Economic And Social Deprivation Predicts Impulsive Choice In Young Children.

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Research Article

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Abstract

Impulsivity is an individual difference in decision-making that is a risk factor for a number of health concerns including addiction and obesity. Although impulsivity has a large heritable component it, the health concerns associated with impulsivity are not uniformly distributed across society. For example, people from poorer backgrounds are more likely to be overweight, and be dependent on tobacco or alcohol. This suggests that the environmental component of impulsivity might be related to economic circumstances and availability of resources. This paper provides evidence that children aged 4 to 12 from the most deprived areas show greater impulsivity in the form of delay discounting than do children from the least deprived areas. The data are discussed with reference to scarcity based models of decision-making and to public health inequalities.

Introduction

Why are some people more impulsive than others? The origins of most individual differences are little more than academic curiosity but impulsivity has a wide range of consequences for the individual and for society generally. Impulsivity is an individual difference that is defined by its behavioural consequences. For example, the overconsumption of food or alcohol is considered impulsive, as is gambling or shopping using expensive forms of debt such as credit cards. Similarly, unhealthy and potentially life-limiting behaviours such as tobacco use, or drug abuse, are associated with impulsivity. On the other hand, life extending behaviours such as exercise, dietary restraint and abstinence from tobacco and alcohol are regarded as self-controlled, as is saving money for the future and living within one's financial means. The relationship between impulsivity and mental health is not confined to addictive behaviours because impulsivity features as a diagnostic criterion in many seemingly unrelated disorders listed the Diagnostic and Statistical Manual of the American Psychological Association (DSM, and APA respectively) including Bipolar Disorder, Attention Deficit Hyperactivity Disorder (ADHD), and Antisocial Personality Disorder. The question of why some people are prone to making impulsive decisions is therefore of interest to the public health. This paper reports the results of a study that tested the hypothesis that environmental factors, and relative deprivation, is associated with impulsive choice in children.

Although the word impulsivity is used to describe a great many phenomena, it is typically characterised as a general time preference for smaller-sooner rewards instead of larger-later rewards ¹¹. Impulsive choice appears in early childhood. For example, in Mischel's studies of delay of gratification ² – the well-known marshmallow task – children are given a choice between a single marshmallow or, if they can resist temptation, two marshmallows sometime later. Video-recordings of children engaged in this task often show evidence that self-control is effortful for some children but not others. Observations of this sort led Mischel to hypothesise opponent hot (impulsive) and cold (controlled) processes ³ that is reminiscent of other dual-process models of decision-making ⁴.

A conceptually similar approach to the study of impulsivity the measurement of how much people discount delayed monetary rewards ⁵. In a typical study, participants are given a series of choices between an immediate amount of money and a smaller amount of money to be received at some point in the future (e.g would you prefer £10 now, or £20 in 12 months?). The delay period is titrated to determine the point at which the participant is indifferent between the immediate and the delayed outcome. This indifference point reveals the subjective discounted value of the value of the delayed reward. For example, if a decision maker was indifferent between the delayed reward of £25 in 12 months, and £10 immediately, we would say that the subjective value of the delayed £25 was discounted by £15. By titrating the delays and values of the outcomes it is possible to use the formula (1) to derive a single discount rate parameter (k) ^{6,7} that numerically describes an individual's relative preference for smaller-sooner or larger later rewards.

$$v = \frac{V}{1 + kD}$$

(1)

Both delay of gratification and delay discounting are closely associated with impulsive behaviours to the extent that discount rates can be considered a measure of the individual difference in impulsivity, and as a risk factor for health problems. For example, daily smokers have higher discount rates than either social or non-smokers ⁸, problem gamblers have higher discount rates than non-gamblers ⁹, people who are dependent on opiates have higher discount rates than people who don't use opiates ¹⁰. Heavy drinkers discount the value of delayed rewards more steeply than light drinkers ¹¹, and people with larger Body Mass Indexes (BMI) have higher discount rates than people with healthy BMIs ¹². Discounting may even be a risk factor in the transition from recreational to problem gaming ¹³. Discounting is also associated with symptoms of Conduct Disorder and ADHD ¹⁴. Follow-up studies of the children aged originally studied by Mischel between 1968 and 1974 suggested that delay of gratification when aged 4 years was positively associated with higher Scholastic Aptitude Test scores when aged 15 ¹⁵. Some evidence also seems to indicate that delay of gratification in children is also associated with divorce, higher BMIs, and cocaine use in adulthood ¹⁶.

