Supplemental Material

Sense of agency in social hierarchies

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Supplementary Methods and Exploratory Analyses

Experiment 1

Methods

The original German wording of the ratings are shown in Supplementary Table 1.

Supplementary Table 1. Original German wording of the rating questions. Verbal anchors are shown in parentheses.

	English	German
Perceived causation	"How much did you just feel you caused the win or loss to happen?" (from "not at all" to "completely")	Wie sehr haben Sie sich gerade als Verursacher des Gewinnes bzw. Verlustes gefühlt" (from "überhaupt nicht" to "völlig")
Attributed causation (self/we/other)	"Who caused the win or loss the most?" (from "the other" to "we together" to "myself")	"Wer hat den Gewinn bzw. Verlust am Stärksten verursacht?" (from "der Andere" to "wir zusammen" to "ich")
Perceived responsibility	"How much did you just feel responsible for the win or loss?" (from "not at all" to "completely")	"Wie sehr fühlen Sie sich für den Gewinn bzw. Verlust verantwortlich?" (from "überhaupt nicht" to "völlig")
Attributed responsibility (self/we/other)	"Who is most responsible the win or loss?" (from "the other" to "we together" to "myself")	"Wer ist für den Gewinn bzw. Verlust am Stärksten verantwortlich?" (from "der Andere" to "wir zusammen" to "ich")
Happiness with outcome (HWO)	"How happy are you with the result of the last trial?" (from "I am disappointed" to "undecided" to "I am happy")	"Wie zufrieden sind Sie mit dem Ergebnis der letzten Durchganges?" (from "ich bin enttäuscht" to "unentschieden" to "ich bin zufrieden")

As personality measures, we additionally asked all participants to answer questionnaires regarding their tendency to objectify others (Gruenfeld et al., 2008) as well as the NEO-FFI (Costa & McCrae, 1992) with its subscales Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness.

All personality scales came with satisfactory reliability, Cronbach's α > .70 (see Supplementary Table 2), with the sole exception of the "Objectification Scale" whose interpretation therefore has to be taken with caution.

Results

As a purely exploratory analysis, we correlated personality scores of the NEO-FFI subscales and the objectification scale with the participants' mean perceived causation, perceived responsibility, and happiness with outcome rating.

Across roles, no significant relationships emerged between personality scores and their experimental ratings. However, responsibility ratings correlated slightly with Neuroticism scores, r = .19, p = .067, 95% CI [-.01; .39]. When separated by role, interestingly another association became visible: supervisors were happier with the outcome, the higher their tendency to objectify others, r = .39, p = .009, 95% CI [.10; .61]. In contrast, subordinates were happier with the investment outcome the lower their tendency to objectify others, r = -.42, p = .005, 95% CI [-.63; -.14]. The subordinates' happiness with outcome seemed further negatively associated with their conscientiousness, r = -.29, p = .054, 95% CI [-.54; <.01]. Moreover, supervisors showed higher sense of agency (perceived causation) ratings, the higher their "Openness to Experience" score, r = .30, p = .047, 95% CI [<.01; .54]. All other correlations remained non-significant. Please note, however, that the lack of further associations may be due to the low statistical power of the correlational analysis.

Detailed descriptive and inferential statistics of the main analyses

Supplementary Table 2. Descriptive statistics of all measured personality constructs.

	Mean	SD	Min	Max	Cronbach's α
Objectification	4.17	0.81	2.10	5.80	.68
Extraversion	2.40	0.59	0.75	3.75	.82
Agreeableness	2.72	0.58	1.17	3.67	.81
Conscientiousness	2.73	0.66	1.08	4.00	.87
Neuroticism	1.78	0.64	0.42	3.17	.84
Openness	2.61	0.53	1.17	3.83	.72

Supplementary Table 3. Experiment 1: Perceived causation and attributed causation results.

