Figures and figure supplements

Sperm competition risk drives rapid ejaculate adjustments mediated by seminal fluid

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Figure 1. Experimental design using a two-stage social status manipulation in chinook salmon. For each trial, in stage 1, four males of unknown social status were used to form two pairs and the social hierarchy within each pairing was then determined, assigning one male as dominant (D) and the other subdominant (S). After 48 hr, ejaculates were collected from each male (D, S, D, S). In stage 2, we reformed pairs, putting males with the same social status together, and re-determined the social hierarchy within each pairing. Males either retained the same status, dominant (DD) or subdominant (SS) in both stages, or changed status in either direction, dominant to subdominant (DS) or subdominant to dominant (SD). After 48 hr, ejaculates were recollected from each male (DD, DS, SD, SS).

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Figure 2. Sperm velocity (VAP in µm s⁻¹) in males of dominant (D) and subdominant (S) social status after a: the first social challenge (D, n = 22; S, n = 22) and b: the second social challenge (D, n = 19; S, n = 19). Boxplots display the median of each group with the 25th and 75th percentiles and whiskers extend to data within 1.5 x the inter-quartile range.

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Figure 2—figure supplement 1. Across all sperm samples collected in this study, Average Path Velocity (VAP) at 10 s post-activation was strongly correlated with Curvilinear Velocity (VCL; $r = 0.85$, $p < 0.0001$, $n = 126$).

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Figure 3. Sperm concentration (cells/ml) in males of dominant (D) and subdominant (S) social status after a: the first social challenge (D, n = 22; S, n = 22) and b: the second social challenge (D, n = 19; S, n = 19). Boxplots display the median of each group with the 25th and 75th percentiles and whiskers extend to data within 1.5 x the inter-quartile range.

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Figure 4. Average sperm velocity (VAP, μm s\(^{-1}\);±s.e.m.) and average sperm concentration (cells/ml;±s.e.m.) in males of the four social phenotypes after each stage of a social status manipulation experiment in chinook salmon. Blue colour denotes males dominant in both stages (DD, n = 10), green colour denotes males subdominant in both stages (SS, n = 9), a change from blue to green colour denotes males that changed from dominant to subdominant status (DS, n = 10) and a change from green to blue colour denotes males that changed from subdominant to dominant status (SD n = 9). The change in VAP for DS males was statistically significant.
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Figure 5. Average difference in sperm velocity (VAP, µm s⁻¹ ± s.e.m.) between sperm incubated in their own seminal fluid and incubated in the seminal fluid of their rival in each dyad of a social status manipulation experiment in chinook salmon (n = 42 males in 39 dyads). Seminal fluid from dominant rival males on average decreased VAP of sperm from subdominant males. In contrast, seminal fluid from rival subdominant males on average increased VAP of sperm from dominant males. Social status was a significant predictor of the difference in sperm velocity between sperm incubated in their own seminal fluid and incubated in the seminal fluid of their rival. DOI: https://doi.org/10.7554/eLife.28811.017
Figure 6. Significant linear relationship between the difference in sperm velocity (VAP, μm s⁻¹), between sperm incubated in their own seminal fluid and incubated in the seminal fluid of their rival, and the difference in VAP between sperm from the males in each pairing incubated in their own seminal fluid for each dyad of a social status manipulation experiment in chinook salmon (n = 42 males in 39 dyads). Incubating sperm in the seminal fluid of a rival with faster VAP generally results in an increase in that male’s sperm velocity. Likewise, incubating sperm in the seminal fluid of a rival with slower VAP generally results in a decrease in that male’s sperm velocity. Raw data is displayed for ease of interpretation, data analysis required transformation (refer to Materials and methods: Statistical analyses and supplementary material for details).

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Figure 7. Statistically significant relationship between the difference in the proportion of eggs sired by the focal male in each triad from sperm competition trials using chinook salmon (n = 20) when that male’s sperm were either incubated in their own or their rival’s seminal fluid, and the difference in relative sperm velocity (VAP, μm s⁻¹) between males in each pair when sperm were either incubated in their own or their rival’s seminal fluid. The relationship shows that change in fertilisation success across seminal fluid treatments is correlated with the change in relative sperm velocity between competing males in each seminal fluid treatment.

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