Evidence that impulsive choice appears very early in childhood and remains stable throughout life (Green et al., 1994) suggests that there may be a large heritable component. Indeed, estimates of heritability suggest that around 50% of the variance in time preferences are attributable to genetic factors ^{14,19–22}. This leaves around 50% of environmental factors to be identified. Although it is already recognised that there are health inequalities across the UK relating to impulsive behaviour ^{23–25}, there is emerging evidence that the underlying impulsivity itself is not uniformly distributed across society and that it may be related to differences in economic circumstances. For example, Anokhin et al. ¹⁴ noted that discount rates in 14 year olds were associated with socio-economic status based on parental occupation. More recently, Tunney and James ²⁶ reported that social-economic classification based on occupation predicted time-preferences in older adults. Why might a person's occupation predict how impulsive they are? Perhaps occupation is a

proximal variable associated with a more fundamental driver of behavioural choice. One possibility is that a scarcity of resources or economic uncertainty leads the decision-maker to prefer immediate rewards when they become available, rather than waiting for larger and perhaps equally unpredictable rewards. In this respect, impulsive choice does not imply irrational choice. To test this hypothesis, Tunney and James²⁶ compared time preferences in older adults from areas in England that ranged from the most deprived to the most affluent using the English Index of Multiple Deprivation (IMD). This is the official measure of relative deprivation in England and ranks each small area in terms of income, employment, education, health, crime, housing, and environment. Tunney and James observed that people in the most deprived areas were more likely to prefer smaller sooner rewards than people from the least deprived areas, and people in technical or routine occupations tended to prefer smaller sooner rewards than people in professional or intermediate occupations. Of course, the direction of a causal connection between working in a poorly paid profession and living in a deprived area, and impulsive choice cannot be established in older adults. It could be that impulsive people drift into poorly paid positions and towns based on the choices that they make. On the other hand, if deprivation is a causal environmental influence on impulsivity then we should see that economic and social deprivation predicts impulsivity in children. The study that follows seeks to test the hypothesis that that relative deprivation is causally related to impulsivity by measuring delay discounting in children aged between 4 and 12 years, from a range of backgrounds from the relatively deprived to the relatively affluent.

Method

This study was conducted as part of the University of Nottingham Summer Scientist week in 2018. This is an annual event in which children from the Nottingham community take part in a wide range of psychological studies during the school holiday period.

Participants

Informed consent to take part in this research was obtained from the parents or legal guardians of each participant. One-hundred and fifty-six children took part in this study. Their average age was 8.395 years (sd = 2.067). The youngest was 4.15 years old, and the oldest was 12.13 years old. Sixty-nine were female and 87 were male. The parents or legal guardians completed demographic information including post-codes that were used to derive the Index of Multiple Deprivation for their address, and also about ethnicity and the languages spoken in the home. The majority (143) indicated that English was the only language spoken at home, 2 Arabic and English, 2 Arabic, 3 English and Urdu, 1 French and English, 1 Japanese and German, 2 Mandarin, 2 did not respond to this question.

Ethics statement

The study was approved by the University of Nottingham School of Psychology Ethics committee and performed in accordance with the World Medical Association Declaration of Helsinki for ethical principles for medical research involving human subjects²⁷ and the British Psychological Society’s Code of Ethics and Conduct²⁸.

Procedure

There were five-time preference questions from which the parameter k was derived. On each trial the participants were given a choice between £10 after an interval or an immediate outcome that titrated upwards from £0.50 to £9.50 in 50p increments. These choices were displayed on an smaller-sooner card (Figure 1A) and a larger later card (Figure 1B) that showed the value of the choice in coins. The intervals were “in one-week” (coded as 7-days), “in two weeks” (14-days), “when school starts (30-days)”, “£10 at Christmas” (180-days), or “£10 next summer” (365-days). For example, the child would first be asked “would you prefer £10 in one-week, or £0.50 now?” followed by “would you prefer £10 in one-week, or £1.00 now?”. The larger later card was titrated from the largest to the smallest value. Each trial would stop when the participant switched their preference from the larger later outcome to the smaller sooner outcome.

INSERT FIGURE 1A&B ABOUT HERE

The participants completed the British Picture Vocabulary Scale III (Alessi & Petry, 2003). The BPVS-3 is used to test receptive vocabulary in children ages from 3 to 18 years that provides an age adjusted standard score with a mean of 100. They also completed the Autism Quotient Children's Version (AQ-Child: Auyeung et al., 2008). The minimum AQ-Child score (0) indicates no autistic traits; the maximum score (150) suggests full endorsement on all autistic items. Finally, participants completed the Strengths and Weaknesses of Attention Deficit Hyperactivity Disorder Symptoms and Normal Behaviour (SWAN: Swanson et al., 2012). This measure has two subscales for Inattention and Hyperactivity/ Impulsivity.

