Supplementary Material

**More frequent, shorter trials enhance acquisition in a training session:**

**There is a free lunch!**

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The raw data are available at <https://github.com/santiagocdo/ABC_cells_paper>

For Tables S1, S2, and S3, the factor of reference was 36 for frequency and 800 for duration. Consequently, every coefficient (e.g., freq\_A144) was compared against the Baseline (e.g., freq\_A36).

# Experiment 1a

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| TableS1. |  |  |  |  |  |  |  |  |  |  |  |
| *Experiment 1a: Full Linear Mixed Model* | | | | | | | | | | | |
| Model | Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| Full | (Intercept) | -0.047 | 0.648 | -0.072 | 646.37 | > .1 | -0.205 | 0.134 | NA | -1.318 | 1.225 |
| freq\_A9 | -2.767 | 0.874 | -3.168 | 688.00 | < .01\*\* | -0.573 | 0.181 | medium | -4.482 | -1.053 |
| freq\_A144 | 5.744 | 0.874 | 6.575 | 688.00 | < .001\*\*\* | 1.190 | 0.181 | large | 4.030 | 7.459 |
| freq\_B9 | 3.070 | 0.874 | 3.514 | 688.00 | < .001\*\*\* | 0.636 | 0.181 | medium | 1.355 | 4.784 |
| freq\_B144 | -3.163 | 0.874 | -3.620 | 688.00 | < .001\*\*\* | -0.655 | 0.181 | medium | -4.877 | -1.448 |
| freq\_C9 | 3.326 | 0.874 | 3.807 | 688.00 | < .001\*\*\* | 0.689 | 0.181 | medium | 1.611 | 5.040 |
| freq\_C144 | -3.116 | 0.874 | -3.567 | 688.00 | < .001\*\*\* | -0.646 | 0.181 | medium | -4.831 | -1.402 |
| freq\_D9 | 0.163 | 0.874 | 0.186 | 688.00 | > .1 | 0.034 | 0.181 | very small | -1.552 | 1.877 |
| freq\_D144 | 1.256 | 0.874 | 1.438 | 688.00 | > .1 | 0.260 | 0.181 | small | -0.459 | 2.970 |
| dur\_A200 | 1.837 | 0.874 | 2.103 | 688.00 | < .05\* | 0.381 | 0.181 | small | 0.123 | 3.552 |
| dur\_A3200 | 1.907 | 0.874 | 2.183 | 688.00 | < .05\* | 0.395 | 0.181 | small | 0.192 | 3.622 |
| dur\_B200 | 2.093 | 0.874 | 2.396 | 688.00 | < .05\* | 0.434 | 0.181 | small | 0.378 | 3.808 |
| dur\_B3200 | -0.070 | 0.874 | -0.080 | 688.00 | > .1 | -0.014 | 0.181 | very small | -1.784 | 1.645 |
| dur\_C200 | 1.698 | 0.874 | 1.943 | 688.00 | = 0.05° | 0.352 | 0.181 | small | -0.017 | 3.412 |
| dur\_C3200 | 1.070 | 0.874 | 1.225 | 688.00 | > .1 | 0.222 | 0.181 | small | -0.645 | 2.784 |
| dur\_D200 | 2.302 | 0.874 | 2.635 | 688.00 | < .01\*\* | 0.477 | 0.181 | small | 0.588 | 4.017 |
| dur\_D3200 | 1.442 | 0.874 | 1.650 | 688.00 | = 0.1° | 0.299 | 0.181 | small | -0.273 | 3.156 |
| Note: Effect Size column is a label to the standardized coefficient (Coef\_std), which follows the standard interpretation of Cohen’s d. | | | | | | | | | | | |

