**Supplementary Material**

with the paper **Reward-driven distraction: A meta-analysis**

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# 1. Exploring associations between moderators

In this section, we first present two tables (Tables S1 and S2) that contain measures of the strength of association between all our moderators. Then, we further examine the associations that are potentially relevant for interpreting the results from our meta-analysis.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Moderator (no. of categories) | 1b | 2 | 3 | 4 | 5 | 8 | 9 | 10 | 11 |
| 1a. Type of performance task (6) | .88 | .38 | .33 | .34 | .42 | .53 | .29 | .34 | .37 |
| 1b. Type of performance task (2) | 1 | .47 | .18 | .10 | .37 | .61 | .24 | .30 | .25 |
| 2. Difference training vs. test (3) |  | 1 | .14 | .69 | .38 | .38 | .41 | .28 | .47 |
| 3. Task instructions (2) |  |  | 1 | .05 | .41 | .22 | .00 | .20 | .36 |
| 4. Type of learning (2) |  |  |  | 1 | .35 | .34 | .35 | .35 | .59 |
| 5. Type of reward (2) |  |  |  |  | 1 | .50 | .15 | .25 | .33 |
| 8. Stimulus features (5) |  |  |  |  |  | 1 | .21 | .47 | .29 |
| 9. Type of distraction measure (2) |  |  |  |  |  |  | 1 | .26 | .50 |
| 10. Physical salience of distractor (2) |  |  |  |  |  |  |  | 1 | .47 |
| 11. Laboratory (4) |  |  |  |  |  |  |  |  | 1 |

**Table S1.** Association strength (Cramer’s V) between all nominal (categorical) moderators. The numbering in the leftmost column corresponds to the numbering in Tables 1 and 2 in the main text. Moderators 6 and 7 were omitted from this table, as these moderators are numerical, rather than nominal. Moderator 11 was added; this moderator was tested as an exploratory analysis (see main text). Derived from χ2, Cramer’s V is an effect size measure for pairs of nominal variables. V can range between 0 (no association) and 1 (perfect association). V is sometimes referred to as φC.

Following common rules of thumb (Cohen, 1988), the interpretation of V depends on the lowest number of categories in the variable pair.

* If the variable with the lowest number of categories has 2 categories, V is considered large when V ≥ .50.
* If the variable with the lowest number of categories has 3 categories, V is considered large when V ≥ .35.
* If the variable with the lowest number of categories has 4 categories, V is considered large when V ≥ .29.
* If the variable with the lowest number of categories has 5 categories, V is considered large when V ≥ .22.

Shaded cells in Table S1 contain effect sizes that can be considered large, following these rules of thumb.

|  |  |  |
| --- | --- | --- |
| Moderator | 6. Ratio between low and high reward | 7. Length of training |
| 1a. Type of performance task | 0.17 | 0.23 |
| 1b. Type of performance task | 0.16 | 0.01 |
| 2. Difference training vs. test | 0.00 | 0.00 |
| 3. Task instructions | 0.09 | 0.04 |
| 4. Type of learning | 0.14 | 0.00 |
| 5. Type of reward | 0.00 | 0.06 |
| 8. Stimulus features | 0.05 | 0.40 |
| 9. Type of distraction measure | 0.15 | 0.01 |
| 10. Physical salience of distractor | 0.15 | 0.04 |
| 11. Laboratory | 0.15 | 0.04 |

**Table S2**. Association strength (η2) between the two numerical (scale) moderators with all other moderators. η2 is an effect size measure that can be used to quantify the strength of associations between numerical and nominal variables. Shaded cells contain effect sizes that can be considered large, η2 ≥ .14, following common rules of thumb (Cohen, 1988). Ratio between low and high reward was coded only for studies in which reward value was quantifiable and in which the low-value reward was greater than zero cents/points (k = 71). Length of training was analyzed only for studies that included a separate training phase (k = 58).

