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Crime propensity, criminogenic exposure and violent scenario responses: Testing situational action theory in regression and Rasch models

DIRK-HINRICH HAAR[1] and PER-OLOF H. WIKSTRÖM[2]

[1]*Deutsche Hochschule der Polizei, Zum Roten Berge 18 - 24, 48165 Münster, Germany*
[2]*University of Cambridge, Institute of Criminology Sidgwick Avenue, CB3 9DT Cambridge, UK*

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In this paper, we argue that quantitative empirical research to explain and predict criminal and related behaviour can benefit greatly from explicit theories of action linking individual and contextual factors in the causation of crime. Such theories foster a systematic selection of causal variables for data collection and hypothesis testing instead of a more indiscriminate accumulation of 'risk factor' correlates. Moreover, action theory encourages statistical modelling of crime causation beyond the most common linear regression. This paper illustrates both points by estimating two empirical models – a conventional logistic model and a Rasch model – on scenario response data concerning youth violence. The findings of this study show that the extent to which young people indicate a violent response to a provocation is dependent on their (law relevant) morality and ability to exercise self-control as well as the deterrent qualities (monitoring) of the setting.

1 Introduction

Theoretical hypotheses addressed in criminological research often remain oriented towards testing through standard forms of statistical regression. This simple mathematical method of predicting crime incidence through multiple independent variables and their effect parameters encourages a pragmatic accumulation and ranking of observable 'risk factors' which are correlated with crime. However, especially in the absence of possibilities to assign independent variables randomly to subjects in controlled experimental studies, a tentative empiricist fitting of statistical models with a multitude of available variables remains limited in its potential to ascertain the causal mechanisms which generate data of crime incidence. Coherent criminological theory based on credible assumptions is required to guide the selection of possible causal variables from among both individual differences and environmental features. Such theory is equally needed to develop hypotheses regarding the exact nature of relationships between various causes and between these and additional variables.

In this paper, we argue that general considerations of action theory provide a highly desirable framework to guide quantitative criminological research in both the collection and analysis of data. This framework allows the linkage of individual and environment, proximate and distant causes of crime in an increasingly rigorous and comprehensive

manner. Key issues in the theory of action, i.e. in the explanation of mechanisms of individual behavioural choice, are a matter of ongoing philosophical, psychological and social science debate. However, recurrent arguments and an analytic position on remaining issues can be combined fruitfully in a general framework. One of the authors of this paper has developed such a framework, the Situational Action Theory (SAT), and applied it to crime causation (Wikström, 2006, 2010).

Below, we illustrate the implications of action theory in general, and the Situational Action Theory of Crime Causation specifically, for formal criminological research. For this purpose, we analyse empirical data from the Peterborough Adolescent and Young Adult Development Study (PADS+). In this study, a set of questions referring to hypothetical scenarios prompted young people from an urban sample to consider whether or not they would behave aggressively when faced with a specific situation.

We outline in brief below the SAT and how it provides an analytical framework to guide further criminological theorising and empirical research. Afterwards, we present the Peterborough Adolescent and Young Adult Development Study and introduce the scenario method by which it addresses key hypotheses of this criminological action theory. Subsequently, we construct and test two different models of the SAT. The test of the first model provides systematic evidence that the theory applies well to explaining which individuals resort to violence in a provocative setting; the strength of individual (law relevant) morality and individual ability to exercise self-control, apart from setting characteristics, are indeed pivotal. In this test, we focus on major theoretical causes of crime and on data immediately relating to these. The second model recognizes the limits of conventional statistical regression models in the formalised prediction and explanation of crime. It adopts the form of a Rasch model, and confirms the meaningfulness of predicting the probability of violence exclusively through the interplay of *crime propensity* and *criminogenic exposure*.

2 The situational action theory of crime causation

In criminology, recognition of the need to base social aggregate level hypotheses upon hypotheses about individual behaviour and change (Coleman, 1990) has rarely led to explicit consideration of action theory as a link between aggregate variables. Similarly, studies of individual offending rates or of other individual behaviour over time are normally unconcerned with the precise causal constellation at the time of a single act. However, no causes can be causes of crime unless they credibly bear on those intervening variables whose interaction directly leads to a crime-relevant individual behavioural choice in a specific setting. Conversely, all influences bearing on those variables merit an inquiry into the extent of their relationship with crime.

Explicit action theory as applied in criminological research so far has been epitomised by concepts of the rational offender, usually non-formally stated (e.g. Cornish & Clarke, 1986; McCarthy, 2002). Yet exclusive accounts of instrumental rationality fall behind psychological research and philosophical and sociological action theory in their scope. They exclude questions of perception, individual change, and habitual action. With the SAT, Wikström (2006, 2010) provides a synthetic treatment of action theory applied

to criminal behaviour that addresses these and further recurrent theoretical themes. According to SAT, actions (including acts of crime) are an outcome of a perception-choice process in response to motivations (temptations or provocations) guided by a person's crime propensity (dependent on his or her morality and ability to exercise self-control) and the criminogenic features of the setting in which the person takes part (its moral rules and their enforcement). People are, for example, expected to respond differently to provocations dependent on their morality and ability to exercise self-control and the deterrent qualities of the setting in which they take part.

