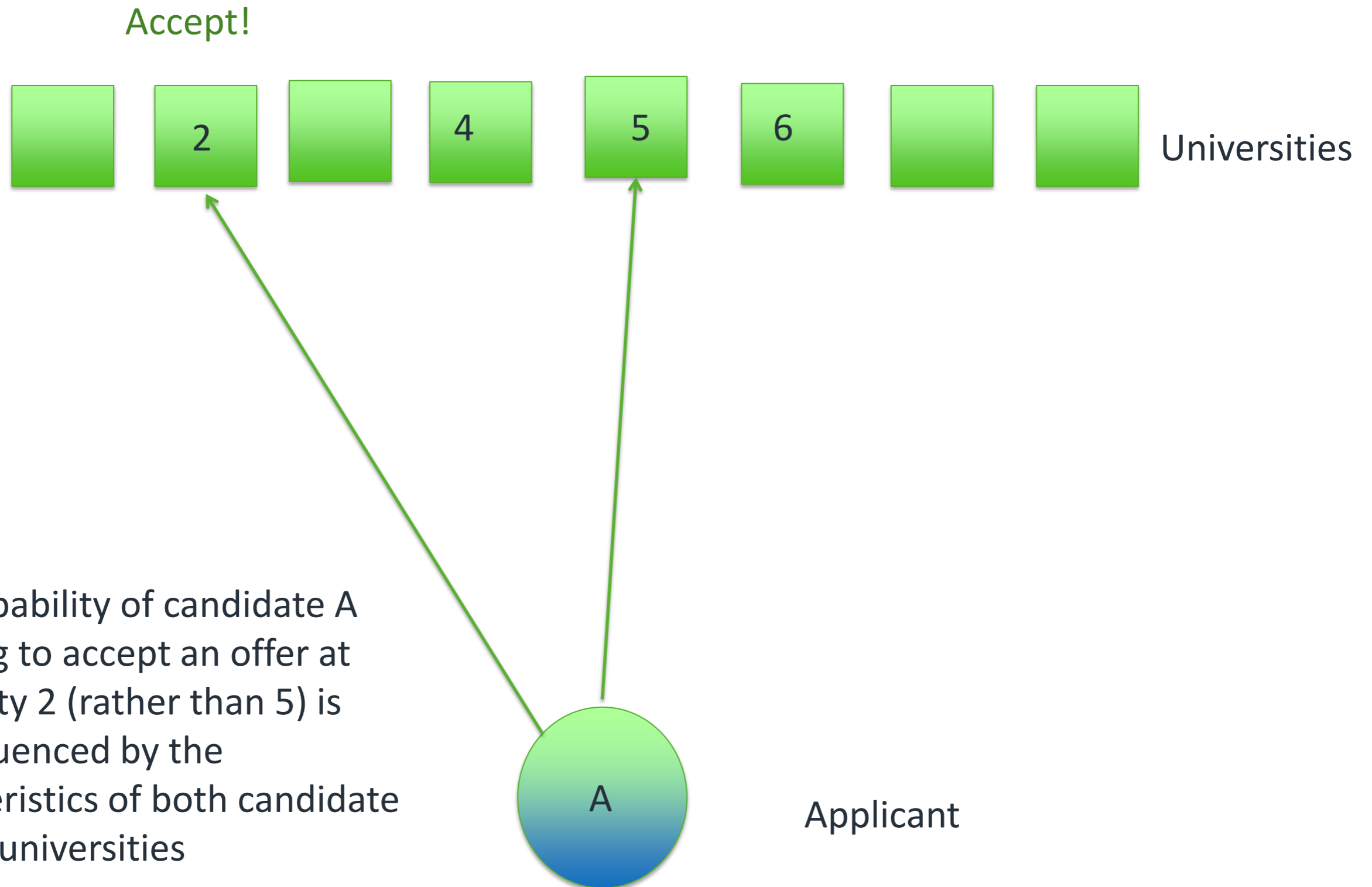The probability of candidate A being given an offer is also BOTH related to candidate and university characteristics

