Physical Aggression Is Associated with Heightened Social Reflection Impulsivity:

Supplementary Material

Supplementary Method

Supplementary Measures

Shipley Institute of Living Scale (Zachary, 1986). The Shipley Institute of Living Scale is a measure of intelligence that consists of two subtests: vocabulary, a 40-item subtest in which participants choose a word (out of four options) that is synonymous with the word provided; and pattern matching, a 20-item subtest in which participants complete verbal and numerical patterns by writing in correct answers. Examiners convert raw scores on each subtest and then the total raw score to age-corrected T-scores. The total age-corrected T-score can then be used to estimate a participant's WAIS-R Full-scale IQ score, which has been shown to be an accurate means of predicting IQ (Weiss & Schell, 1991).

Wide Range Achievement Test-III Reading Subtest (WRAT3 Reading Subtest; Wilkinson, 1993). The WRAT3 Reading Subtest is a measure of reading grade-level consisting of 42 items. Participants are instructed to pronounce a series of words aloud until they make 10 consecutive errors. If they make 10 errors, they are then asked to read a string of 15 letters aloud. Participants are awarded one point for each correctly pronounced word and letter, for a maximum score of 42. The final reading grade-level is determined by normed age adjustments.

Delis-Kaplan Executive Function System (D-KEFS): Color-Word Interference Test (CWIT; Delis, Kaplin, & Kramer, 2001). The D-KEFS comprises nine stand-alone tests designed to evaluate executive functions such as problem solving, inhibition, and flexibility of thinking. One of these nine tests is the CWIT, which consists of four conditions: Condition 1 (Color Naming), Condition 2 (Word Reading), Condition 3 (Inhibition; color names are written

in ink colors that are different from the color itself), and Condition 4 (Inhibition/Switching; participants must name the ink color when the word is not boxed and read the word when it is boxed). Participants are scored based on number of corrected and uncorrected errors that they make, as well as total time taken to complete each condition. Errors and total completion time for the condition are summed to create a raw score, which is then scaled (by age level) to determine Cumulative Percentile rank. We used the Inhibition/Naming contrast scaled score, which provides a measure of the difference between performance on Condition 3 (Inhibition) and performance on Condition 1 (Color Naming), as our measure of inhibition to identify potential contributions of executive functioning to the social reflection impulsivity-physical aggression relationship.

Multidimensional Personality Questionnaire–Brief (MPQ-B; Patrick, Curtin, & Tellegen, 2002). The MPQ-B is a shortened, 155-item measure adapted from the MPQ that assesses personality at the trait and structural levels. Participants respond to each of the 155 items by selecting one of two responses, typically "true" or "false." The MPQ-B consists of 12 primary trait scales, and three higher-order factor scores can be derived from the measure as well. One of these factor scores is Constraint, which is a measure of disinhibition and impulsivity (lower scores on Constraint indicate higher levels of disinhibition and impulsivity). We used the Constraint score as a measure of trait impulsivity to identify potential contributions of trait impulsivity to the social reflection impulsivity-physical aggression relationship. The MPQ-B is a reliable and valid measure of personality, and the Constraint score is a commonly used measure of impulsivity in research on aggression and externalizing behaviors (Kotov, Gamez, Schmidt, & Watson, 2010; Krueger et al., 2002).

Structured Clinical Interview for DSM-5 Disorders Substance Use Disorders

Module (SCID-5 SUD; First, Williams, Karg, & Spitzer, 2015). The SCID-5 SUD was used

to determine diagnoses of current (past year) or past (prior to the past year) alcohol use disorder

(AUD) and substance use disorder (SUD). A diagnosis of AUD or SUD was given if at least two

symptoms were present.