# Experiment 1b

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| Table S2. |  |  |  |  |  |  |  |  |  |  |  |
| *Experiment 1b: Full Linear Mixed Model* | | | | | | | | | | | | |
| Model | Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| Full | (Intercept) | 0.791 | 0.749 | 1.055 | 458.74 | > .1 | 0.014 | 0.136 | NA | -0.681 | 2.262 |
| freq\_A9 | -3.465 | 0.952 | -3.639 | 688.00 | < .001\*\*\* | -0.631 | 0.173 | medium | -5.334 | -1.596 |
| freq\_A144 | 5.744 | 0.952 | 6.033 | 688.00 | < .001\*\*\* | 1.046 | 0.173 | large | 3.876 | 7.613 |
| freq\_B9 | 2.163 | 0.952 | 2.272 | 688.00 | < .05\* | 0.394 | 0.173 | small | 0.294 | 4.031 |
| freq\_B144 | -4.047 | 0.952 | -4.250 | 688.00 | < .001\*\*\* | -0.737 | 0.173 | medium | -5.915 | -2.178 |
| freq\_C9 | 1.605 | 0.952 | 1.685 | 688.00 | = 0.09° | 0.292 | 0.173 | small | -0.264 | 3.473 |
| freq\_C144 | -3.651 | 0.952 | -3.835 | 688.00 | < .001\*\*\* | -0.665 | 0.173 | medium | -5.520 | -1.782 |
| freq\_D9 | 0.000 | 0.952 | 0.000 | 688.00 | > .1 | 0.000 | 0.173 | very small | -1.869 | 1.869 |
| freq\_D144 | 0.047 | 0.952 | 0.049 | 688.00 | > .1 | 0.008 | 0.173 | very small | -1.822 | 1.915 |
| dur\_A200 | -2.233 | 0.952 | -2.345 | 688.00 | < .05\* | -0.407 | 0.173 | small | -4.101 | -0.364 |
| dur\_A3200 | 0.860 | 0.952 | 0.904 | 688.00 | > .1 | 0.157 | 0.173 | very small | -1.008 | 2.729 |
| dur\_B200 | 2.744 | 0.952 | 2.882 | 688.00 | < .01\*\* | 0.500 | 0.173 | small | 0.876 | 4.613 |
| dur\_B3200 | -0.953 | 0.952 | -1.001 | 688.00 | > .1 | -0.174 | 0.173 | very small | -2.822 | 0.915 |
| dur\_C200 | 1.953 | 0.952 | 2.052 | 688.00 | < .05\* | 0.356 | 0.173 | small | 0.085 | 3.822 |
| dur\_C3200 | -0.791 | 0.952 | -0.830 | 688.00 | > .1 | -0.144 | 0.173 | very small | -2.659 | 1.078 |
| dur\_D200 | -0.488 | 0.952 | -0.513 | 688.00 | > .1 | -0.089 | 0.173 | very small | -2.357 | 1.380 |
| dur\_D3200 | -0.767 | 0.952 | -0.806 | 688.00 | > .1 | -0.140 | 0.173 | very small | -2.636 | 1.101 |
| Note: Effect Size column is a label to the standardized coefficient (Coef\_std), which follows the standard interpretation of Cohen’s d. | | | | | | | | | | | |

# Experiment 1 (1a and 1b pooled)

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| Table S3. |  |  |  |  |  |  |  |  |  |  |  |
| *Experiment 1: Full Linear Mixed Model* | | | | | | | | | | | |
| Model | Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| Full | (Intercept) | 0.372 | 0.499 | 0.745 | 1089.71 | > .1 | -0.088 | 0.097 | NA | -0.607 | 1.351 |
| freq\_A9 | -3.116 | 0.652 | -4.776 | 1376.00 | < .001\*\*\* | -0.603 | 0.126 | medium | -4.396 | -1.837 |
| freq\_A144 | 5.744 | 0.652 | 8.804 | 1376.00 | < .001\*\*\* | 1.112 | 0.126 | large | 4.465 | 7.024 |
| freq\_B9 | 2.616 | 0.652 | 4.010 | 1376.00 | < .001\*\*\* | 0.506 | 0.126 | medium | 1.337 | 3.896 |
| freq\_B144 | -3.605 | 0.652 | -5.525 | 1376.00 | < .001\*\*\* | -0.698 | 0.126 | medium | -4.884 | -2.325 |
| freq\_C9 | 2.465 | 0.652 | 3.778 | 1376.00 | < .001\*\*\* | 0.477 | 0.126 | small | 1.185 | 3.745 |
| freq\_C144 | -3.384 | 0.652 | -5.186 | 1376.00 | < .001\*\*\* | -0.655 | 0.126 | medium | -4.663 | -2.104 |
| freq\_D9 | 0.081 | 0.652 | 0.125 | 1376.00 | > .1 | 0.016 | 0.126 | very small | -1.198 | 1.361 |
| freq\_D144 | 0.651 | 0.652 | 0.998 | 1376.00 | > .1 | 0.126 | 0.126 | very small | -0.628 | 1.931 |
| dur\_A200 | -0.198 | 0.652 | -0.303 | 1376.00 | > .1 | -0.038 | 0.126 | very small | -1.477 | 1.082 |
| dur\_A3200 | 1.384 | 0.652 | 2.121 | 1376.00 | < .05\* | 0.268 | 0.126 | small | 0.104 | 2.663 |
| dur\_B200 | 2.419 | 0.652 | 3.707 | 1376.00 | < .001\*\*\* | 0.468 | 0.126 | small | 1.139 | 3.698 |
| dur\_B3200 | -0.512 | 0.652 | -0.784 | 1376.00 | > .1 | -0.099 | 0.126 | very small | -1.791 | 0.768 |
| dur\_C200 | 1.826 | 0.652 | 2.798 | 1376.00 | < .01\*\* | 0.353 | 0.126 | small | 0.546 | 3.105 |
| dur\_C3200 | 0.140 | 0.652 | 0.214 | 1376.00 | > .1 | 0.027 | 0.126 | very small | -1.140 | 1.419 |
| dur\_D200 | 0.907 | 0.652 | 1.390 | 1376.00 | > .1 | 0.176 | 0.126 | very small | -0.373 | 2.187 |
| dur\_D3200 | 0.337 | 0.652 | 0.517 | 1376.00 | > .1 | 0.065 | 0.126 | very small | -0.942 | 1.617 |

Note: Effect Size column is a label to the standardized coefficient (Coef\_std), which follows the standard interpretation of Cohen’s d.

