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**Play Your Genetic Cards Right: an interactive game to illustrate the causes of mental health conditions and how they are diagnosed**

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Need to include NCMH and Cardiff University logos and relevant hyperlinks/URLs

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**Factors influencing mental (ill) health**

Whether you develop a mental health condition or not is dependent upon the combination of, and interactions between, three key factors (ref):

1. The DNA you inherit (your ‘genetics’) - so-called ‘developmental’ conditions, which present in childhood (e.g. **autism** or **Attention Deficit Hyperactivity Disorder (ADHD)**)are particularly strongly influenced by genetic factors, although all mental health conditions are influenced by genetics to some extent (ref)
2. External factors you are exposed to throughout your life (your ‘environment’) – the risk of developing ‘affective’ conditions such as **anxiety disorders** and **depression** is substantially increased by environmental factors such as trauma, abuse and stress (ref)
3. Chance or ‘stochastic processes’ (even individuals with identical genetics and very similar environments can have very different mental health risks)

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**A game of chance**

Individuals have **no say** in the DNA they inherit, have **little choice** in the early-life environments they experience, and **cannot influence** chance processes

Although not always possible, individuals can reduce their chances of being affected by mental health symptoms in several ways:

1. Through a healthy lifestyle (e.g. a good diet, plenty of exercise, interacting with a support network including family and friends)
2. Through consulting a medical professional when mental health symptoms appear – generally, the earlier mental health issues are identified, the more effectively they can be treated
3. Through adhering to treatment programmes – these may involve taking medication regularly, or talking therapies such as Cognitive Behavioural Therapy (CBT)

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**The game**

There are four steps in this game:

1. First, you choose a character whose mental health risk you will determine. Factors such as a person’s gender and age can influence the type of mental health conditions they are likely to develop
2. Next, you determine the individual’s ‘genetic risk’ by making an educated guess as to whether successive playing cards are higher or lower than the preceding one – if you guess correctly, you draw a ‘Good genetics card’ and if you guess wrongly, you draw a ‘Bad genetics card’. The more effect a genetic factor has on mental health risk, the more points you gain (or lose!)
3. Then, you determine the individual’s ‘environmental risk’ by guessing whether successive playing cards are higher or lower than the preceding one – this time, if you guess correctly, you draw a ‘Good environment card’ and if you guess wrongly, you draw a ‘Bad environment card’. The more effect an environmental factor has on mental health risk, the more points you gain (or lose!)
4. Finally, you combine the overall genetics and environment risk scores to get an overall risk score for your character. You can then compare your individual’s risk score to that of other individuals to assess their likelihood of being diagnosed with a mental health condition.

Note that you have no control over which cards are drawn (reflecting your individual’s predetermined genetics and early-life environment), but you can reduce the individual’s chances of a mental health condition by making sensible decisions (reflecting the life choices potentially available to an individual).

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**Choose your character!**

Need diverse selection to choose from (gender may influence subsequent choice of available cards)

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**Calculating ‘genetic risk’**

Do you think the next card will be higher or lower than the one shown? Note that Aces score higher than Kings! Is it possible to avoid two equal value cards being drawn successively?

If guessed correctly, flash up ‘CORRECT! DRAW A GOOD GENETICS CARD’ – then draw a ‘Good genetics’ card (but don’t show) and place on ‘Genetics cards’ pile

If guessed incorrectly, flash up ‘INCORRECT! DRAW A BAD GENETICS CARD’ – then draw a ‘Bad genetics’ card (but don’t show) and place on ‘Genetics cards’ pile

Repeat 5x

Then show all ‘Genetics cards’ sequentially and add up overall score – when first score of ‘0’ appears show following text: ‘Most genetic changes have no, or very little effect, on mental health risk’. For cards with non-zero scores, I’ll include a couple of lines of text and reference(s) later with URLs/hyperlinks

**20 ‘Good Genetics’ cards**

*APOE2* (reduction in Alzheimer’s Disease risk) +5

G allele at rs4388808 within *CYP2C19* (reduction in Alzheimer’s Disease pathology) +2

G allele at rs72824905 in *PLCG2* (reduction in Alzheimer’s Disease risk) +3

22q11.2 duplication (reduction in schizophrenia risk) +4

XX genotype (reduction in developmental disorder risk) +5 (available for female characters only)

XY genotype (reduction in major depression risk) +2 (available for male characters only)

15 cards with: Neutral +0

**20 ‘Bad Genetics’ cards**

*APOE4* (increase in Alzheimer’s Disease risk) -3

R47H mutation in *TREM2* (increase in Alzheimer’s Disease risk) -5

T allele at rs1344706 in *ZNF804A* (increase in psychosis risk) -1

XX genotype (increase in major depression risk) -2 (available for female characters only)

XY genotype (increase in developmental disorder risk) -2 (available for male characters only)

22q11.2 deletion (increase in developmental disorder and psychosis risk) -4

A allele at rs9677504 in *SPAG16* (increase in ADHD risk) -1

Exonic deletion in *NRXN1* (increase in schizophrenia risk) -5

T allele at rs10994336 in *ANK3* (increase in bipolar disorder risk) -1

A allele at rs1432639 in *NEGR1* (increase in major depression risk) -1

Single X chromosome (increase in ADHD risk) -2

10 cards with: Neutral -0

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**Calculating ‘environmental risk’**

Do you think the next card will be higher or lower than the one shown? Note that Aces score higher than Kings!