Psychopathy Checklist–Revised (PCL-R; Hare, 2003). The PCL-R is an interview-

based measure that assesses 20 items related to psychopathic traits and behavior (e.g.,

glibness/superficial charm, shallow affect, impulsivity, poor behavior controls). Interviewers

score each item from 0 to 2, with 0 indicating that the item does not apply to the individual, 1

indicating that the item applies to a certain extent, and 2 indicating that the item applies to the

individual. Scores can range from 0 to 40, with higher scores indicating higher resemblance to a

prototypical psychopath. Inter-rater reliability based on 21.42% of the sample was .98 for PCL-R

total score. Information gathered as part of the PCL-R was used to assess Antisocial Personality

Disorder (APD) symptoms based on the Diagnostic and Statistical Manual of Mental Disorders

(DSM) criteria for APD (American Psychiatric Association, 2013).

Reactive-Proactive Aggression Questionnaire (RPQ; Raine et al., 2006). The RPQ is

a 23-item self-report measure designed to assess aggression according to motivations for

engaging in aggressive acts. Participants rate each item on a scale of 0-2 (0="never,"

1="sometimes," 2="often") based on how often they perform specific aggressive behaviors. The

RPQ consists of two subscales: a reactive aggression subscale (11 items) and a proactive

aggression subscale (12 items). Higher scores for each subscale indicate higher levels of reactive

and proactive aggression, respectively. For this sample, good internal consistency was

demonstrated for each subscale (Proactive Aggression Cronbach's α=.87, Reactive Aggression Cronbach's α=.79).

Need for Closure Scale (NCS; Kruglanski, Webster, & Klem, 1993). The NCS is a 42-item self-report questionnaire that measures an individual's motivated proclivity to obtain firm answers and to avoid ambiguity (Kruglanski et al., 1993; Webster & Kruglanski, 1996). Participants respond to each of 42 items using a 6-point Likert scale (1 ="strongly disagree" to 6="strongly agree"). The NCS consists of five subscales: desire for predictability (8 items), need for order (10 items), intolerance of ambiguity (9 items), decisiveness (7 items), and closed-mindedness (8 items). Internal consistency for the NCS was acceptable (Cronbach's α=.77).

Supplementary Results

Controlling for social information sampling task "accuracy"

In order to ensure that highly aggressive individuals' performance on the social information sampling task was not attributable to differences in "accuracy" (e.g., identifying someone as "nasty" when most of the behaviors they engaged in were negative), all primary analyses were run with "accuracy" (z-scored) included as a covariate. When controlling for "accuracy," all of the results remained the same. Crucially, even after controlling for "accuracy," the association between physical aggression and social reflection impulsivity remained, B=-1.46, SE=0.63, p=.023, 90% CI [-2.46, -0.62].

Controlling for executive functioning

In order to rule out inhibition (a major component of executive functioning) as a potential confound, all primary analyses were run with the D-KEFS CWIT Inhibition/Naming Contrast Scaled Score (z-scored) included as a covariate. When controlling for inhibition, all of the results remained the same except for one slight difference in the analysis of subjective certainty.

Specifically, when controlling for inhibition, we failed to detect a condition×physical aggression interaction, $F(1,82)=3.27$, $p=.074$, $\eta_p^2=.04$, 90% CI [0.00, 0.13]. Crucially, however, even after controlling for inhibition, the association between physical aggression and social reflection impulsivity remained, $B=-1.86$, $SE=0.76$, $p=.016$, 90% CI [-3.05, -0.78].

Controlling for IQ and reading ability

In order to ensure that highly aggressive individuals' performance on the social information sampling task was not attributable to differences in IQ, which is inversely related to aggressive behavior (Séguin, Nagin, Assaad, & Tremblay, 2004), or reading ability, which may have impacted performance of the task since stimuli were read, all primary analyses were run with IQ (z-scored) and reading level (z-scored) included as covariates. When controlling for IQ, all of the results remained the same except for some slight differences in the analyses of frequency of social judgments and subjective certainty. First, in terms of frequency of social judgments, controlling for IQ introduced a main effect of physical aggression on social judgments, $F(1,91)=4.40$, $p=.039$, $\eta_p^2=.05$, 90% CI [0.001, 0.14], such that more physically aggressive individuals made *fewer* hostile social judgments, $B=-0.04$, $SE=0.02$, $p=.038$, 90% CI [-0.07, -0.01]. Second, in terms of subjective certainty, when controlling for IQ, we failed to detect a condition×physical aggression interaction, $F(1,84)=3.09$, $p=.083$, $\eta_p^2=.04$, 90% CI [0.00, 0.12]. The same exact pattern was found when controlling for reading ability (condition×physical aggression interaction: $F(1,84)=3.71$, $p=.057$, $\eta_p^2=.04$, 90% CI [0.00, 0.13]).