# Experiment 2

|  |  |  |  |  |  |  |  |  |  |  |
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| Table S4. |  |  |  |  |  |  |  |  |  |  |
| *Experiment 2: Full Linear Mixed Model (including duplicated Baseline, one per Cell type)* | | | | | | | | | | |
| Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| (Intercept) | 2.134 | 0.581 | 3.675 | 655.77 | < .001\*\*\* | 0.056 | 0.115 | NA | 0.994 | 3.274 |
| frequency9 | -3.767 | 0.671 | -5.617 | 867.11 | < .001\*\*\* | -0.820 | 0.146 | large | -5.082 | -2.451 |
| frequency144 | 5.048 | 0.669 | 7.543 | 867.01 | < .001\*\*\* | 1.099 | 0.146 | large | 3.735 | 6.361 |
| Adjusted yes | 0.000 | 0.669 | 0.000 | 867.00 | > .1 | 0.000 | 0.146 | very small | -1.313 | 1.313 |
| cellB | 0.000 | 0.669 | 0.000 | 867.00 | > .1 | 0.000 | 0.146 | very small | -1.313 | 1.313 |
| cellC | 0.000 | 0.669 | 0.000 | 867.00 | > .1 | 0.000 | 0.146 | very small | -1.313 | 1.313 |
| cond\_order | -0.030 | 0.031 | -0.955 | 890.45 | > .1 | -0.024 | 0.025 | very small | -0.090 | 0.031 |
| frequency9:adjusted yes | 0.905 | 0.947 | 0.956 | 867.02 | > .1 | 0.197 | 0.206 | very small | -0.952 | 2.762 |
| frequency144:adjusted yes | -1.007 | 0.946 | -1.064 | 867.00 | > .1 | -0.219 | 0.206 | small | -2.864 | 0.850 |
| frequency9:cellB | 5.960 | 0.946 | 6.298 | 867.00 | < .001\*\*\* | 1.298 | 0.206 | large | 4.103 | 7.817 |
| frequency144:cellB | -9.101 | 0.947 | -9.614 | 867.02 | < .001\*\*\* | -1.982 | 0.206 | large | -10.958 | -7.244 |
| frequency9:cellC | 5.177 | 0.947 | 5.470 | 867.01 | < .001\*\*\* | 1.127 | 0.206 | large | 3.320 | 7.034 |
| frequency144:cellC | -9.349 | 0.946 | -9.878 | 867.01 | < .001\*\*\* | -2.036 | 0.206 | large | -11.206 | -7.492 |
| adjustedyes:cellB | 0.000 | 0.946 | 0.000 | 867.00 | > .1 | 0.000 | 0.206 | very small | -1.857 | 1.857 |
| adjustedyes:cellC | 0.000 | 0.946 | 0.000 | 867.00 | > .1 | 0.000 | 0.206 | very small | -1.857 | 1.857 |
| frequency9:adjusted yes:cellB | -1.501 | 1.338 | -1.121 | 867.00 | > .1 | -0.327 | 0.291 | small | -4.127 | 1.125 |
| frequency144:adjustedyes:cellB | 2.042 | 1.338 | 1.525 | 867.01 | > .1 | 0.445 | 0.291 | small | -0.585 | 4.668 |
| frequency9:adjusted yes:cellC | -0.897 | 1.339 | -0.670 | 867.02 | > .1 | -0.195 | 0.292 | very small | -3.524 | 1.730 |
| frequency144:adjustedyes:cellC | 2.943 | 1.338 | 2.199 | 867.00 | < .05\* | 0.641 | 0.291 | medium | 0.317 | 5.569 |
| Note: Effect Size column is a label to the standardized coefficient (Coef\_std), which follows the standard interpretation of Cohen’s d | | | | | | | | | | |

## Post hoc

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| Table S5 |  |  |  |  |  |  |  |
| *Experiment 2: Post hoc analysis per event cell type* | | | |  |  |  |  |
| **Model** | **Effect** | **df** | **df\_Residuals** | **Sum\_Squares** | **Mean\_Square** | **F** | **p** |
| A | Frequency | 2 | 255.31 | 3163.94 | 1581.97 | 129.61 | < .001\*\*\* |
| Adj\_duration | 1 | 254.91 | 0.10 | 0.10 | 0.01 | > .1 |
| Condition order | 1 | 301.88 | 1.68 | 1.68 | 0.14 | > .1 |
| Frequency x Adj\_duration | 2 | 254.99 | 46.11 | 23.05 | 1.89 | > .1 |
|  |  |  |  |  |  |  |  |
| B | Frequency | 2 | 255.27 | 1550.57 | 775.29 | 72.07 | < .001\*\*\* |
| Adj\_duration | 1 | 254.92 | 1.58 | 1.58 | 0.15 | > .1 |
| Condition order | 1 | 292.01 | 1.91 | 1.91 | 0.18 | > .1 |
| Frequency x Adj\_duration | 2 | 254.86 | 34.65 | 17.32 | 1.61 | > .1 |
|  |  |  |  |  |  |  |  |
| C | Frequency | 2 | 255.00 | 1211.32 | 605.66 | 45.12 | < .001\*\*\* |
| Adj\_duration | 1 | 254.74 | 32.01 | 32.01 | 2.38 | > .1 |
| Condition order | 1 | 288.59 | 4.89 | 4.89 | 0.36 | > .1 |
| Frequency x Adj\_duration | 2 | 254.72 | 63.46 | 31.73 | 2.36 | = 0.1° |
| Note: Adj\_duration = adjusted in total exposure time by varying duration inversely to frequency. | | | | | | | |

