



RESEARCH NOTE

Strong evidence that callous–unemotional traits are not related to risk-taking task performance [version 1; referees: 2 approved]

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Abstract

A hypothesized association between callous–unemotional (CU) traits and risk-taking may account for the link between CU traits and real-world risky behaviors, such as illegal behavior. Prior findings show that reward and punishment responsivity differs in relation to CU traits, but is not associated with general risk-taking. However this has only been examined previously with one task, only with a frequentist framework, and with limited interpretation. Here, we expand to another task and to Bayesian analyses. A total of 657 participants (52% female) completed the Inventory of Callous–Unemotional Traits, the Balloon Analogue Risk Task (essentially a gambling task), and the Stoplight driving task, which repeatedly presents participants with riskier or less risky choices to make while driving. We found strong evidence for the null model, in which there is no relation between the two risk-taking tasks and CU traits ($R^2 = 0.001$; $BF_{10} = 1/60.22$). These results suggest that general risk-taking does not underlie the real-world risky behavior of people with CU traits. Alternative explanations include a different method of valuing certain outcomes.

Keywords

Callous–unemotional traits, risk taking, decision making, driving, gambling, Bayesian, re-analysis

Open Peer Review

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Author roles: **Centifanti LCM:** Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Writing – Original Draft Preparation, Writing – Review & Editing; **Negen J:** Conceptualization, Formal Analysis, Software, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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Introduction

Callous–unemotional (CU) traits are an aspect of psychopathy, which includes traits such as callously using others for one’s personal gain, a lack of caring for society’s values and lacking emotional depth¹. Risk-taking includes choosing behaviors with uncertain outcomes (but possibly higher rewards) over behavior with more certainty in its rewards². Here, we show that the two are unrelated when measured in a laboratory setting.

This is surprising for three reasons. First, a variety of risky real-world behaviors and illegal behaviors¹—themselves risky—are associated with CU traits (e.g., substance use, sexual risk-taking)^{3–7}. Second, there is a difference in reward and punishment responsivity in relation to CU traits^{4,6,8–12}. For example, in a test of gambling, the Balloon Analogue Risk Task (BART), CU was related to weaker reward responsivity, in that adolescents with these traits failed to show an increase in risk-taking following successful (rewarded) trials^{4,13}. Third, CU traits are one aspect of a cluster of traits known as psychopathy, which is associated with risk-taking^{14–16}.

These data were originally collected as part of a study about the influence of peer presence on risk-taking behavior, with two laboratory tasks conducted^{13,17}. CU traits were measured as a potential moderator. Results on the relationship between CU traits and a gambling task have been previously reported using frequentist methods, but the null finding failed to be interpreted¹³. Here, we re-analyze the data in a Bayesian framework, allowing for the relationship between CU traits and gambling to be interpreted. In addition, for the first time, we report our findings on the association between CU traits and a driving risk-taking task¹⁷.

Methods

Participants and tasks

A total of 675 people (52% female; 16–18 years of age) from six schools in Northwest England participated in 2010. Heads of schools acted *in loco parentis*, and verbal consent was obtained to ensure privacy, which was approved by the ethics committee, within the schools where the research was conducted. Ethical approval was given by the University of Central Lancashire to the first author (PSY0809122). Complete information about the sample and recruitment can be found in a previous report¹⁷.

A total of 657 participants produced usable data on all three measures reported here. The Inventory of Callous Unemotional Traits (ICU)^{18–20}, a self-reporting questionnaire, was used to assess CU traits. The BART²¹, where participants can repeatedly gamble by pumping a balloon for greater reward but risk popping it and receiving no reward, was one measure of risk-taking. The Stoplight driving task²², where participants repeatedly choose to either enter yellow/red lights and risk time-consuming crashes

or stop and then proceed on the green light, was also given in counterbalanced order as an additional risk-taking task. All three are standard choices that have been validated^{19,21,23}. At the time of writing, the ICU and BART tasks can be obtained online, and the Stoplight can be obtained by contacting the authors²². Unrelated to the aims of the present study, participants were asked to bring two friends of the same gender and completed the tasks either in their presence or not.