In this paper, we provide a coherent empirical test of this theoretical framework based on a random sample. Unlike the consideration of strategic alternatives in response to temptations and deterrents, which have received attention in previous criminological as well as in broader research on individual decision-making in concrete situations (e.g. Nagin & Paternoster, 1993; Klepper & Nagin, 1989; Connolly *et al*., 2000), concepts of provocation, self-control and, particularly, morality have often been omitted and merit a systematic study of their respective explanatory contributions with regards to the single act. As necessary with any criminological model aimed at explanation, we will carefully include in our statistical model only those variables which make an independent causal contribution or confound such contributions according to a developed theoretical framework.

3 Scenario vignettes in the Peterborough Adolescent and Young Adult Development Study

Empirically, in this paper we rely on the responses of 710 randomly selected young people aged 12 and 13 to scenario questions in the first wave of the Peterborough Adolescent and Young Adult Development Study (see www.pads.ac.uk). This longitudinal study began in 2003 in the city of Peterborough (UK). It studies individual development and changes in exposure to different social contexts during adolescence and into young adulthood (see Wikström *et al*., 2011).

Within the framework of this survey and embedded in detailed questionnaires, each young person was randomly assigned one of four scenarios (A to D) in a form adapted to his/her gender (i.e. males got scenarios involving male actors, and females scenarios involving female actors). Scenario item A consisted of the following description:

It is the break between two lessons. David [Charlotte] is standing in the school corridor together with a group of other pupils. Steve [Helen] comes up to David [Charlotte] and falsely accuses him [her] of having stolen some money. There are no teachers or other adults around that can see what is happening.

What would you do if you were David [Charlotte]? Would you hit Steve [Helen]?

Answer options:

No, I would tell a teacher about it. – No, I would just tell Steve [Charlotte] that he [she] is an idiot. – No, I would do nothing. – Yes, I would hit Steve [Charlotte].

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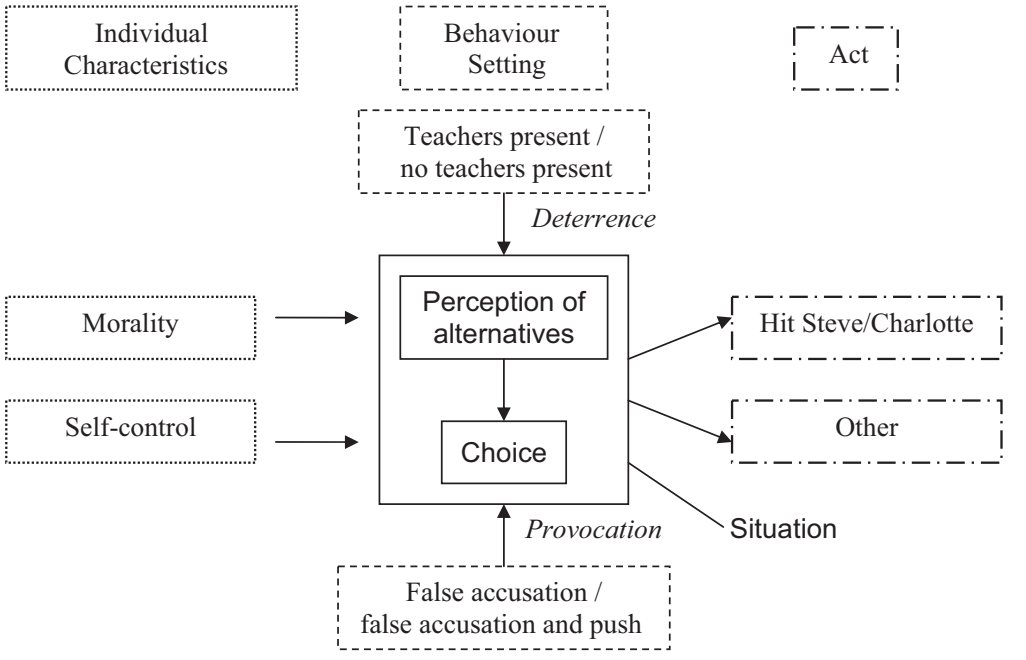

FIGURE 1. Situational action theory in contexts of provocation.