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| Table S6. |  |  |  |  |  |  |  |  |  |  |
| *Experiment 3: Full Linear Mixed Model (including Baseline)* | | | | | | | | | | | |
| Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| (Intercept) | 1.502 | 0.750 | 2.002 | 253.66 | < .05\* | 0.023 | 0.147 | NA | 0.026 | 2.979 |
| dur600 | -0.946 | 0.781 | -1.212 | 989.02 | > .1 | -0.195 | 0.161 | very small | -2.478 | 0.586 |
| dur5400 | 0.552 | 0.780 | 0.708 | 989.00 | > .1 | 0.114 | 0.161 | very small | -0.978 | 2.083 |
| adjustedyes | 0.000 | 0.780 | 0.000 | 989.00 | > .1 | 0.000 | 0.161 | very small | -1.530 | 1.530 |
| cellB | 0.000 | 0.780 | 0.000 | 989.00 | > .1 | 0.000 | 0.161 | very small | -1.530 | 1.530 |
| cellC | 0.000 | 0.780 | 0.000 | 989.00 | > .1 | 0.000 | 0.161 | very small | -1.530 | 1.530 |
| cellD | 0.000 | 0.780 | 0.000 | 989.00 | > .1 | 0.000 | 0.161 | very small | -1.530 | 1.530 |
| cond\_order | -0.027 | 0.025 | -1.089 | 997.28 | > .1 | -0.027 | 0.024 | very small | -0.076 | 0.022 |
| dur600:adjustedyes | 5.376 | 1.103 | 4.874 | 989.00 | < .001\*\*\* | 1.107 | 0.227 | large | 3.212 | 7.541 |
| dur5400:adjustedyes | -2.339 | 1.103 | -2.120 | 989.00 | < .05\* | -0.481 | 0.227 | small | -4.503 | -0.175 |
| dur600:cellB | 1.119 | 1.104 | 1.014 | 989.01 | > .1 | 0.230 | 0.227 | small | -1.047 | 3.285 |
| dur5400:cellB | -2.340 | 1.104 | -2.120 | 989.01 | < .05\* | -0.482 | 0.227 | small | -4.505 | -0.175 |
| dur600:cellC | 1.136 | 1.103 | 1.030 | 989.00 | > .1 | 0.234 | 0.227 | small | -1.028 | 3.301 |
| dur5400:cellC | -0.954 | 1.103 | -0.865 | 989.00 | > .1 | -0.196 | 0.227 | very small | -3.119 | 1.210 |
| dur600:cellD | 0.753 | 1.103 | 0.682 | 989.01 | > .1 | 0.155 | 0.227 | very small | -1.412 | 2.917 |
| dur5400:cellD | -1.142 | 1.103 | -1.035 | 989.00 | > .1 | -0.235 | 0.227 | small | -3.307 | 1.022 |
| adjustedyes:cellB | 0.000 | 1.103 | 0.000 | 989.00 | > .1 | 0.000 | 0.227 | very small | -2.164 | 2.164 |
| adjustedyes:cellC | 0.000 | 1.103 | 0.000 | 989.00 | > .1 | 0.000 | 0.227 | very small | -2.164 | 2.164 |
| adjustedyes:cellD | 0.000 | 1.103 | 0.000 | 989.00 | > .1 | 0.000 | 0.227 | very small | -2.164 | 2.164 |
| dur600:adjustedyes:cellB | -7.619 | 1.560 | -4.883 | 989.00 | < .001\*\*\* | -1.568 | 0.321 | large | -10.680 | -4.558 |
| dur5400:adjustedyes:cellB | 4.021 | 1.560 | 2.578 | 989.00 | < .05\* | 0.828 | 0.321 | large | 0.960 | 7.081 |
| dur600:adjustedyes:cellC | -7.270 | 1.560 | -4.660 | 989.00 | < .001\*\*\* | -1.496 | 0.321 | large | -10.331 | -4.209 |
| dur5400:adjustedyes:cellC | 4.146 | 1.560 | 2.658 | 989.00 | < .01\*\* | 0.853 | 0.321 | large | 1.085 | 7.206 |
| dur600:adjustedyes:cellD | -4.652 | 1.560 | -2.982 | 989.00 | < .01\*\* | -0.958 | 0.321 | large | -7.713 | -1.592 |
| dur5400:adjustedyes:cellD | 2.574 | 1.560 | 1.650 | 989.00 | = 0.1° | 0.530 | 0.321 | medium | -0.487 | 5.634 |
| Note: Effect Size column is a label to the standardized coefficient (Coef\_std), which follows the standard interpretation of Cohen’s d. | | | | | | | | | | |