Statistical analysis

MultiLevel Data Manipulations were conducted in MLwiN 2.30 (University of Bristol, 2014), resulting in an outcome variable for each task that was adjusted to be equated across peer group membership. Descriptive statistics, zero-order Pearson correlations and p-values were calculated using JASP 0.8.2.0²⁴. An online tool was used to calculate Bayes factors²⁵.

Results

Figure 1 shows scatterplots of the relations among the three variables. There was a significant zero-order correlation between the tasks, $r=0.22$, $p<0.001$, but not between the ICU scores and either the BART, $r=0.033$, $p=0.397$, $N=657$, $BF_{10}=1/8.09$ or the driving task, $r=0.013$, $p=0.738$, $N=672$, $BF_{10}=1/11.00$. More importantly, a multiple linear regression, with the risk-taking tasks predicting ICU scores, showed no significant relation to the BART, $\beta=0.033$, $t=0.824$, $p=0.410$, or the driving task, $\beta=-0.000$, $t=-0.012$, $p=0.990$. The overall fit was $F(2, 654)=0.359$, $p=0.698$; $R^2=0.001$, $R=0.033$, $N=657$, $BF_{10}=1/60.22$. In a Bayesian analysis, this is considered strong evidence for the null hypothesis^{25,26}.

We also examined the comparability of our sample to others. The mean \pm SD for total ICU (21.62 ± 7.85) was comparable to previous community and at-risk samples. For example, our scores were similar to those from a community sample (male, 25.25 ± 7.90 ; female, 21.76 ± 9.4)²⁷, as well as to youths from a residential facility (25.74 ± 7.95)²⁸.

Dataset 1. Subject demographic information, together with Inventory of Callous–Unemotional Traits score and results of the tasks

<http://dx.doi.org/10.5256/f1000research.14623.d201818>

Data are provided in raw form and peer-level adjusted format within the same spreadsheet²⁹. Condition: peer present, 1; peer absent, 0; Subject ID, anonymized participant ID number; Female: female gender, 1; male gender, 0; Age, age in years; BART Pumps AdjAvg_raw data, adjusted average pumps; Peer group level adjusted BART Pumps, peer-group level-adjusted average pumps; Peer ID, peer group membership ID number; Stoplight Intersections_raw data, number of intersections entered on the Stoplight driving task; Peer group level adjusted Stoplight, peer-group level-adjusted number of intersections entered on the Stoplight driving task; Total ICU, number of CU traits using the Inventory of Callous-Unemotional Traits.