Controlling for trait impulsivity

In order to rule out trait impulsivity as a potential confound, all primary analyses were run with trait impulsivity (MPQ-B Constraint z-scored) included as a covariate. When controlling for trait impulsivity, all of the results remained the same. Crucially, even after

controlling for trait impulsivity, the association between physical aggression and social reflection impulsivity remained, B=-1.80, SE=0.77, p=.022, 90% CI [-2.95, -0.71].

Controlling for substance use disorders

Based on research indicating that substance misuse is associated with heightened reflection impulsivity (Clark, Robbins, Ersche, & Sahakian, 2006; Clark, Roiser, Robbins, & Sahakian, 2009) and frequently co-occurs with aggressive behavior (Garofalo & Wright, 2017; Krueger, Markon, Patrick, Benning, & Kramer, 2007), we wanted to ensure that the relationship between physical aggression and social reflection impulsivity was not attributable to substance misuse. To do this, linear regression analyses were run with substance use disorder diagnosis (a dummy variable indicating whether the participant has ever in his lifetime met criteria for a substance use disorder) included as a covariate. In these analyses, the association between physical aggression and social reflection impulsivity remained, B=-1.92, SE=0.74, p=.011, 90% CI [-3.15, -0.70]. The association also remained after controlling for reflection impulsivity in the non-social task as well (i.e., both SUD diagnosis and non-social reflection impulsivity were entered as covariates), B=-0.99, SE=0.40, p=.016, 90% CI [-1.66, -0.32].

Controlling for Psychopathy and Antisocial Personality Disorder symptoms

In order to ensure that highly aggressive individuals' performance on the social information sampling task was not attributable to Psychopathy or APD symptoms (both of which are robustly associated with aggressive behavior; Hare & McPherson, 1984; Raine, Lencz, Bihrle, LaCasse, & Colletti, 2000), all primary analyses were run with PCL-R total score (z-scored) and APD symptom count (z-scored) included as covariates, respectively. When controlling for Psychopathy, all of the results remained the same except for some slight differences in the analyses of frequency of social judgments and subjective certainty. First, in

terms of frequency of social judgments, controlling for Psychopathy introduced a main effect of physical aggression on social judgments, $F(1,91)=4.83$, $p=.030$, $\eta_p{}^2=.05$, 90% CI [0.003, 0.15], such that more physically aggressive individuals made *fewer* hostile social judgments, $B=-0.40$, $SE=0.02$, $p=.029$, 90% CI [-0.07, -0.01]. The same pattern was found when controlling for APD symptoms, $F(1,91)=5.94$, $p=.017$, $\eta_p{}^2=.06$, 90% CI [0.01, 0.16], such that more physically aggressive individuals made *fewer* hostile social judgments when controlling for APD symptoms, $B=-0.43$, $SE=0.02$, $p=.016$, 90% CI [-0.07, -0.01]. Second, in terms of subjective certainty, when controlling for Psychopathy, we failed to detect a judgment×physical aggression interaction, $F(1,84)=3.68$, $p=.058$, $\eta_p{}^2=.04$, 90% CI [0.00, 0.13]. The same pattern was found when controlling for APD symptoms, $F(1,84)=3.42$, $p=.068$, $\eta_p{}^2=.04$, 90% CI [0.00, 0.13]).