Data Availability

All data generated or analysed during this study are included in this published article and its supplementary information file (Supplementary Table S1).

Results

Figure 2 shows the average subjective discounted value for each delay period. A repeated measures ANOVA indicated a reliable main effect of delay ($F_{4, 516} = 32.822, MS_e = 1.592, p < .001, \eta_p^2 = .203$), and a reliable linear effect of delay ($F_{1, 129} = 67.756, MS_e = 2.970, p < .001, \eta_p^2 = .344$) indicating that the participants showed a robust discounting effect.

INSERT FIGURE 2 ABOUT HERE

The discount function (k) was derived from the subjective discounted value (v) defined as the preferred smaller sooner outcome (v) from the five intervals (D) using Mazur's (1987) hyperbolic discount function (1). Table 1 shows the average discount rates (k), BPVS scores, AQ scores, and SWAN scores for males and females. There were reliable differences between males and females in AQ and SWAN Scores, but not in discount rates or BPVS.

Table 1 Average discount rates (k), BPVS scores, AQ scores, and SWAN scores for males and females.

	Male			Female			<i>t</i>	<i>p</i>
	Mean	<i>n</i>	<i>sd</i>	Mean	<i>n</i>	<i>sd</i>		
Discount rate (<i>k</i>)	0.0038	83	0.0091	0.0025	67	0.0047	1.070	.286
BPVS-3								
Raw score	115.875	84	26.473	118.132	68	22.777	0.560	.576
Standardised score	105.134	82	13.707	102.250	67	11.828	1.364	.175
Equivalent year	8.536	82	2.885	8.537	67	2.245	.002	.999
AQ-Child								
	64.090	82	18.226	50.620	66	14.932	4.828	<.001
SWAN								
Inattention	-0.318	82	0.967	-0.829	66	0.808	3.436	<.001
Hyperactive/impulsive	-0.446	82	0.983	-0.819	66	0.973	2.310	<.022
Combined	-0.382	82	0.849	-0.825	66	0.785	3.261	<.001

INSERT TABLE 1 ABOUT HERE

The indices of multiple deprivation (IMD) were computed from the demographic information provided by parents using the publicly available resource provided by the Ministry of Housing, Communities and Local Government (<http://imd-by-postcode.opendatacommunities.org/>). This provides decile ranks from 1 = most deprived to 10 = least deprived. These were collapsed into quintiles (from 1 to 5). The average subjective discounted value for delay period for each IMD decile are shown in Table 2.

Table 2 Average subjective discounted value of £10 and discount rate (k) for each decile of multiple deprivation.

		Delay										Discount rate (<i>k</i>)	
IMD		7-days		14-days		30-days		180-days		365-days			
Quintile	n	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
1	19	8.778	1.457	8.187	2.337	7.559	2.963	7.464	2.257	6.786	3.173	0.0086	0.0041
2	19	9.289	0.384	8.868	0.704	8.789	1.018	7.289	2.893	6.917	3.469	0.0036	0.0013
3	31	8.661	1.881	8.283	2.156	8.500	1.402	7.481	2.199	6.552	2.971	0.0040	0.0012
4	33	9.109	1.517	8.906	0.902	8.742	1.040	7.968	2.105	8.000	2.017	0.0020	0.0007
5	53	9.260	0.394	8.706	1.001	8.570	1.355	8.410	1.466	8.240	1.523	0.0014	0.0003

INSERT Table 2 ABOUT HERE

Figure 3 shows the implied discount curves for each IMD quintile. A one-way ANOVA on discount rates with IMD quintile as a between-subject factor was significant ($F_{1,149} = 3.639$, $MS_e = < .001$ $p = .007$, $\eta_p^2 = .208$) indicating that there are reliable differences in impulsive choice made by children from different economic and social backgrounds. Planned contrasts showed that participants from the most deprived postcodes (IMD 1) show steeper discounting than participants in the least deprived postcodes (IMD 5, $p < .001$), and the each of the other postcodes (IMD 4, $p = .002$; IMD 3, $p = .33$; IMD 2, $p = .035$).