Perceived Causation	*F*	df	*p*	η_p^2
***Role	22.66	1, 88	< .001	.21
Money Choice	1.33	1, 88	.253	.02
***Role x Money Choice	381.58	1, 88	< .001	.81
Stock Choice	0.72	1, 88	.399	< .01
***Role x Stock Choice	408.75	1, 88	< .001	.82
***Money Choice x Stock Choice	31.67	1, 88	< .001	.27
***Role x Money Choice x Stock Choice	18.89	1, 88	< .001	.18
Attributed Causation	*t*	*df*	*p*	*d*
***Supervisor (tested against 50)	6.18	44	< .001	0.92
Subordinate (tested against 50)	-0.51	44	.615	-0.08
Perceived Causation x Valence of Outcome	*F*	df	*p*	η_p^2
***Role	30.38	1, 88	< .001	.26
Valence of Outcome	1.43	2, 176	.243	.02
Role x Valence of Outcome	2.13	2, 176	.122	.02

***indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 4. Experiment 1: Perceived responsibility and attributed responsibility results.

Perceived Responsibility	*F*	df	*p*	η_p^2
***Role	33.77	1, 88	< .001	.28
Money Choice	3.12	1, 88	.081	.03
***Role x Money Choice	288.06	1, 88	< .001	.76
Stock Choice	3.59	1, 88	.061	.04
***Role x Stock Choice	236.80	1, 88	< .001	.79
***Money Choice x Stock Choice	17.02	1, 88	< .001	.16
***Role x Money Choice x Stock Choice	44.21	1, 88	< .001	.33
Perceived Responsibility Overall	*t*	df	*p*	*d*
***Summed-up score of both roles (tested against 100)	7.59	44	< .001	1.13
Attributed Responsibility	*t*	df	*p*	*d*
***Supervisor (tested against 50)	6.10	44	< .001	0.91
Subordinate (tested against 50)	-1.27	44	.211	-0.19
Perceived Responsibility x Valence of Outcome	*F*	df	*p*	η_p^2
***Role	38.28	1, 88	< .001	.30
Valence of Outcome	2.49	2, 176	.086	.03
Role x Valence of Outcome	2.95	2, 176	.055	.03

***indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 5. Experiment 1: Happiness with Outcome.

Happiness with Outcome	*F*	df	*p*	η_p^2
Role	1.41	1, 88	.238	.02
Money Choice	0.14	1, 88	.712	< .01
Role x Money Choice	1.57	1, 88	.214	.02
Stock Choice	2.26	1, 88	.137	.03
*Role x Stock Choice	6.57	1, 88	.012	.07
Money Choice x Stock Choice	0.10	1, 88	.754	< .01
Role x Money Choice x Stock Choice	< 0.01	1, 88	.956	< .01
Follow up: Role x Stock Choices	*t*	df	*p*	*d*
*Supervisor (Stock Choice Sup vs. Sub)	2.52	44	.015	0.38
Subordinate (Stock choice Sup vs. Sub)	-0.89	44	.376	-0.13
Happiness with Outcome x Valence of Outcome	*F*	df	*p*	η_p^2
Role	3.19	1, 88	.078	.04
***Valence of Outcome	668.23	2, 176	< .001	.88
Role x Valence of Outcome	0.10	2, 176	.902	< .01

***indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 6. Experiments 2-3: Perceived causation results.

Perceived Causation	*F*	df	*p*	η_p^2
Experiment	0.17	1, 104	.677	< .01
***Role	627.06	1, 104	< .001	.86
**Experiment x Role	7.77	1, 104	.006	.07
***Execution	65.47	1, 104	< .001	.39
Experiment x Execution	1.00	1, 104	.320	< .01
***Role x Execution	196.14	1, 104	< .001	.65
***Experiment x Role x Execution	23.34	1, 104	< .001	.18
Follow-up: Experiment x Role x Execution	*t*	*df*	*p*	*d*
***Experiment 2: Supervisor (Exec Sup vs. Sub)	4.55	53	< .001	0.62
***Experiment 2: Subordinate (Exec Sup vs. Sub)	-6.69	53	< .001	-0.91
***Experiment 3: Supervisor (Exec Sup vs. Sub)	8.76	51	< .001	1.22
***Experiment 3: Subordinate (Exec Sup vs. Sub)	-10.66	51	< .001	-1.48
***Supervisor: Exec Sub (Experiments 2-3)	3.45	104	< .001	0.67
**Subordinate: Exec Sub (Experiments 2-3)	-2.66	104	.009	-0.52
Perceived Causation x Valence of Outcome	*F*	df	*p*	η_p^2
Experiment	0.42	1, 98	.519	< .01
***Role	568.21	1, 98	< .001	.85
***Experiment x Role	12.64	1, 98	< .001	.11
Valence of Outcome	2.50	2, 196	.085	.03
Experiment x Valence of Outcome	0.43	2, 196	.650	< .01
Role x Valence of Outcome	0.63	2, 196	.532	< .01
*Experiment x Role x Valence of Outcome	3.32	2, 196	.038	.03

*** indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 7. Experiments 2-3: Perceived responsibility results.

Perceived Responsibility	*F*	df	*p*	η_p^2
Experiment	0.12	1, 104	.729	< .01
***Role	681.26	1, 104	< .001	.87
**Experiment x Role	7.38	1, 104	.008	.07
***Execution	81.07	1, 104	< .001	.44
Experiment x Execution	0.40	1, 104	.529	< .01
***Role x Execution	171.35	1, 104	< .001	.62
***Experiment x Role x Execution	24.30	1, 104	< .001	.19
Follow-up: Experiment x Role x Execution	*t*	*df*	*p*	*d*
*Experiment 2: Supervisor (Exec Sup vs. Sub)	2.48	53	.016	0.34
***Experiment 2: Subordinate (Exec Sup vs. Sub)	-6.81	53	< .001	-0.93
***Experiment 3: Supervisor (Exec Sup vs. Sub)	9.04	51	< .001	1.25
***Experiment 3: Subordinate (Exec Sup vs. Sub)	-9.94	51	< .001	-1.38
Rating Type (Causation vs. Responsibility)	*F*	df	*p*	η_p^2
Experiment	0.15	1, 104	.698	< .01
*Rating Type	4.36	1, 104	.039	.04
Experiment x Rating Type	0.03	1, 104	.856	< .01
***Role	688.82	1, 104	< .001	.87
**Experiment x Role	7.99	1, 104	.006	.07
***Execution	79.01	1, 104	< .001	.43
Experiment x Execution	0.72	1, 104	.397	< .01
Rating Type x Role	0.57	1, 104	.453	< .01
Experiment x Rating Type x Role	0.11	1, 104	.746	< .01
Rating Type x Execution	1.71	1, 104	.193	.02
Experiment x Rating Type x Execution	0.49	1, 104	.487	< .01
***Role x Execution	194.53	1, 104	< .001	.65
***Experiment x Role x Execution	25.24	1, 104	< .001	.20
Rating Type x Role x Execution	3.44	1, 104	.067	.03
Experiment x Rating Type x Role x Execution	0.05	1, 104	.818	< .01
Perceived Responsibility x Valence of Outcome	*F*	df	*p*	η_p^2
Experiment	0.14	1, 98	.712	< .01
***Role	633.18	1, 98	< .001	.87
**Experiment x Role	10.65	1, 98	.002	.10
Valence of Outcome	2.56	2, 196	.080	.03
Experiment x Valence of Outcome	0.17	2, 196	.848	< .01
Role x Valence of Outcome	0.54	2, 196	.583	< .01
Experiment x Role x Valence of Outcome	2.35	2, 196	.098	.02

*** indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 8. Experiments 2-3: Happiness with outcome results.

Happiness with Outcome	*F*	df	*p*	η_p^2	ε
**Experiment	7.32	1, 104	.008	.07	
**Role	9.16	1, 104	.003	.08	
Experiment x Role	1.96	1, 104	.165	.02	
Execution	< 0.01	1, 104	.950	< .01	
Experiment x Execution	3.52	1, 104	.063	.03	
Role x Execution	3.04	1, 104	.084	.03	
Experiment x Role x Execution	0.38	1, 104	.540	< .01	
Happiness with Outcome x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	2.48	1, 98	.118	.03	
**Role	10.78	1, 98	.001	.10	
*Experiment x Role	5.29	1, 98	.024	.05	
***Valence of Outcome	685.01	1, 98	< .001	.88	0.68
Experiment x Valence of Outcome	0.13	2, 196	.796	< .01	0.68
**Role x Valence of Outcome	7.15	2, 196	.001	.07	
Experiment x Role x Valence of Outcome	0.51	2, 196	.600	< .01	

*** indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 9. Experiments 2-3: Excluding veto trials; effect of factor Experiment