Generalizability of findings to different types of aggression

In order to assess whether the findings reported here apply to general aggression (operationalized as the AQ Total score), the primary analyses were run with AQ Total score (z-scored) as the independent variable instead of the AQ Physical Aggression score. We failed to detect an association between general aggression and social reflection impulsivity, $B=-0.16$, $SE=0.11$, $p=.132$, 90% CI [-0.34, 0.02]. However, there was a judgment×general aggression interaction, $F(1,88)=6.65$, $p=.012$, $\eta_p{}^2<.01$, 90% CI [0.01, 0.17]. Specifically, participants with higher levels of general aggression demonstrated higher reflection impulsivity when they judged a person as nasty compared to when they judged a person a nice. However, we failed to detect a simple main effect of general aggression on reflection impulsivity in the context of hostile judgments, $B=-1.44$, $SE=0.76$, $p=.061$, 90% CI [-2.70, -0.18], as well as in the context of benign judgments, $B=-0.46$, $SE=0.85$, $p=.592$, 90% CI [-1.88, 0.96]. Finally, the 2 (condition: partial information, full information) × 2 (judgment: nasty, nice) repeated measures GLM revealed a

main effect of general aggression on certainty, such that more aggressive individuals endorsed higher certainty about their social judgments, $F(1,84)=7.03$, $p=.010$, $\eta_p^2=.08$, 90% CI [.01, .18]. We failed to detect any other effects in the remaining analyses.

In order to assess whether the findings reported here apply to different forms of aggression (reactive and proactive aggression), the primary analyses were run with RPQ Reactive Aggression (z-scored) and RPQ Proactive Aggression (z-scored) scores as the independent variables. Regression analyses failed to detect associations between proactive aggression and social reflection impulsivity, $B=-0.17$, $SE=0.11$, $p=.121$, 90% CI [-0.34, 0.01], and between reactive aggression and social reflection impulsivity, $B=-0.11$, $SE=0.11$, $p=.301$, 90% CI [-0.29, 0.07].[1] We also failed to detect a judgment×aggression interaction (with social reflection impulsivity as the DV) for both proactive and reactive aggression. However, in terms of certainty, there were main effects of both proactive aggression, $F(1,84)=6.96$, $p=.010$, $\eta_p^2=.08$, 90% CI [0.01, 0.18], and reactive aggression, $F(1,84)=4.16$, $p=.044$, $\eta_p^2=.05$, 90% CI [0.001, 0.14], on certainty, such that more proactively aggressive individuals and more reactively aggressive individuals endorsed higher certainty about their social judgments overall. Furthermore, both proactive aggression, $F(1,84)=6.59$, $p=.012$, $\eta_p^2=.07$, 90% CI [0.01, 0.17], and reactive aggression, $F(1,84)=4.40$, $p=.039$, $\eta_p^2=.05$, 90% CI [0.001, 0.14], interacted with condition to predict certainty. For proactive aggression, more proactively aggressive individuals were more certain in the full condition compared to the partial condition (simple main effect of proactive aggression in the full information condition: $B=10.39$, $SE=4.24$, $p=.001$, 90% CI [5.18, 15.59], simple main effect of proactive aggression in the partial information condition: $B=3.67$,

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[1] We also examined residualized scores on RPQ Reactive Aggression (variance associated with RPQ Proactive Aggression partialled out) and RPQ Proactive Aggression (variance associated with RPQ Reactive Aggression partialled out) as independent variables. Results were similar for residualized reactive and proactive aggression scores.

SE=2.79, *p*=.192, 90% CI [-0.96, 8.30]). The same pattern of results was found for reactive aggression: more reactively aggressive individuals were more certain in the full information condition compared to the partial information condition (simple main effect of reactive aggression in the full information condition: *B*=9.18, *SE*=3.17, *p*=.005, 90% CI [3.90, 14.45], simple main effect of reactive aggression in the partial information condition: *B*=4.31, *SE*=2.78, *p*=.124, 90% CI [-0.30, 8.93]). In addition, there was a condition×judgment×reactive aggression interaction, $F(1,84)=8.92$, *p*=.004, η_p^2=.10, 90% CI [0.02, 0.20], such that more reactively aggressive participants were more certain when making hostile judgments in the full information condition, *B*=14.67, *SE*=4.10, *p*=.001, 90% CI [7.85, 21.48].