A   Applicant

Conceptualising selection as a complex system:
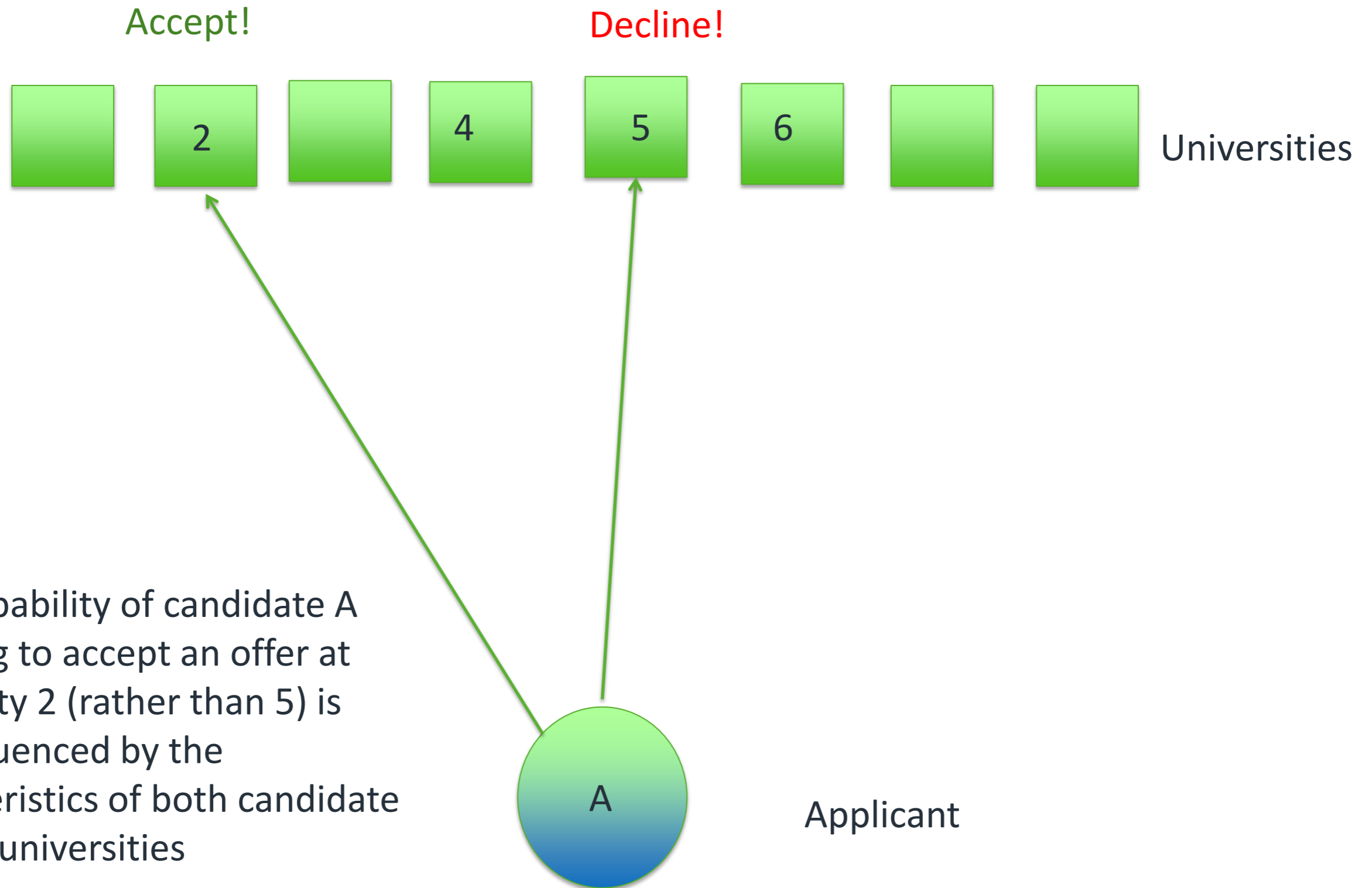
Accept!

| | 2 | | 4 | 5 | 6 | | | Universities |

A   Applicant

The probability of candidate A choosing to accept an offer at University 2 (rather than 5) is also influenced by the characteristics of both candidate and the universities

Conceptualising selection as a complex system:

Accept! Decline!