Scenario B differed from scenario A only in the presence of 'several teachers', i.e. greater monitoring (and hence a greater risk of intervention and sanctions). In scenarios C (no teachers) and D (several teachers), the following aggravating provocation was inserted after the false accusation: 'Steven [Helen] pushes David [Charlotte] to the ground so he [she] hurts his [her] back.' In our data analysis, we focus on the binary distinction whether a violent or non-violent response was chosen.

Scenario vignettes are a common tool in social and psychological research on behaviour and judgement (e.g. Alexander & Becker, 1978; Goldstein & Hogarth, 1997). They provide a full account of all situational factors to be considered by the respondent. Key situational constructs vary in a controlled and theoretically interesting way, since they are manipulated by the researcher in the verbal description. Moreover, lying and socially desirable answering appear minor problems with hypothetical low-stakes situations in questionnaires.

While the scenario questions and recorded answers do not refer to actual empirical behaviour, they are assumed to have some truth to them. This assumption is tentatively supported by a comparison with self-reported violent behaviour in the sample: a scenario answer implying violence predicts self-reported violence with Nagelkerke's $R^2 = 0.154$. Here, a perfect prediction is neither required nor expected.

Figure 1 outlines the situational model of SAT as adapted to the scenarios of provocation.

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Table 1. *Individual characteristics (crime propensity)*

Self-control scale		Morality scale	
Response categories:	Strongly disagree (3) Disagree Agree Strongly agree (0)	Response categories:	Very wrong (3) Wrong A little wrong Not wrong at all (0)
1. When I am really angry, other people better stay away from me.		1. Ride a bike through red light.	
2. I often act on the spur of the moment without stopping to think.		2. Skip school without an excuse.	
3. Other people often annoy me.		3. Tease a class mate because of the way he or she dresses.	
4. I sometimes find it exciting to do things that may be dangerous.		4. Get drunk with friends on a Friday evening.	
5. I donot devote much thought and effort preparing for the future.		5. Hit another child who makes a rude remark.	
6. Sometimes I will take a risk just for the fun of it.		6. Steal a pencil from a classmate.	
7. I often try to avoid things that I know will be difficult.		7. Paint graffiti on a house wall.	
8. I never think about what will happen to me in the future.		8. Smash a street light for fun.	
9. I easily get bored with things.		9. Steal a CD from a shop.	
10. I lose my temper pretty easily.		10. Break into or try to break into a building to steal something.	
Cronbach's $\alpha = 0.79$		Cronbach's $\alpha = 0.89$	

4 Methods

4.1 Operationalisation and formalisation of situational action theory

To employ data obtained through our scenario vignettes for a quantitative test of key elements of the Situational Action Theory of Crime Causation, two conventional preparatory steps are required.

Firstly, within our detailed questionnaires we achieve an operationalisation of our independent individual variables of self-control and (law relevant) morality by constructing two additive indices out of ten dedicated items each, with some missing values estimated (see Table 1). The resulting approximately normal distributions for both indices in our sample are *z*-standardized. The indices are correlated at a low Pearson's R = 0.288.

Secondly, a systematic theory test demands a formalised statement of SAT regarding how some variables measured in the Peterborough study are causally linked to others. Because mathematical formalisation in criminology has been so tightly associated with a number of statistical methods in the past, this step deserves a detailed mention.

Similar to the operationalisation of measurement, the use of formal language in theoretical statements substitutes precise definitions for the residual ambiguity often inherent to natural language constructs. Formalisation thus enables more clear-cut falsification.

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Point predictions can be obtained and complex theories involving multiple variables can be tested instead of otherwise more broadly stated associations. Moreover, rigorous shorthand notations help to bring remaining theoretical inconsistencies, potentials for logical deduction and underlying assumptions to the fore. For all these reasons, formally explicit modelling has proven vital to progress in the sciences and remains an important indicator for the maturity of theoretical statements (cf. Coleman, 1964; Luce, 1999; Morton, 1999).

In quantitative empirical criminology, formalisation is usually limited to the adaptation of conventional statistical equations, mostly those associated with linear regression, to relate observed variables. It has been criticised in other fields that these straightforward equations originally devised for mere prediction can result in overly crude models when the aim is to demonstrate causal relationships (cf. Freedman, 1992; Sørensen, 1998; Bunge, 1999: 30; Achen, 2005). Often, causal mechanisms could find better representation through a broader array of mathematical and simulation techniques applicable to social and behavioural phenomena (e.g. Axelrod, 1997; Gill, 2006). Moreover, common statistical models require a selection of operational variables which correspond best to the key mechanisms under study among the innumerable concurrent causes normally relevant to such phenomena. Even a model containing highly fitting operational concepts usually must remain non-exhaustive of all conceivable causes. In our case of violent scenario responses, physical capabilities are one example from a larger array of observable variables relevant to action theory but omitted from a more conventional approach.

4.2 Logit models

Before addressing in a second step the need for innovative formal theoretical models, first we present our key empirical findings within a framework more familiar to criminologists and well suited to testing the basic associations implied in SAT.