INSERT FIGURE 3 ABOUT HERE

Finally, to test the hypothesis that relative deprivation is a casual factor in the development of impulsivity the IMD quintiles, age, gender, AQ score, SWANN score, and standardised BPVS-3 scores were entered into a linear regression as predictors of the discount function. The model was significant ($F_{1,35} = 2.834$, $MS_e = < .001$ $p = .013$). Table 3 shows the regression coefficients. The Index of Multiple Deprivation was the only reliable predictor of discount rates.

Table 3 Regression coefficients predictor variables onto discount rates.

	Regression coefficients		
	<i>b</i>	<i>t</i>	<i>p</i>
Age	.083	0.972	.333
Sex	.008	0.083	.333
Standardised BPVS-3	.064	0.721	.472
AQ-Child	.139	1.488	.139
SWANN Combined	.120	1.353	.178
IMD Quintile	-.256	-2.986	.003

INSERT Table 3 ABOUT HERE

Discussion

Relative deprivation predicts delay discounting in children aged 4 to 12 years. The data confirm a the finding of a link between Indices of Multiple Deprivation and time preferences based on the English Longitudinal Study of Aging²⁶. This adds to the growing evidence that economic uncertainty is an environmental factor in an individual difference in decision-making that is associated with a range of individual and social issues.

Previous research has shown a relationship between impulsive behaviours such as gambling and both social status based on occupation and relative deprivation based on IMD³². For example, unhealthy diets resulting in high BMI and obesity in both children³³ and adults³⁴. Both time preferences⁸

and relative deprivation³⁵ are key risk factors in the severity of tobacco dependence. Similarly, excessive alcohol consumption is associated with relative deprivation³⁶ and delay discounting¹¹. One previous study explored if time preferences play a mediating role between relative deprivation and smoking and BMI³⁷. Time preference in that study was measured using a psychometric scale Consideration of Future Consequences Scale (CFCS) that is only partially related discount rates³⁸. Although this study did not find a clear relationship between time preferences and smoking that suggests that is not as a robust measure of time preferences as discount rates. Nonetheless there is considerable evidence that discount rates as a stable individual difference may be a risk factor in for impulsive behaviours and poor health. The evidence presented here indicates that at least some of the individual difference in the impulsivity may have relative deprivation has its cause.

The relationship between childhood obesity and relative deprivation is particularly interesting when impulsivity is viewed through the lens of ecological models of foraging. Obesity in nursery age children is associated with both relative deprivation and food insecurity³⁹. Evidence from the Bradford Cohort study shows that families living with relative deprivation tend to consume fewer fruit and vegetables and more high sugar drinks than more affluent families⁴⁰. The UK Millennium Cohort study of 7262 children aged 11, showed that two thirds of children living in the most deprived areas in England were overweight or obese, compared to one fifth in the least deprived areas⁴¹. The link between food insecurity and relative deprivation is thought to be food consumption cycling in which food, and particularly energy dense food, is overconsumed in periods of abundance in anticipation of periods of scarcity^{42,43}. This mechanism is synonymous if not identical to the Thrifty Phenotype Hypothesis⁴⁴ and the Insurance Hypothesis⁴⁵.

Early experience of relative deprivation, economic uncertainty, or food scarcity could result in a shift in choice parameters to generally prefer smaller sooner rather than larger later rewards. If this shift becomes stable, then it may result in overconsumption and unhealthy behaviours and a risk of developing dependencies and addictions throughout life²⁶. Since 2010 the number of families in poverty in the United Kingdom has increased. Relative poverty in the UK has essentially unchanged in from 2007 to 2020 at around 22% of households. However, relative child poverty has continued to increase to around 700,000⁴⁶. Between 2020 and 2021, the UKs largest network of food banks distributed 2.5 million emergency food parcels to people in crisis, a 33% increase the number of parcels and a 53% increase in the volume of parcels on the previous year⁴⁷. Of these nearly 1 million went to children. Many of these were due to problems with the benefits system including delays, insufficient welfare payments and cuts to welfare payments. The Trussell Trust reports that in 2020 72% of families who received a food parcel had a family member with poor mental health. If it is the case that relative deprivation in childhood is causally related to impulsivity related health inequalities in adult life then current welfare policies may be creating future health inequalities and potentially a public crisis in mental health.

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Figures

(A)

(B)

Figure 1

A. Example stimulus depicting a smaller sooner reward. The value varied and the delay was fixed.

B. Example stimulus depicting a larger-later reward. The value was fixed and the delay varied.

Figure 2

Showing the average subjective discounted value for each delay period. Error bars are standard errors of the mean.

Figure 3

Showing the implied discount curves for each index of multiple deprivation quintile from 1 = most deprived to 5 = least deprived.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryTableS1.pdf](#)