**Further examination of potentially interesting associations**

By presenting crosstabulations, we will now further explore the direction of all large associations that involved the moderators that were significant (1a, 9, and 11; see main text).

**Type of performance task (1a)** showed large associations with difference between training and test (2), ratio between low and high reward (6), length of training (7), stimulus features (8), and laboratory (11). We omit a discussion of the relationship with type of performance task (1b), as this variable (1b) was directly derived from type of performance task (1a).

|  |  |  |
| --- | --- | --- |
|  | Different | Same |
| Conflict | 2 | 0 |
| Judgment | 1 | 2 |
| RSVP | 2 | 0 |
| Spatial cueing | 4 | 2 |
| Visual memory | 4 | 1 |
| Visual search | 10 | 32 |

**Table S3a.** Crosstabulation with type of performance task (rows) against whether the training phase was different from the test phase (columns). Our interpretation: In studies that used a visual search task during the test phase, the learning phase was often also a visual search task. Studies that used other task types, more often mixed up the tasks used during learning vs. test phases.

|  |  |  |
| --- | --- | --- |
|  | Mean ratio between low vs. high reward | Mean length of training (trials) |
| Conflict | 0.20 | 148 |
| Judgment | 0.27 | 1937 |
| RSVP | 0.20 | 672 |
| Spatial cueing | 0.15 | 325 |
| Visual memory | 0.14 | 535 |
| Visual search | 0.14 | 595 |

**Table S3b**. Mean ratio between low vs. high reward and mean length of training (columns) as a function of type of performance task (rows). Our interpretation: Studies that used judgment tasks tend to use a smaller relative difference between low vs. high reward; studies that used spatial cueing, visual memory, or visual search used a larger difference. Studies that used judgment tasks used many training trials; studies that used conflict or spatial cueing tasks used few training trials.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Color | Orientation | Picture | Shape | Sound |
| Conflict | 4 | 0 | 1 | 0 | 0 |
| Judgment | 2 | 0 | 0 | 2 | 3 |
| RSVP | 0 | 0 | 7 | 0 | 0 |
| Spatial cueing | 4 | 1 | 1 | 2 | 0 |
| Visual memory | 5 | 0 | 0 | 0 | 0 |
| Visual search | 50 | 5 | 1 | 1 | 2 |

**Table S3c.** Crosstabulation with type of performance task (rows) against the type of stimulus feature that was rewarded (columns). Our interpretation: Studies that used visual search predominantly used color as the rewarded dimension. Studies that used RSVP often used pictures.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Anderson | Le Pelley | Theeuwes | Other |
| Conflict | 1 | 0 | 0 | 4 |
| Judgment | 1 | 0 | 0 | 6 |
| RSVP | 0 | 5 | 1 | 1 |
| Spatial cueing | 0 | 0 | 2 | 6 |
| Visual memory | 0 | 0 | 1 | 4 |
| Visual search | 16 | 8 | 14 | 21 |

**Table S3d.** Crosstabulation with type of performance task (rows) against laboratory (columns). Our interpretation: See the caption of Table S5a.

**Type of distraction measure (9)** showed large associations with ratio between low and high reward (6) and laboratory (11).

On average, studies that employed direct measures were characterized by a smaller low reward / high-reward ratio (M = 0.08) compared to studies that used indirect measures (M = 0.17).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Anderson | Le Pelley | Theeuwes | Other |
| direct | 0 | 6 | 5 | 1 |
| indirect | 18 | 7 | 13 | 41 |

**Table S4.** Crosstabulation with type of distraction measure (rows) against laboratory (columns). Our interpretation: See the caption of Table S5f.