Below, we estimate the respective influence weights of our self-control and morality indices as well as those of two situational dummy variables representing the degree of provocation (no pushing = 0, pushing = 1) and the degree of monitoring (no teachers present = 0, several teachers present = 1) in a so-called logit model. Here, the log-odds of the probability of a violent response to a scenario are predicted by the weighted sum of a constant and the independent variables, for which we expect negative effects on violence except for a positive effect of provocation (see Model 1):

$$\text{(Model 1)} \qquad \begin{aligned} &\Pr(violence = 1|\pi) = \varphi \\ &Log\left(\frac{\varphi}{1-\varphi}\right) = \pi_0 + \pi_1 X_1 + \pi_2 X_2 + \pi_3 X_3 + \pi_4 X_4, \end{aligned}$$

with X_1 = self-control X_2 = morality X_3 = monitoring X_4 = provocation.

Model 2 in our test represents a slightly modified approach to SAT. Pro-social morality is not represented by the full index, but exclusively by the response categories to item 5 of the index (see above). Moreover, the analysis is restricted to scenarios A and B, in which no provocation through pushing occurred. Thus, we test more closely the relationship between an individual's precise stated normative position on the action to be considered

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("hitting a child who makes a rude remark') and the respective action, understanding the precise relevant normative position as an intervening variable between a broader pro-social morality orientation and the single act.

In both models, we avoid the inclusion of correlates without plausible causal relevance which could affect the estimated influence of theoretical variables. Our data having been collected with clearly delimited theoretical concepts in mind, the models also seem a credible representation of independent effects without the incorporation of causal control variables.

However, in accordance with the previous section a number of limitations apply to Models 1 and 2 as conventional logit models and formal statements of an action theory. The models incorporate explanatory variables, but they do not yet go a long way in providing a formal structural representation of supposed causal mechanisms generating the behaviour over time. They assume a straightforward additive combination of a non-exhaustive string of variable effects instead of reflecting in detail processes of cognition and interplay of individual characteristics.

Ultimately, developing alternative explicit models of supposed causal processes immediately leading to violent or other action can be a task of vast complexity, leading to hypotheses about human cognition too complex for application in most empirical research (cf. Anderson *et al*., 2004). Below, we suggest as an interesting advancement a Rasch model conceived as a formalised model of action. When it applies sufficiently well to a set of empirical data, it elegantly solves the problems of exhaustiveness and meaningful variable choice and has a theoretically argued mathematical structure. At the same time, it carries significant practical and methodological appeal.

4.3 Rasch models

One of the authors of this article previously summarized considerations of action theory in the exhaustive statement that criminal or other action results from the interaction of *crime propensity* and *criminogenic exposure* (Wikström 2004, 2006, 2010). This statement can be directly expressed by adapting a form of the Rasch model, which originated in psychological testing (Rasch, 1960). If this model applies to a set of data, this shorthand conception for explaining behaviour makes empirically confirmed sense.

In this article we re-interpret the basic form of the Rasch model as the prediction of the log-odds of the probability of a violent response to a scenario item through the unidimensional subtraction of a situation's conduciveness ψ_m (i.e. criminogenic exposure) from an individual's (crime) propensity π_j (Model 3):

$$\text{(Model 3)} \qquad \begin{aligned} &\Pr(violence = 1|\pi) = \varphi \\ &Log\left(\frac{\varphi}{1-\varphi}\right) = \eta \\ &\eta_{mj} = \pi_j - \psi_m. \end{aligned}$$

In the conventional language of the Rasch model, the proposed equations fully correspond to the prediction of an individual's success at solving a test item exclusively through

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individual ability and item difficulty (for detailed discussions of the model, see Andrich, 1988; Fischer & Molenaar, 1995).

In this context, individual propensity and situational conduciveness are unconstrained rational numbers with no absolute zero or maximum. For the probabilistic nature of the Rasch model prediction, two alternative reasons are commonly assumed: either momentary individual propensity varies at random around the individual propensity values identified, leading to randomness in individual behaviour when confronted repeatedly with a situation, or each level of individual propensity in a population still subsumes a group with latent relevant variation so that a certain proportion of each propensity level group would always commit the crime or related act when confronted with a specific situation whereas the remainder would not (cf. Molenaar, 1995).

The Rasch model as proposed here can be applied to extract comprehensive values of individual or group mean propensity to commit a criminal or related act as well as of crime conduciveness (i.e. risk) for different situations from a variety of data sets. These must report individual reactions or non-reactions to hypothetical or real temptation or provocation situations whose characteristics are known to the researcher and where systematic biases in self-selection of individuals to specific situations reasonably can be excluded (ideally by research design, as in the case of this scenario-based study).