If guessed correctly, flash up ‘CORRECT! DRAW A GOOD ENVIRONMENT CARD’ – then draw a ‘Good environment’ card (but don’t show) and place on ‘Environment cards’ pile

If guessed incorrectly, flash up ‘INCORRECT! DRAW A BAD ENVIRONMENT CARD’ – then draw a ‘Bad environment’ card (but don’t show) and place on ‘Enviornment cards’ pile

Repeat 5x

Then show all ‘Environment cards’ sequentially and add up overall score – when first score of ‘0’ appears show following text: ‘Most things you experience in your life have no, or very little effect, on mental health risk’. For cards with non-zero scores, I’ll include a couple of lines of text and reference(s) later with URLs/hyperlinks

**20 ‘Good Environment’ cards**

Rural, summer birth +1

Healthy pregnancy and birth +2

Stable family +3

Large social circle +2

Regular employment with reasonable salary +2

Good diet +1

Regular exercise +2

Involvement in hobbies and cognitively-demanding past-times +1

12 cards with: Neutral +0

**20 ‘Bad Environment’ cards**

Urban, winter birth -1

Maternal infection -2

Severe maternal stress -3

Obstetric complications -3

Family discord -2

Little social support -3

Poverty -2

Poor diet -1

Lack of exercise -2

Bullying or victimisation -2

Severe trauma e.g. physical or sexual abuse -5

Drug or alcohol abuse -3

8 cards with: Neutral -0

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**Your character’s overall mental health risk**

Combining your character’s genetic and environmental risk scores gives an overall risk score of XXX.

To see whether this risk score should be regarded as ‘high’ or ‘low’ we need to compare to scores from many other individuals within the population

Show individual’s risk score relative to previously collected data/data from other individuals playing simultaneously

Is this individual at high, medium or low risk of being affected by, and ultimately diagnosed with, a mental health condition? Where should we draw the line, and why?

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**Drawing the line: mentally ill or healthy?**

Everybody displays features associated with mental health conditions to a greater or lesser extent (refs)

How and why do we diagnose certain individuals and not others, and what are the benefits and problems with this classification system?

Mental health conditions are often diagnosed by General Practitioners or by psychiatrists on the basis of behavioural symptoms using criteria defined in manuals such as International Classification of Diseases (ICD)(ref) or Diagnostic and Statistical Manual of Mental Disorders (DSM)(ref)

Whether an individual is diagnosed with a mental health condition, and the specific diagnosis, depends upon several factors:

1. The nature, combination, and severity, of their symptoms
2. The age at which these symptoms appeared
3. The extent to which these symptoms impair the individual’s normal life
4. Whether they have any other medical conditions

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**Diagnosing mental health conditions: useful or not?**

How might a patient having a diagnosis help or hinder: a) that patient, b) medical professionals treating them, or c) scientists trying to understand their condition?

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Possible benefits of diagnoses

* Allows for research into underlying causes (assume individuals with a common diagnosis have a common underlying pathology)
* Allows initiation of medical treatment and may allow access to social and community services
* Can help medical professionals to identify and treat medical symptoms that are associated with the disorder
* Diagnostic label can provide reassurance for patients; patients can self-inform and can contact others with a similar diagnosis
* When patient transfers between doctors, diagnostic label may help new doctor identify likely issues and prescribe appropriate treatments

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Challenges with diagnosis

* Unlike for diseases like cancer, there are no biological ‘biomarkers’ which can tell you whether someone has a mental health condition or not; diagnosis can only be made on the basis of an individual’s behavioural symptoms which are: difficult for medical professionals to observe over long periods, can vary with time, and may be misreported by individuals
* Medical professionals may not agree with what diagnoses to make; misdiagnosis of bipolar disorder as depression and treatment with antidepressants may worsen symptoms (ref)
* Two individuals with the same diagnosis can behave very differently and respond very differently to therapies – it is probably not the case that individuals with the same diagnosis share completely overlapping cause(s). In other contexts such as getting your car serviced, the term ‘diagnosis’ is associated with a fault that can be identified and fixed – this is not the case in medicine.
* It is difficult to get the diagnostic balance correct: under-diagnosis of mental health conditions results in affected individuals not receiving the treatment they require, whilst over-diagnosis results in pathologising normal behaviour and individuals receiving potentially harmful treatments they don’t require
* In some cases, having a diagnosis can cause the patient to adopt a ‘sick role’ which may actually impair recovery

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Further reading and contact details (TBC)