Role of need for closure in aggressive individuals' judgment certainty

Since the finding that physical aggression was related to greater certainty in the full (versus partial) information condition was unexpected, we conducted a follow-up analysis to determine whether a potential third variable might shed light on the relationship (MacKinnon, Krull, & Lockwood, 2000). We reasoned that need for closure, an individual's motivation to have a firm understanding and avoid ambiguity (Kruglanski & Webster, 1996), might contribute to an individual's sense of certainty about a decision, particularly when they are under the impression that they have all of the information relevant for making the decision. We noted that this construct was positively associated with physical aggression in the present sample (see Supplementary Table 1), making it a potential candidate for elucidating physically aggressive individuals' performance on the social information sampling task. After adding the NCS Total score as a covariate in the GLM, we failed to detect a condition×physical aggression interaction, $F(1, 84)=2.58$, *p*=.112, η_p^2=.03, 90% CI [0.00, 0.11], suggesting that a need for closure may be implicated in heightening physically aggressive individuals' certainty in the full information

condition. The judgment×physical aggression interaction, on the other hand, remained, $F(1,$ 84)=3.99, p=.049, η_p^2=.05, 90% CI [0.0001, 0.13].

Supplementary Discussion

Across supplementary analyses, the effects reported in the main analyses are largely specific to physical aggression, with few effects seen for general aggression and subtypes of aggression (i.e., reactive and proactive). Furthermore, the effects reported in the main analyses are robust, with little impact of task "accuracy," executive functioning, IQ, reading ability, trait impulsivity, substance use disorders, Psychopathy, and APD symptoms. Therefore, the social information sampling task appears to tap into deficits that are highly specific to physical aggression, rather than being associated with other forms of aggression, psychiatric diagnoses, or decrements in IQ or reading ability.

In addition to examining the robustness and specificity of the main analyses, we also explored whether need for closure affects the relationship between aggression and certainty in the context of varying levels of available information. Broadly speaking, heightened need for closure represents a stronger need to reduce ambiguity in decision-making. More specifically, in the present study, heightened need for closure appears to intensify the conviction with which aggressive individuals seize upon social judgments when they are under the impression that they have all of the relevant information about a person. Heightened need for closure can lead to confident but misguided social judgments because in the real world it is never possible to have all of the information needed for judging another person (e.g., the thoughts and intentions of others are never completely knowable and thus always retain some degree of ambiguity). Taken together, the results of this supplementary analysis indicate that heightened need for closure may strengthen the sense of certainty aggressive individuals feel when judging others, and future

research should more directly examine the role of need for closure in aggressive individuals'

social decision-making and social behavior.