Perceived Causation	*F*	df	*p*	η_p^2	ε
Experiment	0.12	1, 104	.728	< .01	
Experiment x Role	0.78	1, 104	.379	< .01	
Experiment x Execution	1.32	1, 104	.254	.01	
Experiment x Role x Execution	1.65	1, 104	.201	.02	
Perceived Causation x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	0.75	1, 98	.387	< .01	
Experiment x Role	1.31	1, 98	.256	.01	
Experiment x Valence of Outcome	0.98	2, 196	.377	.01	
Experiment x Role x Valence of Outcome	2.47	2, 196	.087	.03	
Perceived Responsibility	*F*	df	*p*	η_p^2	
Experiment	0.11	1, 104	.746	< .01	
Experiment x Role	0.61	1, 104	.438	< .01	
Experiment x Execution	0.43	1, 104	.516	< .01	
Experiment x Role x Execution	1.96	1, 104	.164	.02	
Perceived Responsibility x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	0.33	1, 98	.568	< .01	
Experiment x Role	0.51	1, 98	.475	< .01	
Experiment x Valence of Outcome	0.66	2, 196	.922	< .01	0.91
Experiment x Role x Valence of Outcome	1.10	2, 196	.334	.01	
Happiness with Outcome	*F*	df	*p*	η_p^2	
**Experiment	9.40	1, 104	.003	.08	
Experiment x Role	1.74	1, 104	.190	.02	
Experiment x Execution	1.66	1, 104	.200	.02	
Experiment x Role x Execution	0.27	1, 104	.602	< .01	
Happiness with Outcome x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	3.58	1, 98	.061	.04	
Experiment x Role	3.51	1, 98	.064	.04	
Experiment x Valence of Outcome	0.09	2, 196	.834	< .01	0.67
Experiment x Role x Valence of Outcome	0.45	2, 196	.640	< .01	

*** indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 10. Experiments 2-3: Excluding veto trials and trials without veto option; effect of factor Experiment

Perceived Causation	*F*	df	*p*	η_p^2	ε
Experiment	0.18	1, 100	.675	< .01	
Experiment x Role	1.56	1, 100	.215	.02	
Experiment x Execution	1.12	1, 100	.292	.01	
Experiment x Role x Execution	1.41	1, 100	.238	.01	
Perceived Causation x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	0.93	1, 92	.337	.01	
Experiment x Role	2.14	1, 92	.147	.02	
Experiment x Valence of Outcome	0.15	2, 184	.857	< .01	
*Experiment x Role x Valence of Outcome	3.21	2, 184	.043	.03	
Perceived Responsibility	*F*	df	*p*	η_p^2	
Experiment	0.18	1, 100	.669	< .01	
Experiment x Role	1.45	1, 100	.231	.01	
Experiment x Execution	0.30	1, 100	.585	< .01	
Experiment x Role x Execution	1.98	1, 100	.163	.02	
Perceived Responsibility x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	0.57	1, 92	.452	< .01	
Experiment x Role	1.18	1, 92	.280	.01	
Experiment x Valence of Outcome	1.24	2, 184	.292	.01	
Experiment x Role x Valence of Outcome	0.56	2, 184	.572	< .01	
Happiness with Outcome	*F*	df	*p*	η_p^2	
*Experiment	4.64	1, 100	.034	.04	
Experiment x Role	2.11	1, 100	.150	.02	
*Experiment x Execution	5.11	1, 100	.026	.05	
Experiment x Role x Execution	0.10	1, 100	.754	< .01	
Happiness with Outcome x Valence of Outcome	*F*	df	*p*	η_p^2	
Experiment	3.12	1, 92	.081	.03	
Experiment x Role	3.19	1, 92	.077	.03	
Experiment x Valence of Outcome	0.20	2, 184	.724	< .01	0.67
Experiment x Role x Valence of Outcome	1.18	2, 184	.310	.01	

*** indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Supplementary Table 11. Experiments 2-3: Order Effects

Perceived Causation	*F*	df	*p*	η_p^2
Experiment	0.10	1, 104	.758	< .01
***Role	614.73	1, 104	< .001	.86
**Experiment x Role	9.16	1, 104	.003	.08
Quantile	1.39	1, 104	.241	.01
Experiment x Quantile	0.63	1, 104	.430	< .01
**Role x Quantile	9.09	1, 104	.003	.08
**Experiment x Role x Quantile	8.82	1, 104	.004	.08
Perceived Responsibility	*F*	df	*p*	η_p^2
Experiment	0.05	1, 104	.832	< .01
***Role	670.77	1, 104	< .001	.86
**Experiment x Role	8.81	1, 104	.004	.08
Quantile	0.11	1, 104	.737	< .01
Experiment x Quantile	< 0.01	1, 104	.999	< .01
***Role x Quantile	13.94	1, 104	< .001	.12
**Experiment x Role x Quantile	9.86	1, 104	.002	.09
Happiness with Outcome	*F*	df	*p*	η_p^2
**Experiment	7.87	1, 104	.006	.07
**Role	8.50	1, 104	.004	.08
Experiment x Role	2.15	1, 104	.146	.02
Quantile	3.65	1, 104	.059	.03
Experiment x Quantile	1.84	1, 104	.178	.02
Role x Quantile	0.04	1, 104	.836	< .01
Experiment x Role x Quantile	0.21	1, 104	.652	< .01

*** indicates $p < .001$, ** indicates $p < .010$, * indicates $p < .050$

Responsibility ratings in Experiment 2 and 3

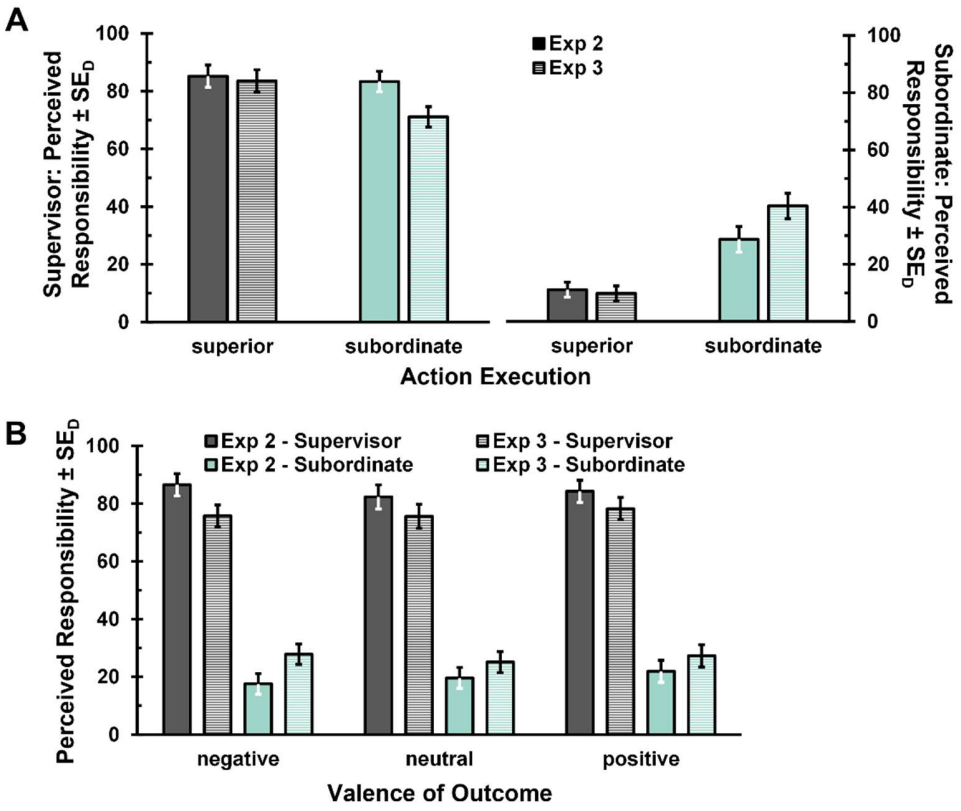

Figure S1. Results of Experiments 2 and 3. Results of Experiment 2 are colored solid, results of Experiment 3 are displayed in striped bars. *A.* The participants' perceived responsibility of the outcome dependent on role and action execution. Both, role (i.e., action decisions) and action execution, impacted the participants' perceived responsibility ratings. *B.* The participants' perceived responsibility dependent on outcome valence. Error bars depict standard error of the difference between experiments (SE_D, between-subjects).

References

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