2   4   5   6   Universities

The probability of candidate A choosing to accept an offer at University 2 (rather than 5) is also influenced by the characteristics of both candidate and the universities

A   Applicant

Conceptualising selection as a complex system:

Universities

We have a hierarchical system whereby applicants are below the level of universities BUT not nested

The DREAMS network:
Toward 'Evidence Based Selection'

- 'Eminence based medicine' vs 'Evidence based medicine'

- cf Clinical research in the 1970's (regression coefficients, ORs)

- 'Number Needed to Treat/Harm', 'Positive Predictive Values' etc as well as economic frameworks for evaluating medical treatments

- Numerical simulation means we can now create similar indices in selection- 'Number Needed to Reject'
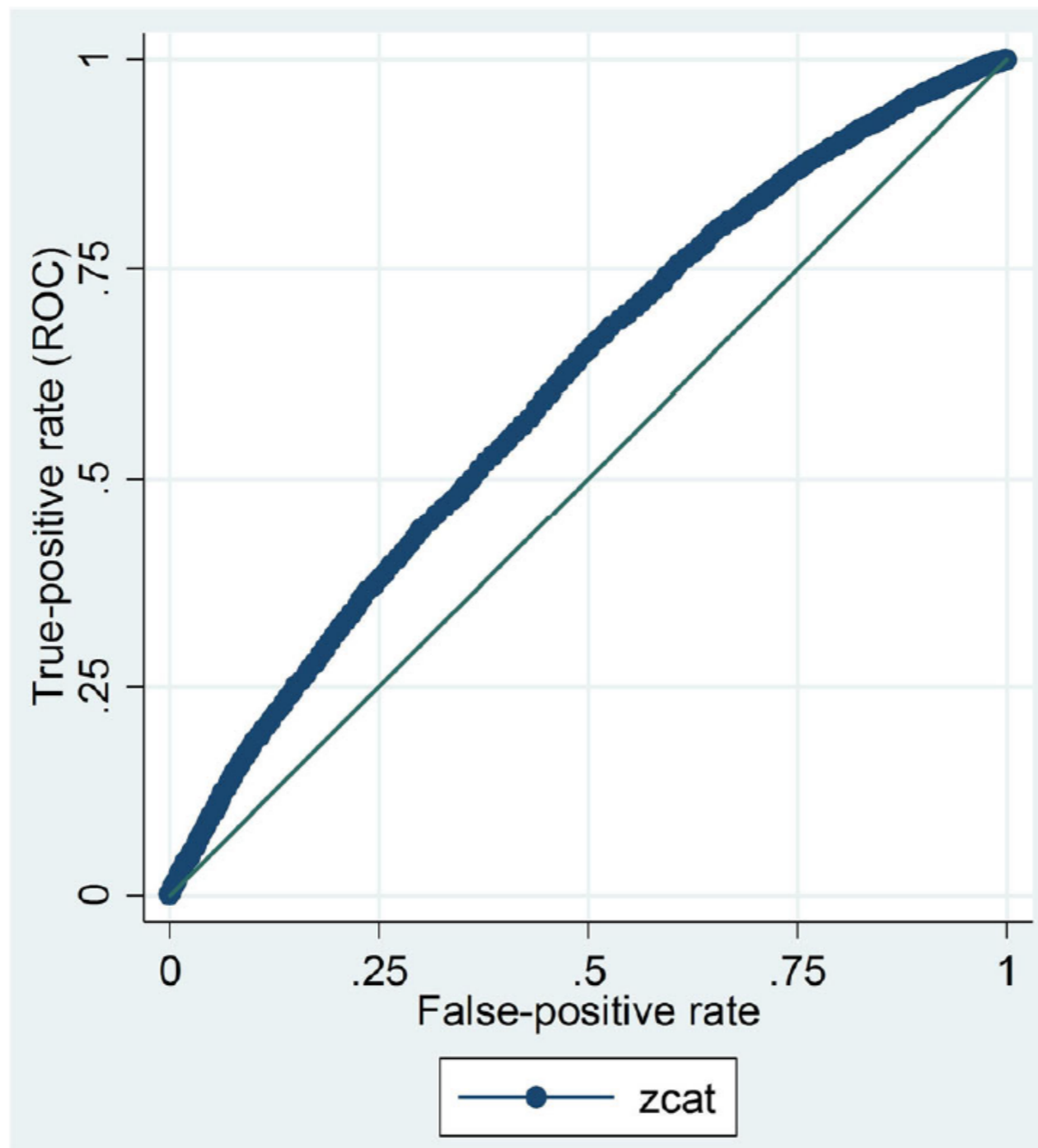
Fig. 8 Receiver operator characteristic curve for the use of the total UKCAT as a tool to screen out medical applicants who are likely to fail at least 1 year of medical school at first attempt; in this case, missing outcomes were singly imputed