# Experiment 3

## Post hoc

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| Table S7 | |  |  |  |  |  |  |  |
| *Experiment 3: Post hoc analysis per event cell type* | | | | | |  |  |  |
| **Model** | **Effect** | | **df** | **df\_Residuals** | **Sum\_Squares** | **Mean\_Square** | **F** | **p** |
| A | Duration | | 2 | 215.35 | 216.95 | 108.47 | 6.94 | < .01\*\* |
| Adj\_frequency | | 1 | 214.93 | 64.95 | 64.95 | 4.15 | < .05\* |
| Condition order | | 1 | 237.39 | 60.88 | 60.88 | 3.89 | < .05\* |
| Duration x Adj\_frequency | | 2 | 214.96 | 656.09 | 328.05 | 20.98 | < .001\*\*\* |
|  |  | |  |  |  |  |  |  |
| B | Duration | | 2 | 215.09 | 40.08 | 20.04 | 1.48 | > .1 |
| Adj\_frequency | | 1 | 215.02 | 0.99 | 0.99 | 0.07 | > .1 |
| Condition order | | 1 | 230.15 | 27.89 | 27.89 | 2.07 | > .1 |
| Duration x Adj\_frequency | | 2 | 215.06 | 144.16 | 72.08 | 5.34 | < .01\*\* |
|  |  | |  |  |  |  |  |  |
| C | Duration | | 2 | 215.25 | 70.01 | 35.00 | 2.87 | = 0.06° |
| Adj\_frequency | | 1 | 214.99 | 0.05 | 0.05 | 0.00 | > .1 |
| Condition order | | 1 | 227.76 | 8.56 | 8.56 | 0.70 | > .1 |
| Duration x Adj\_frequency | | 2 | 215.00 | 146.26 | 73.13 | 6.00 | < .01\*\* |
|  |  | |  |  |  |  |  |  |
| D | Duration | | 2 | 215.25 | 70.01 | 35.00 | 2.87 | = 0.06° |
| Adj\_frequency | | 1 | 214.99 | 0.05 | 0.05 | 0.00 | > .1 |
| Condition order | | 1 | 227.76 | 8.56 | 8.56 | 0.70 | > .1 |
| Duration x Adj\_frequency | | 2 | 215.00 | 146.26 | 73.13 | 6.00 | < .01\*\* |
| Note: Adj\_frequency = adjusted in total exposure time by varying frequency inversely to duration. | | | | | | | | |

# Experiment 4

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| Table S8. |  |  |  |  |  |  |  |  |  |  |
| *Experiment 4: Full Linear Mixed Model (including Baseline)* | | | | | | | | | | |
| Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| (Intercept) | 0.979 | 0.820 | 1.194 | 285.74 | > .1 | -0.053 | 0.138 | NA | -0.633 | 2.591 |
| frequency4 | -1.331 | 0.896 | -1.487 | 782.02 | > .1 | -0.231 | 0.156 | small | -3.089 | 0.426 |
| frequency64 | 4.886 | 0.897 | 5.447 | 782.06 | < .001\*\*\* | 0.849 | 0.156 | large | 3.126 | 6.646 |
| Adjusted yes | 0.000 | 0.895 | 0.000 | 782.00 | > .1 | 0.000 | 0.155 | very small | -1.756 | 1.756 |
| cellB | 0.000 | 0.895 | 0.000 | 782.00 | > .1 | 0.000 | 0.155 | very small | -1.756 | 1.756 |
| cellC | 0.000 | 0.895 | 0.000 | 782.00 | > .1 | 0.000 | 0.155 | very small | -1.756 | 1.756 |
| cond\_order | -0.038 | 0.041 | -0.925 | 793.36 | > .1 | -0.025 | 0.027 | very small | -0.119 | 0.043 |
| frequency4:adjusted yes | -2.315 | 1.265 | -1.830 | 782.00 | = 0.07° | -0.402 | 0.220 | small | -4.798 | 0.168 |
| frequency64:adjusted yes | -0.596 | 1.266 | -0.471 | 782.01 | > .1 | -0.104 | 0.220 | very small | -3.080 | 1.888 |
| frequency4:cellB | 3.034 | 1.265 | 2.398 | 782.00 | < .05\* | 0.527 | 0.220 | medium | 0.551 | 5.517 |
| frequency64:cellB | -6.421 | 1.266 | -5.073 | 782.01 | < .001\*\*\* | -1.116 | 0.220 | large | -8.905 | -3.937 |
| frequency4:cellC | 2.614 | 1.265 | 2.066 | 782.00 | < .05\* | 0.454 | 0.220 | small | 0.131 | 5.097 |
| frequency64:cellC | -6.088 | 1.265 | -4.811 | 782.00 | < .001\*\*\* | -1.058 | 0.220 | large | -8.571 | -3.604 |
| adjustedyes:cellB | 0.000 | 1.265 | 0.000 | 782.00 | > .1 | 0.000 | 0.220 | very small | -2.483 | 2.483 |
| adjustedyes:cellC | 0.000 | 1.265 | 0.000 | 782.00 | > .1 | 0.000 | 0.220 | very small | -2.483 | 2.483 |
| frequency4:adjusted yes:cellB | 1.516 | 1.789 | 0.847 | 782.00 | > .1 | 0.263 | 0.311 | small | -1.996 | 5.027 |
| frequency64:adjustedyes:cellB | 0.207 | 1.790 | 0.116 | 782.00 | > .1 | 0.036 | 0.311 | very small | -3.305 | 3.719 |
| frequency4:adjusted yes:cellC | 3.810 | 1.790 | 2.129 | 782.00 | < .05\* | 0.662 | 0.311 | medium | 0.298 | 7.322 |
| frequency64:adjustedyes:cellC | 1.113 | 1.790 | 0.622 | 782.01 | > .1 | 0.193 | 0.311 | very small | -2.399 | 4.626 |
| Note: Effect Size column is a label to the standardized coefficient (Coef\_std), which follows the standard interpretation of Cohen’s d. | | | | | | | | | | |