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Supplementary Table 1

Sample Characteristics for Final Sample and Correlations among Key Variables

Variable	N	Mean	SD	Range	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1) Age	93	34.73	10.28	21-59	--																		
2) Race					.14	--																	
White	44																						
Black	49																						
3) Ethnicity					-.14	-.26*	--																
Not Hispanic	72																						
Hispanic	21																						
4) IQ	93	104.12	11.52	77-122	-.04	-.20	-.14	--															
5) Reading level	93	10.56	1.74	6-12	-.10	-.22*	-.11	.66*	--														
6) AQ Physical Aggression	93	24.62	6.66	11-38	-.23*	.22*	.24*	-.22*	-.17	--													
7) AQ Total	93	73.72	14.73	44-115	-.19	.14	.13	-.17	-.17	.76*	--												
8) RPQ Proactive Aggression	93	5.22	4.38	0-17	-.21*	.05	.27*	-.15	-.10	.66*	.54*	--											
9) RPQ Reactive Aggression	93	10.78	3.71	3-20	-.21*	.05	.23*	.03	.01	.65*	.66*	.72*	--										
10) Assault charges	93	1.65	3.23	0-20	.14	.06	.08	-.09	-.16	.17	.19	.04	.12	--									
11) PCL-R Total	93	22.83	7.15	6.3-35	.12	.26*	.12	-.09	.13	.41*	.24*	.34*	.25*	.27*	--								
12) APD symptoms	93	3.73	1.75	0-7	.08	.14	.04	-.17	.05	.38*	.29*	.35*	.30*	.14	.72*	--							
13) Lifetime SUD diagnosis					-.20	.03	.11	-.22*	-.09	.19	.00	.33*	.20	-.15	.25*	.32*	--						
No diagnosis	16																						
Diagnosis	77																						
14) NCS Total	93	169.97	16.49	129-207	-.08	.03	.03	.01	.12	.22*	.31*	.15	.27*	.12	.16	.07	.07	--					
15) Boxes opened social task	93	16.07	7.14	1-25	-.11	-.14	.05	.31*	.29*	-.23*	-.15	-.14	-.09	-.20	-.04	-.10	.09	-.01	--				
16) Boxes opened non-social task	93	17.12	7.41	1-25	-.09	-.13	-.02	.31*	.31*	-.16	-.17	-.10	-.07	-.26*	.02	-.02	.13	-.03	.85*	--			
17) Accuracy non-social task	93	.78	.16	.35-1.0	-.02	-.21*	-.04	.38*	.38*	-.15	-.19	-.09	-.06	-.19	-.11	.02	.01	.04	,51*	.63*	--		
18) Hostile judgments	93	.53	.17	.1-1.0	-.22*	-.11	.16	-.06	.13	-.12	-.10	.03	.03	-.11	-.02	.05	.25*	.08	.18	.22*	.25*	--	
19) Certainty	93	38.17	26.33	-23.45-94.90	.02	-.06	-.06	-.02	-.09	.10	.22*	.21*	.21	.16	.10	.20	-.07	.06	.02	.08	.21*	.06	--

Note. Correlations including race, ethnicity, and SUD diagnosis used Spearman's ρ (all other correlations used Pearson's *r*); AQ = Buss Perry Aggression Questionnaire, RPQ = Reactive Proactive Aggression Questionnaire, SUD = substance use disorder, IQ = WAIS IQ estimate from the Shipley Institute of Living Scale, Reading level = reading level from the Wide Range Achievement Test 3 Reading Subtest, PCL-R = Psychopathy Checklist—Revised, APD = Antisocial Personality Disorder, NCS = Need for Closure Scale. * $p < .05$

Supplementary Table 2

Criminal Charges for Final Sample

Crime type	N (% of sample) charged with crime type	Mean charge count	SD	Range
Violent	89 (95.7%)	6.39	7.51	0-35
Weapon	56 (60.2%)	1.81	2.73	0-14
Assault	49 (52.7%)	1.65	3.23	0-20
Murder	35 (37.6%)	1.32	0.66	0-10
Robbery	27 (29.0%)	1.15	2.84	0-15
Sex	24 (25.8%)	2.66	0.95	0-20
Kidnapping	8 (8.6%)	0.18	0.74	0-5
Non-violent	80 (86.0%)	10.75	17.48	0-105
Theft	48 (51.6%)	3.82	11.99	0-101
Escape	47 (50.5%)	1.06	1.77	0-12
Obstruction of justice	45 (48.4%)	1.22	1.90	0-10
Drug	44 (47.3%)	1.56	2.59	0-12
Negligence/driving	31 (33.3%)	0.58	0.97	0-4
Fraud	10 (10.8%)	1.02	7.07	0-66
Crimes against state	1 (1.1%)	0.02	0.21	0-2
Miscellaneous minor	44 (47.3%)	1.47	2.98	0-23

Supplementary Table 3

Institutional Infractions for Final Sample

Infraction type	N (% of sample) charged with infraction type	Mean infraction count	SD	Range
Threats to security	45 (48.4%)	1.20	1.98	0-10
Violations against persons	43 (46.2%)	1.68	3.32	0-19
Substance use violations	16 (17.2%)	0.21	0.48	0-2
Violations against property	14 (15.1%)	0.16	0.40	0-2
Other	54 (58.1%)	3.24	4.59	0-21
Total (any infraction)	70 (75.3%)	7.46	12.59	0-93