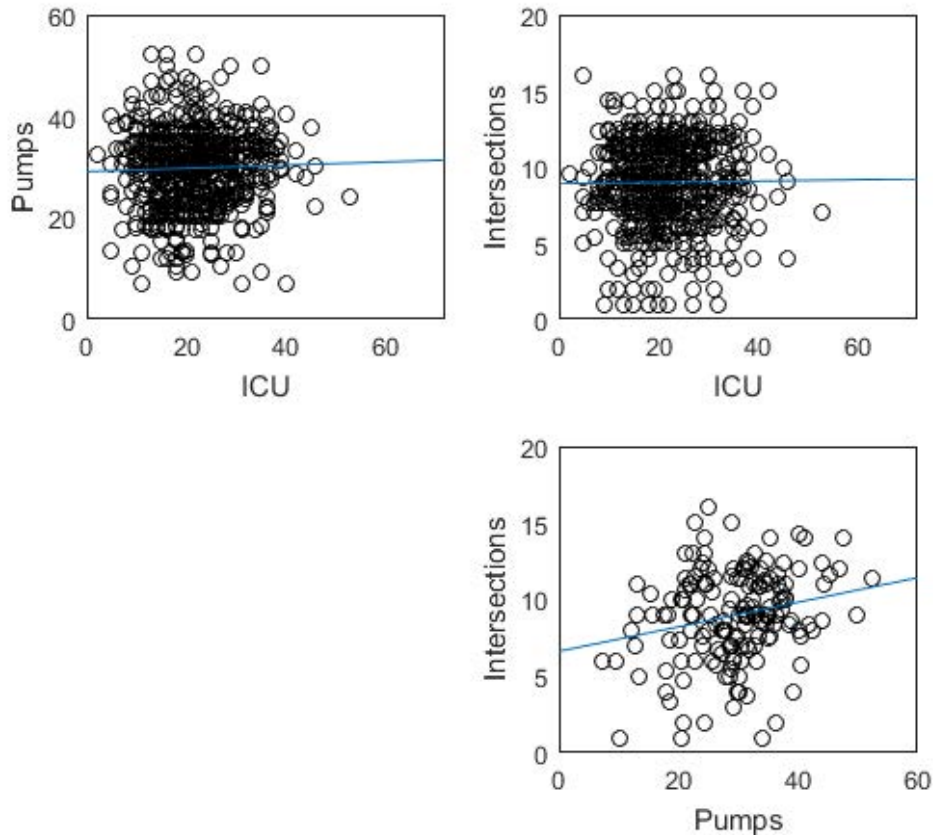


Figure 1. Scatterplots of the relations among the three variables. Scores were adjusted for peer-level clustering, since participants were recruited with two friends.

Discussion

The results of this study rule out a specific theory about why CU traits are related to risky real-world behaviors including illegal behavior. People with CU traits are not more likely to engage in risky behavior in a lab setting, so real-world risky behaviors are unlikely to be driven by risk-seeking for its own sake. More broadly, this is a worked demonstration that differences in reward and punishment responsivity on a task do not necessarily imply differences in overall risk-taking, even in the same dataset. On the basis of previously reported findings^{13,17} and our re-analyses, we conclude that these two concepts should not be used interchangeably in interpreting risk-taking results.

There are potential alternative explanations for why people with high CU traits tend to do risky things, like having unprotected sex. For one, they may simply place different values on the outcomes of catching a disease and/or seeking bodily sensations. However, an interaction between CU traits and antisocial behavior (i.e., conduct disorder) has shown effects on laboratory risk-taking²³. One broad possibility is that CU traits do not operate singly, since psychopathy is multifaceted, and some

factors of psychopathy appear to be more reliably related to risk taking than others^{14,30}.

People who engage in antisocial behavior suffer legal, educational and socio-economic consequences³¹, and we know CU traits predict antisocial behavior^{32,33}. Thus, further research is needed to understand the mechanisms by which people with CU traits (i) engage in antisocial behavior, and (ii) fail to care about the consequences of their behavior on themselves and on other people. The present study sheds light on one part of this, by showing that one obvious idea of how CU traits and illegal behavior relate is not tenable.

Data availability

Dataset 1. Subject demographic information, together with Inventory of Callous-Unemotional Traits score and results of the tasks. Data are provided in raw form and peer-level adjusted format within the same spreadsheet²⁹. Condition: peer present, 1; peer absent, 0; Subject ID, anonymized participant ID number; Female: female gender, 1; male gender, 0; Age, age in years; BART Pumps AdjAvg_raw data, adjusted average pumps; Peer group level adjusted BART Pumps, peer-group

level-adjusted adjusted average pumps; Peer ID, peer group membership ID number; Stoplight Intersections_raw data, number of intersections entered on the Stoplight driving task; Peer group level adjusted Stoplight, peer-group level-adjusted number of intersections entered on the Stoplight driving task; Total ICU, number of CU traits using the Inventory of Callous-Unemotional Traits.

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Competing interests

No competing interests were disclosed.

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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Open Peer Review

Current Referee Status:  

Version 1

Referee Report 11 May 2018

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Timothy R. Stickle¹, **Andrew Gill**², **Ashley Dobbins**², **Amanda Falcon**²

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This is an interesting research note and is likely to contribute to the literature. There are, however, several areas that need elaboration or clarification to better communicate the findings and their contribution.

Use of Bayesian analysis in a reasonably large sample adds strength to the authors interpretation of null findings.

Clarification about some detail of the Bayesian analysis for the reader would be helpful and should include:

How was the prior selected and what was used for the prior distribution?

Was it a noninformative or an informative prior?

Was sensitivity analysis conducted to gauge the effect of the prior?

It is worth noting that the sample is reasonably large, so the effect of the prior on at least some parameters may be small. Nevertheless, it would be helpful for the authors to note the effect of sample size on prior and posterior probabilities.