Screening result	Fail at least one exam at first sitting		
Screen positive (low threshold: z≤-1)	No	Yes	Total
No	14,198	7,808	22,006
Yes	1,152	1,465	2,617
Total	15,350	9,273	24,623
Screen positive (medium threshold: z≤0)	No	Yes	Total
No	9,560	4,370	13,930
Yes	5,790	4,903	10,693
Total	15,350	9,273	24,623
Screen positive (high threshold: z≤1)	No	Yes	Total
No	2,844	939	3,783
Yes	12,506	8,334	20,840
Total	15,350	9,273	24,623

Table 6. Two-by-two contingency tables for the UKCAT as a hypothetical screening test for failing to pass, at first sitting, at least one year at medical school. Three thresholds are set for the standardised UKCAT score: low (z≤-1); medium (z≤ 0); and high (z≤1). Missing values for outcomes (including for unsuccessful applicants) were singly imputed, conditioned on relevant observed variables.

The DREAMS network: Key questions to think about for the next 48 hours…

- What do we mean by 'Widening Access'/'Widening Participation'?
- How do we identify/engage 'WP' candidates?
- What are the potenial benefits of widening access?
- What are the risks/challenges of widening access?
- How might benefits and risks translate into economic impacts?
- How might we model widening access processes?
- Are there datasets where these models could be tested?
- Potential papers
- Potential funders/proposals

Widening access to the professions: potential benefits and challenges

Dr Paul Tiffin

NIHR Career Development Fellow, Reader in Psychometric Epidemiology and Honorary Consultant Psychiatrist, University of York

Widening access

- The philosophy of equality

- What do we mean by 'widening access'?

- Is WP legally defensible? The US experience

- What are the potential benefits?

- What are the potential risks of widening access?

- What are the challenges to widening access?

What is 'equality'/'equal opportunity'?

- '*Equality*' a contested concept: "*people who praise it or disparage it disagree about what they are praising or disparaging*" (Dworkin 2000, p. 2)
- So is *equality* a societal situation where:
- Everyone of equal *ability* has the same probability of success (*proportional* equality/*Libertarianism*)
- Everyone of equal *potential* has the same probability of success (*moral* equality)
- The demographics of the 'successful' sub-population is not different from the that of the wider population (*moral* equality)
- The people most likely to contribute most to society, if successful, have the highest probability of success (the '*capabilities approach*'/*utilitarianism*)
- These are not mutually incompatible

Widening access? UK MSC statements….

- 'With such demanding entry criteria, it is important that candidates are selected in the *fairest* possible way. Concerns have been raised that some people, despite having the necessary *aptitude* to study medicine, are being excluded from this career and that this is to the *detriment* of the future medical profession. Such concerns have been raised in Alan Milburn's reports on 'Fair Access to professional careers' ' MSC

Widening access? UK MSC statements….

- 'As the demographics in the UK are changing and the aspirations for our health service increase, we need to ensure that medical schools are selecting students based on who will be *the most effective doctors*.' MSC

Widening access? US position

- 'Caucasian doctors continue to be overrepresented and Hispanic and African American doctors underrepresented in American medicine, but the issue of affirmative action in medical education continues to be litigated.' Blake, 2012.