In criminological research, a Rasch model has been applied before by Raudenbush *et al.* (2003), whose notation we adopted above. These authors employed the model as an innovative solution to a relatively common problem: predicting the probability of an individual of having committed certain criminal offences during a period of time from both individual and neighbourhood level variables. They did not intend to capitalise on the Rasch model's direct relevance to action theory. Instead, propensity values π_j comprised both individual and contextual factors, while the parameter ψ_m expressed the severity of crimes.

For our purposes, the Rasch model has a number of advantages over more conventional approaches. If it fits the data, the model serves as an exhaustive representation of action theory. It delivers attractive linearised metric values on a single scale which summarise in only two parameters the entirety of relevant 'risk' information about both individual and situational differences. When individual propensity and situational conduciveness are equal, the predicted probability of violence is 0.5.

At the same time, the Rasch model has a well-known feature with little bearing so far on applied social sciences research but of essential importance to theory of measurement: unlike most other social research positing interval scales for unobservables like 'power' or 'morality', the Rasch model is based on explicit measurement axioms whose testable fulfilment may confirm that measurement of empirically valid metric concepts, here individual propensity and situational conduciveness, has occurred with an instrument of data collection (e.g. Andrich, 1988). Only this fully justifies the use of many attractive statistical techniques, from meaningful average calculations and difference comparisons to various forms of regression.

Finally, the Rasch model may be conceived as a multi-level model with normally distributed individual propensity in the sample (Raudenbush *et al.*, 2003). As such, it can incorporate selected theoretically argued covariates or merely helpful, causally irrelevant predictors of individual propensity and situational conduciveness on a higher level, keeping them strictly separate from the assumed causal model structure of propensity and conduciveness interaction.

To apply the Rasch model to our scenario dataset, a further innovation is required. Rasch testing normally demands that each individual responded to a string of items, not to a single one. However, while this eliminates the possibility of obtaining genuinely individual propensity estimates for datasets such as ours where only one behavioural choice (relating to the scenario of provocation) was recorded per person, we may conduct a Rasch analysis which delivers results for both propensities and situational conduciveness at a stratum level.

For example, since we expect theoretically (and test the assumption with the above-described conventional logit models) that morality and self-control are suitable predictors for individual probabilities of opting for a violent response, a straightforward approach consists of recoding the morality and self-control scales into four ordered categories. Subsequently, each empirical individual can be assigned to a stratum in which it shares the values on both recoded variables. Assuming this way that all individuals in a stratum are 'essentially equal' for our analysis, i.e. abstracting from all differences other than in morality and self-control, is equivalent to assuming that all responses in a stratum were obtained from the same 'average' individual in that stratum. Within each stratum, single answers can thus be distributed over hypothetical individuals by randomised assignment, so that always four randomly composed empirical responses to four different items constitute an individual answer pattern as required for Rasch analysis. To avoid a further loss of cases due to varying numbers of answers per scenario in each stratum, we first divide for this procedure the number of violent as well as the number of non-violent responses to each item in each stratum by the overall number of responses to the item within the stratum. Afterwards, we multiply them by the rounded average number of responses per item in the stratum. The resulting numbers of violent or non-violent responses after rounding are randomly assigned to the hypothetical individuals as described.

With this completed setup, the key assumption of the Rasch model of *local independence* is fulfilled by design: Influences of an item trial on success probabilities in subsequent trials are necessarily absent when each original respondent only gave a single answer.

In a resulting three-level dataset and model, individual propensities retain no empirical meaning, while the mean propensity of each stratum and the situational conduciveness of each scenario do. Covariates of propensity may be introduced at the level of hypothetical individuals or at the stratum level, although one must ensure that varying stratum sizes do not bias estimates. Since morality and self-control are already studied in our logit models, they are omitted as covariates below. Formally, the Rasch model to be estimated looks as follows:

$$\text{(Model 4)}\quad \text{Level 1:}\quad \begin{aligned} &\Pr(violence = 1|\pi) = \varphi \\ &Log\left(\frac{\varphi}{1-\varphi}\right)_{M-1} = \eta \\ &\eta_{ijk} = \pi_{jk} - \sum_{m=1} \alpha_m a_{mijk} \end{aligned} \qquad \text{[Single scenario response]},$$

$$\text{Level 2:}\quad \pi_{jk} = \beta_k + u_{jk} \quad \text{[Individual]},$$

$$\text{Level 3:}\quad \beta_k = \gamma_0 + u_k \quad \text{[Stratum]}.$$

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Here, propensity π_{jk} for hypothetical individual j in stratum k is constituted by a stratum constant (i.e. mean) β_k and an individual residual u_{jk} on level 2 (individual level). The stratum constant is constituted by an overall sample constant γ_0 plus a stratum residual u_k on level 3. Situational conduciveness of the M scenarios is represented through three parameters α_m, while the conduciveness of the fourth item (scenario D) is set to zero. Finally, indicator a_{mijk} is minus one when the ith level 1 response (observation) of individual j in stratum k refers to scenario m, and zero otherwise. Thus again, the log-odds of the probability of a violent response to a scenario item are predicted through the subtraction of that item's conduciveness from the respective individual's propensity.