## Post hoc

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table S9 | | | | | | | |
| *Experiment 4: Post hoc analysis per event cell type* | | | | |  |  |  |
| **Model** | **Effect** | **df** | **df\_Residuals** | **Sum\_Squares** | **Mean\_Square** | **F** | **p** |
| A | Frequency | 2 | 230.28 | 2333.56 | 1166.78 | 59.23 | < .001\*\*\* |
| Adj\_duration | 1 | 230.07 | 60.29 | 60.29 | 3.06 | = 0.08° |
| Condition order | 1 | 257.26 | 10.91 | 10.91 | 0.55 | > .1 |
| Frequency x Adj\_duration | 2 | 230.02 | 66.20 | 33.10 | 1.68 | > .1 |
|  |  |  |  |  |  |  |  |
| B | Frequency | 2 | 230.10 | 426.22 | 213.11 | 10.96 | < .001\*\*\* |
| Adj\_duration | 1 | 229.97 | 10.88 | 10.88 | 0.56 | > .1 |
| Condition order | 1 | 250.90 | 1.74 | 1.74 | 0.09 | > .1 |
| Frequency x Adj\_duration | 2 | 229.97 | 7.39 | 3.69 | 0.19 | > .1 |
|  |  |  |  |  |  |  |  |
| C | Frequency | 2 | 230.23 | 419.92 | 209.96 | 10.58 | < .001\*\*\* |
| Adj\_duration | 1 | 230.02 | 34.12 | 34.12 | 1.72 | > .1 |
| Condition order | 1 | 252.88 | 73.45 | 73.45 | 3.70 | = 0.06° |
| Frequency x Adj\_duration | 2 | 229.99 | 28.01 | 14.00 | 0.71 | > .1 |
| Note: Adj\_duration = adjusted in total exposure time by varying frequency inversely to duration. | | | | | | | |

# Experiment 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S10. |  |  |  |  |  |  |  |  |  |  |
| *Experiment 5: Full Linear Mixed Model (including Baseline)* | | | | | | | | | | |
| Variable | Coef | SE | t | df | p | Coef\_std | SE\_std | Effect\_Size | CI\_lower | CI\_higher |
| (Intercept) | 1.512 | 0.851 | 1.777 | 240.23 | = 0.08° | -0.051 | 0.148 | NA | -0.163 | 3.186 |
| freq6 | -1.327 | 0.882 | -1.505 | 989.06 | > .1 | -0.241 | 0.160 | small | -3.057 | 0.403 |
| freq54 | 4.294 | 0.880 | 4.882 | 989.01 | < .001\*\*\* | 0.781 | 0.160 | medium | 2.569 | 6.020 |
| adjustedyes | 0.000 | 0.879 | 0.000 | 989.00 | > .1 | 0.000 | 0.160 | very small | -1.724 | 1.724 |
| cellB | 0.000 | 0.879 | 0.000 | 989.00 | > .1 | 0.000 | 0.160 | very small | -1.724 | 1.724 |
| cellC | 0.000 | 0.879 | 0.000 | 989.00 | > .1 | 0.000 | 0.160 | very small | -1.724 | 1.724 |
| cellD | 0.000 | 0.879 | 0.000 | 989.00 | > .1 | 0.000 | 0.160 | very small | -1.724 | 1.724 |
| cond\_order | 0.054 | 0.027 | 1.975 | 998.70 | < .05\* | 0.048 | 0.024 | very small | 0.000 | 0.108 |
| freq6:adjustedyes | 0.503 | 1.244 | 0.404 | 989.02 | > .1 | 0.091 | 0.226 | very small | -1.938 | 2.944 |
| freq54:adjustedyes | -2.216 | 1.243 | -1.783 | 989.00 | = 0.07° | -0.403 | 0.226 | small | -4.655 | 0.223 |
| freq6:cellB | 3.200 | 1.244 | 2.573 | 989.01 | < .05\* | 0.582 | 0.226 | medium | 0.760 | 5.640 |
| freq54:cellB | -5.826 | 1.243 | -4.687 | 989.00 | < .001\*\*\* | -1.059 | 0.226 | large | -8.265 | -3.387 |
| freq6:cellC | 2.286 | 1.243 | 1.838 | 989.01 | = 0.07° | 0.416 | 0.226 | small | -0.154 | 4.725 |
| freq54:cellC | -6.052 | 1.243 | -4.868 | 989.00 | < .001\*\*\* | -1.100 | 0.226 | large | -8.490 | -3.613 |
| freq6:cellD | 3.488 | 1.245 | 2.802 | 989.03 | < .01\*\* | 0.634 | 0.226 | medium | 1.046 | 5.931 |
| freq54:cellD | -3.749 | 1.244 | -3.014 | 989.01 | < .01\*\* | -0.681 | 0.226 | medium | -6.188 | -1.309 |
| adjustedyes:cellB | 0.000 | 1.243 | 0.000 | 989.00 | > .1 | 0.000 | 0.226 | very small | -2.439 | 2.439 |
| adjustedyes:cellC | 0.000 | 1.243 | 0.000 | 989.00 | > .1 | 0.000 | 0.226 | very small | -2.439 | 2.439 |
| adjustedyes:cellD | 0.000 | 1.243 | 0.000 | 989.00 | > .1 | 0.000 | 0.226 | very small | -2.439 | 2.439 |
| freq6:adjustedyes:cellB | -1.463 | 1.758 | -0.832 | 989.00 | > .1 | -0.266 | 0.320 | small | -4.912 | 1.986 |
| freq54:adjustedyes:cellB | 3.275 | 1.758 | 1.863 | 989.00 | = 0.06° | 0.595 | 0.320 | medium | -0.174 | 6.724 |
| freq6:adjustedyes:cellC | -1.185 | 1.760 | -0.673 | 989.02 | > .1 | -0.215 | 0.320 | small | -4.638 | 2.267 |
| freq54:adjustedyes:cellC | 3.913 | 1.758 | 2.226 | 989.00 | < .05\* | 0.711 | 0.320 | medium | 0.464 | 7.362 |
| freq6:adjustedyes:cellD | -3.620 | 1.759 | -2.058 | 989.01 | < .05\* | -0.658 | 0.320 | medium | -7.071 | -0.170 |
| freq54:adjustedyes:cellD | 2.185 | 1.758 | 1.243 | 989.00 | > .1 | 0.397 | 0.320 | small | -1.264 | 5.634 |
|  |  |  |  |  |  |  |  |  |  |  |