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Table 1. Representation of racial groups in the general and medical populations

	General population (2011) [2]	Physician workforce (2011) [3]	Medical student enrollment (2011) [4]
% Caucasian	63	70	60
% African American	13	4.7	7
% Latino/Hispanic	17	6.3	8
% Asian	5	16	22

Widening access? US position

- **Fisher V. University of Texas at Austin (2012-2013)**
- Any Texas student in the top 10% high school's graduating class automatically admitted (85% of admissions)
- Remaining 15% a "plus" factor to be considered along personal/academic achievements
- 2 Caucasian students denied admission under both pathways filed suit
- 'Discrimination based on race' violation of their 14th amendment right to 'equal protection'
- "*The University's admissions policy flexibly considers race only as a 'factor of a factor of a factor of a factor' ... and is subject to periodic review to ensure that the consideration of race remains necessary and proper to achieve the university's educational objectives ...*" Judge Ginsburg
- Essentially affirmative action/widening participation must be consistent with *Grutter v. Bollinger, i.e. it must be used* in "obtaining the educational benefits that flow from a diverse student body."
- **Fisher V. University of Texas at Austin (2016) 'Fisher II'**
- Justice Scalia raised the 'mismatching' theory and questioned whether black students admitted to top-tier schools suffer because the courses are 'too difficult'.

Widening access? US position

- *'…there are those who contend that it does not benefit African Americans to get them into the University of Texas, where they do not do well, as opposed to having them go to a less-advanced school, a slower-track school where they do well. one of the briefs pointed out that most of the black scientists in this country don't come from schools like the University of Texas. They come from lesser schools where they do not feel that they're being pushed ahead in classes that are too fast for them.'* Justice Scalia, 2016

Widening access- What are the benefits?

- A fairer, more equitable society is a healthier society
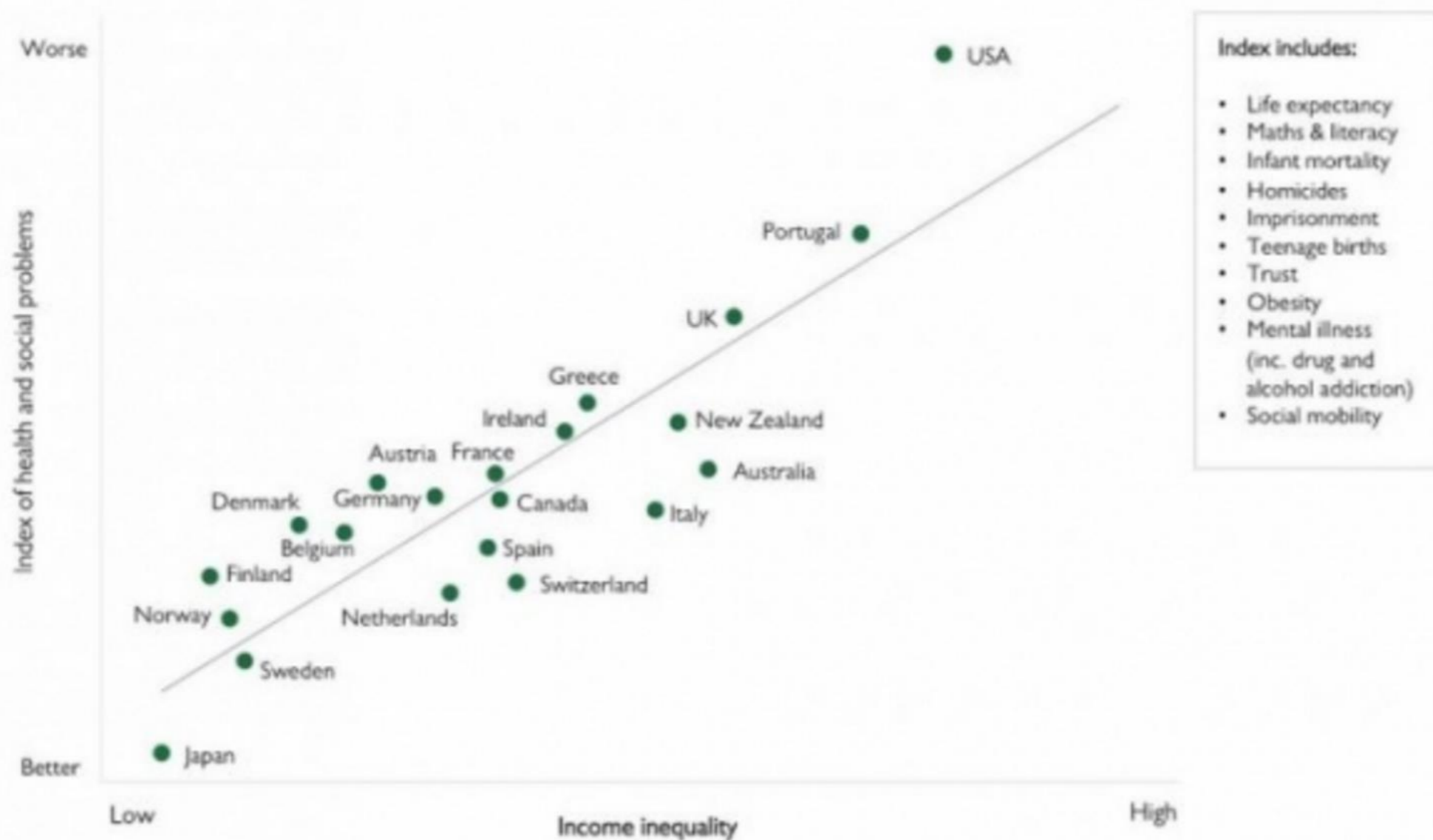- https://www.equalitytrust.org.uk/why-more-equality