Instead of a Rasch analysis with the most obvious choices as stratification variables in our dataset, pro-social morality and self-control, researchers may be interested in alternative distributions of individual propensity. For example, pragmatic interest may arise in easily accessible predictors of individual propensity in our school context. Stratifying the original data firstly according to self-reported achievement in school and secondly according to gender, we obtain group mean propensity estimates below. Here, unlike in conventional regression models at risk of mixing mere correlates like gender with theoretically justifiable independent variables for violence like self-control in a single model, no confusion between causes and otherwise interesting correlates arises: while the Rasch model at the individual level remains fully specified by the causal interaction of individual propensity and situational conduciveness, gender and school success are merely introduced at a higher level to stratify the data and to test whether a relevantly higher proportion of high-propensity individuals is found in specific, identifiable subgroups.

However, for the proposed Rasch model to apply to a set of data, a number of assumptions must be fulfilled. The possibility to explain and predict a specific type of behaviour exclusively through the unidimensional subtraction of situational conduciveness from individual propensity is too straightforward to be taken for granted. When, for example, an increase in teacher monitoring of a situation in our study acts as a strong violence deterrent for some, while for another subgroup teacher presence matters less, then comparisons of propensity values obtained from these items do not show differences 'in degree' (Andrich, 1988: 75), but they mask differences 'in kind'.

Key tests whether the Rasch model fits an empirical dataset include below a test of the key assumption of *equal item discrimination* and, secondly, a further intuitive test of whether comparisons of item difficulties (conduciveness values) are invariant across subpopulations. This latter test allows easier checking of whether subgroups of individuals, not specific items, violate model assumptions. The first test can be done graphically on Item Characteristic Curves (ICCs) depicting probabilities of a violent response for each scenario item over propensity values. Because true individual propensities cannot be estimated for our data set, we need to plot ICCs instead over mean propensities of four strata of our best available correlate for a violent reaction, the pro-social morality index. For this purpose, we stratify individuals as mentioned above according to the four quartiles of the pro-social (i.e. law relevant) morality index into groups 0–3 (with 165, 182, 136, 221 cases, respectively).

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Table 2. *Models predicting log-odds of Pr(violence = yes)*

	Model 1	Model 2
Constant	−2.3848	−0.2754
	(0.2353)	(0.3702)
Self-control	−0.7275	−0.9961
	(0.1184)	(0.2344)
Morality	−0.8304	−1.1380
	(0.1111)	(0.2204)
Monitoring	−0.6156	−1.0909
	(0.2157)	(0.4262)
Provocation	1.9317	
	(0.2505)	
Number of cases	691	338
Nagelkerke's R^2	0.366	0.352

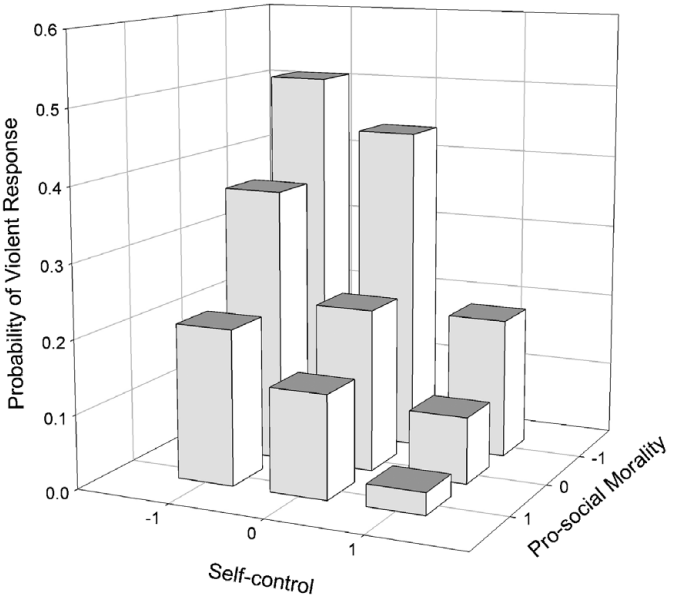

FIGURE 2. Scenario responses.

5 Results

5.1 Logit models

Table 2 reports all estimation results for the logit models 1 und 2 (standard errors in brackets). Figure 2 intuitively illustrates the effects of self-control and pro-social (law relevant) morality by depicting empirical probabilities of a response implying violence for trichotomous strata (grouping together individuals with values on the independent

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Table 3. *Main estimates of Rasch model*

γ_0: Constant	−0.8419
	(0.1644)
α_1: Conduciveness scenario A	−0.9107
	(0.2686)
α_2: Conduciveness scenario B	−1.6067
	(0.3234)
α_3: Conduciveness scenario C	0.3793
	(0.2258)
α_4: Conduciveness scenario D	0.000
N (level 1)	704
N (level 2)	176

variables more than one standard deviation below the mean, less than one standard deviation from the mean and more than one standard deviation above the mean).