**Laboratory (11)** showed large associations with type of performance task (1a), difference training vs. test (2), type of learning (4), ratio between low and high reward (6), stimulus features (8), andtype of distraction measure (9).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Conflict | Judgment | RSVP | Spatial cueing | Visual memory | Visual search |
| Anderson | 1 | 1 | 0 | 0 | 0 | 16 |
| Le Pelley | 0 | 0 | 5 | 0 | 0 | 8 |
| Theeuwes | 0 | 0 | 1 | 2 | 1 | 14 |
| Other | 4 | 6 | 1 | 6 | 4 | 21 |

**Table S5a.** Crosstabulation with lab (rows) against type of performance task (columns). Our interpretation: A question raised by our results, is why Le Pelley’s laboratory reports larger effect sizes, on average, compared to other labs. This crosstab provides a potential answer: More so than other labs, Le Pelley’s lab tends to use task types that produce larger effect sizes (RSVP, visual search), and tends to not use tasks that produce smaller effect sizes (judgment, spatial cueing, visual memory).

|  |  |  |
| --- | --- | --- |
|  | Different | Same |
| Anderson | 3 | 15 |
| Le Pelley | 1 | 0 |
| Theeuwes | 4 | 5 |
| Other | 15 | 17 |

**Table S5b.** Crosstabulation with lab (rows) against difference between training and test phases (columns). Our interpretation: Anderson’s approach is characterized by using the same task in the training and the test phase. Le Pelley’s approach is characterized by a tendency to not use training phases. Most studies that used different training and test phases, originate mainly from laboratories other than the three largest ones (although Theeuwes has also used different training and test phases in several studies).

|  |  |  |
| --- | --- | --- |
|  | Instrumental | Pavlovian |
| Anderson | 18 | 0 |
| Le Pelley | 1 | 12 |
| Theeuwes | 7 | 11 |
| Other | 29 | 13 |

**Table S5c.** Crosstabulation with lab (rows) against type of learning (columns). Our interpretation: Anderson’s lab only uses instrumental conditioning, whereas Le Pelley’s lab mainly uses Pavlovian conditioning. Other labs, including Theeuwes’, have used both.

|  |  |
| --- | --- |
|  | Ratio between low and high reward |
| Anderson | 0.19 |
| Le Pelley | 0.08 |
| Theeuwes | 0.13 |
| Other | 0.17 |

**Table S5d.** Mean ratio between low vs. high reward (column) as a function of lab (rows). Our interpretation: Compared to other labs, Le Pelley’s and Theeuwes’ labs tend to use larger relative differences between low and high reward.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Color | Orientation | Picture | Shape | Sound |
| Anderson | 12 | 3 | 0 | 1 | 2 |
| Le Pelley | 8 | 0 | 5 | 0 | 0 |
| Theeuwes | 16 | 1 | 1 | 0 | 0 |
| Other | 29 | 2 | 4 | 4 | 3 |

**Table S5e.** Crosstabulation with lab (rows) against the type of stimulus feature that was rewarded (columns). Our interpretation: This table is consistent with the different labs using different tasks, which in turn are associated with certain stimulus types.

|  |  |  |
| --- | --- | --- |
|  | Direct | Indirect |
| Anderson | 0 | 18 |
| Le Pelley | 6 | 7 |
| Theeuwes | 5 | 13 |
| Other | 1 | 41 |

**Table S5f.** Crosstabulation with lab (rows) against type of performance measure (columns). Our interpretation: Most eye-tracking studies, i.e., studies with direct measures, come from Le Pelley’s and Theeuwes’ labs

# 2. Identifying studies that contributed strongly to heterogeneity

![A close up of a map

Description automatically generated]()

**Figure S1.** Baujat plot showing individual studies’ contributions to heterogeneity. In the sensitivity analysis reported in the main text, we excluded studies 21 (Bucker, Belopolsky, & Theeuwes, 2014), 40 (Jiao, Du, He, & Zhang, 2015), 46 (Laurent, Hall, Anderson, & Yantis, 2015), 48 (Experiment 2 from Le Pelley, Seabrooke, Kennedy, Pearson, & Most, 2017), and 78 (Experiment 2 from Pearson, Osborn, Whitford, Failing, Theeuwes, & Le Pelley. 2016)

# 3. References

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