Widening access- What are the benefits?

(Graph source: the Equality Trust Website)

Health and social problems are worse in more unequal countries

Source: Wilkinson & Pickett, The Spirit Level (2009)

Widening access- What are the benefits?

- WP groups may be more likely to serve under-served populations after graduation? (Lakhan, 2003; Komaromy et al. 1996)

- Diversity may improve the medical school environment and help prepare graduates for serving minority populations (Saha et al. 2008)

Widening access- what are the risks?

- Do WP entrants (i.e. admitted with lower GPA/A levels) perform less well than 'standard' entrants?
- ?No- identical 1st time pass rates during the clinical years of the programme (Garlick and Brown, 2008)
- ?Yes- slightly lower scores in final (Mahesan et al. 2011)
- BUT- does undergraduate performance translate into postgraduate or even realworld performance?
- Follow-up of *affirmative action* law students (Sander, 2004)

Widening access- what are the risks?

- Are WP entrants less likely to complete training?

- 85% vs 95% completion (Curtis et al. 2015); 90% vs 97%, Garlick and Brown, 2008)

- Are WP entrants at increased risk of professionalism issues? (Yates & James, 2010; Paton et al. In Prep.)

- Are WP entrants at more risk of mental health issues? (Paton et al. In Prep.)

Widening access- what are challenges?

- How do we identify/define WP candidates?
- How do we engage WP candidates?
- How do we 'level' the playing field for WP candidates?
- How do we (legally) defend such approaches?
- Should we target support for certain WP groups?

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WUN WORLDWIDE UNIVERSITIES NETWORK **DAY 2**

Dr Paul Tiffin

NIHR Career Development Fellow, Reader in Psychometric Epidemiology and Honorary Consultant Psychiatrist, University of York

Programme for DREAMS workshop 1: Widening Access to the Professions

13th-14th February 2017, University of York

Day 2: Tuesday 14th February

The Boardroom, Seebohm Rowntree Building, Campus West

09.30: Tea and Coffee available

10.00: **Situational Judgment Tests and widening access to the professions** Fiona Patterson, Work Psychology Group, University of Cambridge, City University

10.45: **Workforce selection- economic perspectives** Martin Chalkley & Idaira Rodríguez Santana, University of York

11.30: Break

11.45: **Use of contextual data in selection: secondary school level performance and undergraduate outcomes in UK medical students** Lazaro M. Mwandigha, University of York

12.05: **Fitness to Practice events in undergraduate medical students and socioeconomic background: Early findings from the UK Medical Education Database** Lewis Paton, University of York

12.25: Lunch

13.15: Reconvene: discuss next steps, identify potential workstreams, outputs and collaborations (small groups)

14.30 Break

16.00: Close