All theoretical variables have strongly significant effects on the choice of a violent response in the given situation, with a remarkable overall model fit[1]. In Model 2, predicting violent responses to scenarios A and B (no pushing, only a 'rude remark') by the full morality index instead of relying exclusively on its item 5 would increase Nagelkerke's R^2 to 0.374. However, given that the reliability of the single item is most likely lower, it makes an excellent predictive contribution.

The four individual and situational variables apparently exert a strong influence over the violent or non-violent hypothetical reaction of a child in such scenarios of provocation. None of them could justifiably be omitted from a conventional regression model or a theory explaining such acts.

5.2 Rasch models

Table 3 reports the estimated situational conduciveness for scenarios A–D as well as the overall constant of our Rasch model synthesizing all relevant situational and individual differences in propensity and conduciveness, or criminogenic exposure, estimates (standard errors in brackets). Instead of estimating mean individual propensities for pro-social (law relevant) morality and self-control strata and testing the relationship between these concepts and our estimates for propensity to violence, which would deliver results as expected very similar to the logit results which we presented above, at this point we forgo the full stratification procedure described earlier and obtain scenario conduciveness estimates and an overall mean of propensity from an analogous two-level model, where all responses are assigned randomly to hypothetical individual patterns within a single stratum.

[1] Conversion of logit results into predicted probabilities can be done algebraically with $\Pr(\text{violence} = \text{yes}) = e^{\text{Logit}}/(1 + e^{\text{Logit}})$, where $e \approx 2.718$. The observed probability of a violent response increases from 0.11 to 0.34 with an increase in provocation, and decreases from 0.27 to 0.19 with an increase in monitoring.

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Table 4. *Strata mean propensities*

How well do you do in school?	
I do very poorly.	1.0667 ($N = 16$)
I do not do very well.	0.3442 ($N = 40$)
I do rather well.	−0.8479 ($N = 484$)
I do very well.	−1.5781 ($N = 167$)
Gender	
Male	−0.5611 ($N = 356$)
Female	−1.2227 ($N = 354$)

The results show scenario C (no teachers present, pushing) as the most conducive to a violent response on the unidimensional interval scale, followed by scenarios D (teachers present, pushing), A (no teachers present, no pushing) and B (teachers present, no pushing).

Table 4 (number of individuals in brackets) shows how mean individual propensities vary between different, easily identifiable subgroups of our sample.

According to the Rasch model estimates, we would be justified to state that the mean propensity towards a violent reaction to the scenario context is about as much higher in the group which does very poorly in school than in the group which does not do very well as it is higher in the group which does rather well in comparison to the group doing very well. Units retain their meaning alongside the entire scale, enabling invariant comparison of the differences. Unlike a direct transformation of subgroup violence probabilities into log-odds for linearised comparison, this maintains a theoretical model at the individual level and accounts for varying difficulties of items to which individuals responded.

However, the Rasch model assumptions must be tested as described in the previous section. Figure 3 displays observed and predicted ICCs for our dataset.

With the exception of scenario B and its minimally higher-than-expected probability of violence in the lowest pro-social (law relevant) morality stratum, the scenarios strictly maintain their conduciveness ordering alongside the latent variable as required. They are predictable by the Rasch model assuming equal discrimination, i.e. that the predictive subtraction of conduciveness from propensity holds without any further parameter moderating the effect of propensity increases on probabilities differently for each item. However, some randomness in probability values remains due to the relatively low original number of cases and resulting standard errors. This applies in particular to scenario B, for which probabilities of a violent response are the lowest.

Finally, we check the four items again in an intuitive graphical manner for the invariance of item difficulty values, i.e. situational conduciveness, across different individuals. This is done here by estimating item difficulties separately for two subgroups of our sample and plotting the results against each other. In the resulting graph (Figure 4), item coordinates ideally must lie on the function $y = x$. To create two subgroups which might most plausibly unveil differences 'in kind', we use our predictor pro-social (law relevant) morality again to divide the sample at its median value (with 347 cases in the lower and 357 cases in the higher stratum).