# Procedure:

A screenshot of a cell phone

Description automatically generated

**Figure S1**. Dimensions of Experiments 4 and 5 stimuli in pixels with an A trial in the left pair of TM frames and a D trial in the right pair of TM frames. On any given trial, only the left or the right TM frames were present.

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All participants received US$3 compensation for completing the task. Before receiving the consent form, all participants will read the following:

*The following task is not smartphone compatible. If you are using a mobile device (i.e., smartphones or tablets), please switch to a computer or Return the HIT. You may not participate using a different device. Unfortunately, this task cannot be run in Internet Explorer. The task will take about 25 minutes (excluding any breaks) and requires your absolute full attention. We ask that you please maximize your browser window, minimize distractions, and refrain from doing anything that will divide your attention. Do not write anything during the experiment or use your keyboard for anything other than responding to questions.*

Clicking the “Click to Continue” button will display:

*The following task includes rapidly moving stimuli that create some risk of inducing a seizure in people who are prone to have seizures. If you have a history of seizures, if you are under 18 years old, or if you are over 50 years old, please Return this HIT (i.e., withdraw from this task).*

Before participating in the experiment, all participants will be required to click a button giving informed consent. Upon the participant signing clicking the button, the instructions for the task will begin, as follows:

Screen #1:

*Please press the {spacebar} to begin.*

Screen #2:

*In this experiment, you will be watching numerous series of rapidly presented shapes and drawings. After each series, a question screen will appear and you will be asked to rate the degree of relatedness between the shape and drawing on a scale from -10 to +10. Please keep your eyes on the cross in the center of the screen.*

[Note: Slide 2, opening instructions, will be presented for 12 s.]

Screen #3:

*In this experiment, you will be watching numerous series of rapidly presented shapes and drawings. After each series, a question screen will appear and you will be asked to rate the degree of relatedness between the shape and drawing on a scale from -10 to +10. Please keep your eyes on the cross in the center of the screen.*

A **strong positive** rating should be given when the shape is followed by the drawing, or when the absent of the shape is followed by the absent of the drawing.

[Note: Slide 3 will be presented for 6 s.]

Screen #4

*In this experiment, you will be watching numerous series of rapidly presented shapes and drawings. After each series, a question screen will appear and you will be asked to rate the degree of relatedness between the shape and drawing on a scale from -10 to +10. Please keep your eyes on the cross in the center of the screen.*

A **strong positive** rating should be given when the shape is followed by the drawing, or when the absence of the shape is followed by the absence of the drawing.

A **strong negative** rating should be given when the shape is followed by the absence of the drawing, or when the absence of the shape is followed by the drawing.

[Note: Screen 4 will be presented for 6 seconds.]

Screen #5

*In this experiment, you will be watching numerous series of rapidly presented shapes and drawings. After each series, a question screen will appear and you will be asked to rate the degree of relatedness between the shape and drawing on a scale from -10 to +10. Please keep your eyes on the cross in the center of the screen.*

A **strong positive** rating should be given when the shape is followed by the drawing, or when the absence of the shape is followed by the absent of the drawing.

A **strong negative** rating should be given when the shape is followed by the absence of the drawing, or when the absence of the shape is followed by the drawing.