In the first paragraph of the Discussion section, the authors make a strong declarative statement that the results "...rule out a specific theory about why CU traits are related to risky real-world behaviors... People with CU traits are not more likely to engage in risky behavior in a lab setting, so real-world risky behaviors are unlikely to be driven by risk-seeking for its own sake."

Although the following statements regarding caution in generalizing reward and punishment processing in laboratory tasks to behavior outside the lab clearly are warranted, the above statements seem a step too far. That is, the results clearly cast some doubt on the links and mechanisms of risk. The notion that the finding is conclusive, however, does not seem warranted. Rather, it is recommended that the authors use language to indicate that the current results fail to support links between the specific measure of risk used here and CU traits. It is a reasonable inference to note that the presence of CU traits alone and documented mechanisms of reward and punishment processing are not de facto predictors of risk. It seems more defensible to state something more akin to noting that the current results call for

reexamination of the mechanisms thought to link CU traits and risky behaviors.

In extending these recommended comments, it would also be helpful for the authors to synthesize the discussion paragraphs a bit more in their discussion of the multifaceted/multidimensional nature of psychopathy and the implications of the broader psychopathy construct in understanding risk and its mechanisms.

Overall, the paper is interesting and the above comments are offered in the spirit of strengthening how the results are communicated.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Referee Expertise: Callous and unemotional traits, youth psychopathy, adolescent substance use, statistics

We have read this submission. We believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Referee Report 08 May 2018

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Carlo Garofalo 

Department of Developmental Psychology, Tilburg University, Tilburg, Netherlands

Thanks for the opportunity to review this manuscript. The study described has important strengths, such as the large sample, the use of well-validated assessment methods, and the sophisticated statistical techniques. I also extremely appreciate the fact that full data are made available, something that happens too rarely to the detriment of the field. The topic is certainly an important one, and one that historically attracts speculations that permeates popular beliefs on the nature and dynamics of callous-unemotional traits. I therefore think that the publication of (null) findings like this is imperative as to not fuel

misconceptions on the topic.

While I am therefore clearly positive regarding this submission, I also list below some issues that occurred to me while reading the manuscript, which I think may deserve further elaboration to strengthen the contribution of this study to the literature. I suspect that the writing was constrained by length limits, which could make it impossible to address my suggestions thoroughly, but I thought I would nevertheless mention what I believe could further improve this well-executed and well-written study.

1. It is clear to me that the findings do not support the hypothesis that CU traits are related to risk taking. But I could not tell: who proposed this link, and whether this hypothesis also guided the present research. I think it would help situate the present study within the broader literature on CU if the manuscript could (briefly) refer whether the CU-risk taking link was just one that 'makes sense', or one that is central in existing theories of CU (e.g., in the opening of the discussion, it is stated that the present study rules out a 'specific theory', but it is unclear which theory is referred to). I think this is important because such theories would have to be re-considered in light of this null finding (as opposed to the scenario in which the CU-risk taking link is more of a popular misconceptions with no footing in scholarly work). Relatedly, as I find the alternative explanation (i.e., 'a different method of valuing certain outcomes') equally – if not more – compelling, I think it would be helpful to know whether this possibility was already acknowledged before the study was conducted, or followed the null findings that did not support the initial hypothesis.
2. A second conceptual clarification that may be needed concern the overlap and dissociation between reward/punishment sensitivity and risk-taking. This seems relevant to understand specific abnormalities related to CU traits and what they can mean. Related to this – it looks like CU traits were also not related in punishment sensitivity, if I am not misunderstanding. If that is the case, how does this null finding aligns with existing theories of psychopathy such as the low-fear hypothesis or the response modulation model?
3. For non-familiar readers (as myself), it may be worth expanding on how the Bayesian framework adopted allows for an interpretation of the null finding in a way that frequentist methods would not (also just a brief mention of why the overall fit can be considered strong evidence of null hypothesis).
4. I cannot help but wonder what the results look like if the ICU is examined at a sub-scale level. I do not expect differences, but I think it is important to rule out that the overall null effect is not due to differential associations between ICU subscales and risk-taking.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Referee Expertise: Clinical forensic psychology

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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