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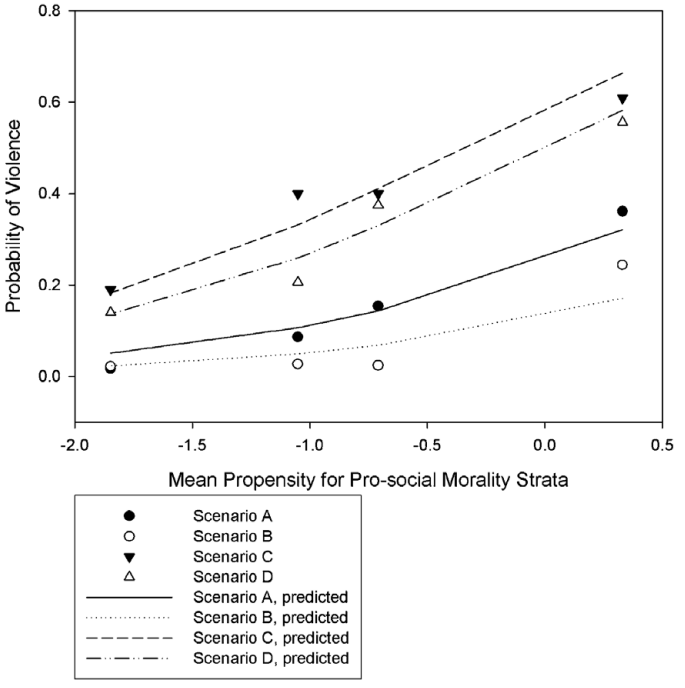

FIGURE 3. Item characteristic curves – observed and predicted.

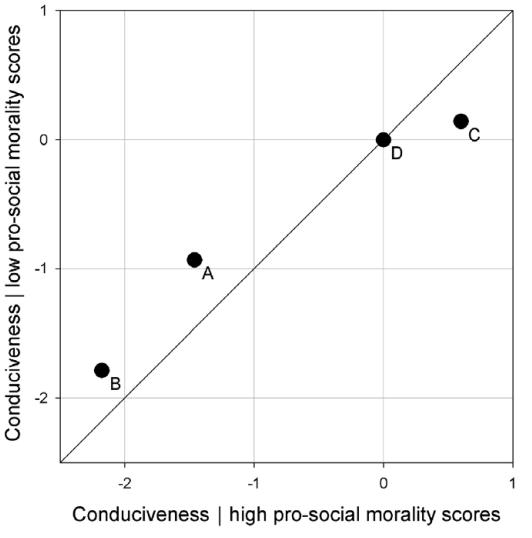

FIGURE 4. Scenario parameters by pro-social morality.

The scenarios vary in their conduciveness around the ideal line without deviations which are significant individually or suggest a different line. Because of relatively low probabilities of a violent response in the high pro-social (law relevant) morality stratum, substantial standard errors arise given the relatively small numbers of item responses.

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Similar random variation around the function $y = x$ also occurs when other variables are used for stratification.

In all cases, the use of scenarios with controlled systematic variation offers a superior means to check whether findings indicate a breach in unidimensionality with a specific scenario whose conduciveness values differ between the samples, which therefore would have to be excluded from the model, or whether randomness inherent in the data is responsible for the deviation. For example, the factual difference between scenarios A and B on one hand and C and D on the other hand consists equally in the exclusive modification from 'no teachers present' to 'several teachers present'. In the absence of a plausible argument and further supporting statistical evidence in our data for an interaction effect between this degree of monitoring and the degree of provocation, which then again would have to be dependent on pro-social (law relevant) morality, we may ascribe certain differences with added confidence to random variation. Thus, our data suggest that speaking of the causation of violent responses exclusively through the subtractive interaction of individual propensity and situational conduciveness (criminogenic exposure) is sufficiently empirically meaningful for our scenarios and sample.

6 Conclusion

In this article, a test of key arguments of the Situational Action Theory of Crime Causation on scenario answers given by school children suggests that the theory serves to explain light violence in concrete situations very well: a remarkably strong influence of individual pro-social (law relevant) morality and self-control as well as of levels of provocation and monitoring on the probability of violent responses was detected.

Moreover, we argued above that theoretical models available for quantitative research and theoretical deduction are desirable which go beyond conventional regression models in formally representing the causal mechanism of action in an exhaustive and differentiated manner. We presented a statistical variant which describes crime act causation as the unidimensional interplay of *individual propensity* and *criminogenic exposure* alone, as expressible through a Rasch model. From the perspective of applied criminology, this attractively reduces all information relevant to a probabilistic 'risk assessment' in our and potentially in many applications to two confirmed comprehensive variables on an interval scale, one individual and one situational factor. At the same time, it does not preclude the identification of causal or non-causal correlates of these factors.

In general, this paper encourages researchers studying criminal and related behaviour to ground their endeavours further into a gradually improving, explicit understanding of the causal mechanisms of individual action in concrete situations as discussed in the SAT – not only in verbal theorising, but also in quantitative efforts. For this purpose, our first model emphasised crucial intervening variables. The second model described a useful shorthand conception. A detailed tractable formalisation of action theory still remains to be achieved.

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