*Please press the {spacebar} to begin.*

After reading the instructions, each participant will press the spacebar and complete the pre-experimental, “warm-up” condition first.

Pre-experimental, “warm-up” condition

The warm-up condition will be a replication of the ‘Baseline’ condition and have 18 A, 18 B, 18 C, and 18 D events, all 900 ms long. These 72 total trials will be presented in 6 blocks, each consisting of: 3 A-cell events, 3 B-cell events, 3 C-cell events, and 3 D-cell events, with each event lasting 900 ms. Within a block, the order of trials will be random. Each 900 ms trial will consist of either simultaneous cue and outcome presentations (A), cue alone presentations (B), outcome alone (C), or neither cue nor outcome (D). When the cue (C), outcome (B), or both (D) are absent, the position of the missing image will be framed by a trial marker. The 'warmup' contingency will be the same as the baseline condition with the exception of a different cue and outcome pair.

## Control Conditions

The baseline condition will be identical to the warm-up condition, except that a different cue-outcome dyad will be used.

## Experimental Conditions

For the ‘adjusted’ conditions, the duration of the cell events will vary from the baseline condition for each cell manipulation while the number of events for each condition will be kept the same. Thus, in the “Few Cell-A adj” condition the A-cell event will last 5400 ms and the B, C, D cell events will last 900 ms, in the “Few Cell-B adj” condition the B-cell events will last 5400 ms and the A, C, D cell events will last 1200 ms, and in the “Few Cell-C adj” condition the C-cell events will last 5400 ms and the A, B, D cell events will last 900 ms. In the “Many Cell-A adj” condition the A-cell events will last 150 ms and the B, C, D cell events will last 900 ms, in the “Many Cell-B adj” condition the B-cell events will last 120 ms and the A, C, D cell events will last 900 ms, and in the “Many Cell-C adj” condition the C-cell events will last 150 ms and the A, B, D cell events will last 900 ms. Similar to the ‘control’ conditions, there will be 60 total trials presented in 6 blocks for the ‘Few’ conditions, where the “Few Cell-A adj” condition will have 1 A-cell event, 6 B-cell events, 6 C-cell events, and 6 D-cell events, the “Few Cell-B adj” condition will have 6 A-cell events, 1 B-cell event, 6 C-cell events, and 6 D-cell events, and the “Few Cell-C adj” condition will have 6 A-cell events, 6 B-cell events, 1 C-cell event, and 6 D-cell events. In each “Many” condition, 108 total trials will be presented in 6 blocks, where the “Many Cell-A adj” condition will have 18 A-cell events, 6 B-cell events, 6 C-cell events, and 6 D-cell events, the “Many Cell-B adj” condition will have 6 A-cell events, 18 B-cell events, 6 C-cell events, and 6 D-cell events, the “Many Cell-C adj” condition will have 6 A-cell events, 6 B-cell events, 18 C-cell events, and 6 D-cell events.

Trial order will be randomly selected without replacement for each subject, for each of the 17 experimental conditions. Including the stimuli for the warm-up condition, the 17 cues and 17 outcomes will be organized into 17 pairs and will be randomly selected without replacement for the 17 runs for each participant. The warm-up run will have a fixed pair of cue and outcome across participants – specifically, “Cue01” and “Outcome02”. These pairs of cues and outcomes will be the same pairs as used in previous experiments. Participants will be asked to rate the contingency judgement between the cue and outcome following each of the 17 runs (consisting of 60, 72, or 108 trials/run).

The question will read:

*Please indicate the degree of relatedness between the [cue picture inserted here] and the [outcome picture inserted here] in the series that you just saw. Use the rating scale below to enter the degree of relatedness:*

*-10 = strongly negatively related*

*0 = not related*

*+10 = strongly positively related*

Subjects will then record their ratings by controlling a slider scale with tick marks ranging from values -10 to +10, increasing by a unit of 1.

After the question is answered by the participant, a screen will appear saying:

*Now prepare for the next sequence of shapes and drawings. Press the {spacebar} when you are ready to begin.*

The data from the warm-up run will be ignored. That is, no participant will be excluded based on performance on this run.

Testing

Following the warm-up run, the order of the remaining 17 runs will be fully randomized for each subject. Full randomization should minimize any systematic order effects, due to our large sample size. After each of the 17 experimental conditions, subjects will immediately be asked the same question (except for different cue and outcome pictures) to rate their contingency judgement between the presented cue and outcome of the just completed run. The question and the subsequent screen preparing the subject for the next sequence will read exactly as it did for the warm-up run.

Participants will rate their contingency judgement using the same aforementioned method and scale following the 17 experimental conditions for a total of 17 responses (plus the warm up run). The total training time for the running of the 18 conditions, including the “warm-up” run should be about be about 25 minutes, including about 5 minutes for subjects to answer the 18 contingency judgement questions.

At the end of the experiment, a debriefing will read:

*You have now completed this experiment. Thank you for participating.**This experiment is part of a larger study to understand how people change their relatedness judgements based on their perception of absent events. Please be quiet as you leave the laboratory by the same route through which you entered so that other participants are not disturbed.*