

Appendix A

Pilot Study 1

In pilot Study 1, participants rated either two brightness differences on a screen (e.g., a black screen, or a white screen), or two settings of the light fixture (e.g., a dim light, or a bright light) in terms of evaluation, activity, potency, and aggression. These explicit association studies were meant to provide more insight into the dimension distances of screen brightness (black-white) and light in a fixture (bright-dim). Pilot 1 additionally included 32 dynamic scenarios (e.g., an increase in luminance, or a change from black to white), but those specific results are not relevant for the current manuscript, and are therefore not reported.

Method

Participants

Two samples of participants answered a series of questions on either different settings of screen brightness (20) or different settings of an LED fixture (42).

Materials

Participants were asked to explicitly rate light scenarios on valence, activity, potency, and aggression. The light scenarios for screen brightness consisted of two static scenarios: white (111.8 cd/m²) and black (0.28 cd/m²), which were displayed full screen using Authorware software. The light scenarios for illumination brightness consisted of two settings: bright (835 cd/m²) and dim (19.52 cd/m²), displayed by means of a Philips Hue A19 (see <https://osf.io/agvz3/> for a picture of the set-up). The dim scenario was not completely dark: We expected that it would be difficult to explicitly rate a light scenario where the light is off, as there would be nothing to see. After each light scenario, participants answered on a 9-point Likert scale how negative/positive, passive/active, weak/powerful, and calm/aggressive they thought the scenario was.

Procedure

Participants were approached in the lunch facility of the Eindhoven University of Technology for the screen brightness test. They completed the experiment voluntarily in an Authorware questionnaire on the experimenter's laptop. Participants completed the light fixture text in an Authorware questionnaire individually and voluntarily in dimmed cubicles.

Results

Screen Brightness. To investigate the associations people have with white compared to black, we conducted 4 paired samples *t*-tests comparing the means of the ratings on valence, activity, potency, and aggression for white and black. The first paired samples *t*-test showed that static white ($M = 6.30$, $SD = 1.56$) is perceived as more positive compared to black ($M = 3.50$, $SD = 1.76$), 95% CI [1.45, 4.15], JZS $BF_{10} = 93.54$, $t(19) = 4.35$, $p < .001$, Hedges' $g = -1.62$, 95% CI [-2.59, -0.74]. There were no significant differences between black and white for the scores on activity (JZS $BF_{10} = 0.26$, $t(19) = .47$, $p = .641$, Hedges' $g = .12$, 95% CI = [-0.36, .58]) and potency (JZS $BF_{10} = 0.38$, $t(19) = 1.06$, $p = .301$, Hedges' $g = .3$, 95% CI = [-0.28, .89]). Unexpectedly, white ($M = 3.65$, $SD = 2.46$) was not rated as less aggressive compared to black ($M = 4.70$, $SD = 2.49$), 95% CI [-0.08, 2.18], JZS $BF_{10} = 1.11$, $t(19) = 1.94$, $p = .07$, Hedges' $g = .42$, 95% CI [-0.03, .87], although the effect size is close to the medium effect size in psychology. The dimension distances seem to be the higher on the evaluation dimension as compared to the activity dimension.

Light Fixture. To investigate the associations people have with bright light compared to dim light, we conducted 4 paired samples *t*-test comparing the means of the ratings on valence, activity, potency, and aggression. Unexpectedly, static bright ($M = 4.43$, $SD = 1.95$) is evaluated as slightly more negative compared to static dimmed light ($M = 5.33$, $SD = 1.56$), 95% CI [0.04, 1.77], JZS $BF_{10} = 1.24$, $t(41) = 2.11$, $p = .041$, Hedges' $g = 0.5$, 95% CI [.02, 1]. This could be due to the relatively high brightness of the LED which might be considered

uncomfortable. As expected, participants perceived static bright light ($M = 4.55$, $SD = 3.34$) to be more active than static dimmed light ($M = 2.07$, $SD = 1.57$), 95% CI [-3.41, -1.54], JZS $BF_{10} = 5151.88$, $t(41) = -5.35$, $p < .001$, Hedges' $g = -0.93$, 95% CI [-1.35, -0.54]. Moreover, participants perceived bright light ($M = 6.21$, $SD = 2.93$) as more powerful than dimmed light ($M = 2.07$, $SD = 1.22$), $t(41) = -9.31$, 95% CI = [-5.04, -3.24], JZS $BF_{10} = 798550125.34$, $p < .001$, Hedges' $g = -1.81$, 95% CI [-2.4, -1.29]. In line with our predictions, static bright ($M = 5.52$, $SD = 2.73$) was also rated as more aggressive compared to static dimmed light ($M = 2.19$, $SD = 1.38$), 95% CI [-4.26, -2.41], JZS $BF_{10} = 1753966.72$, $t(41) = 7.26$, $p < .001$, Hedges' $g = -1.51$, 95% CI [-2.06, -1]. The dimension distances seem to be higher on the activity dimension as compared to the evaluation dimension. See Figure A1 for the mean scores on valence, activity, potency, and aggression for black, white, bright light, and dim light.

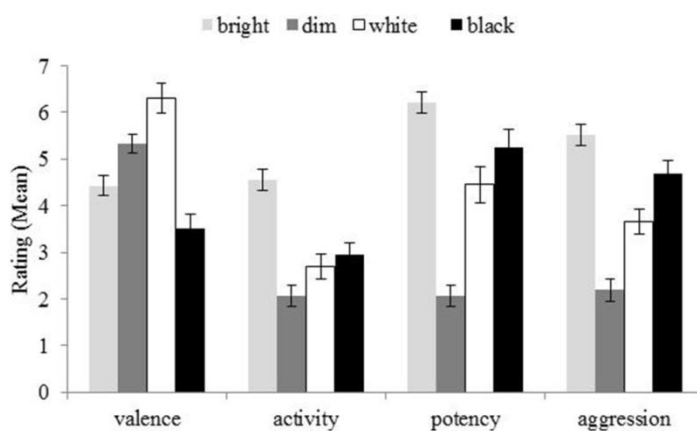


Figure A1. Means for the evaluation scores on valence, activity, potency, and aggression for screen brightness (white and black) and a light fixture (dark and light grey). Error bars represent standard error of the mean.

Appendix B

Pilot Study 2

In pilot Study 2, participants rated a hundred aggression and calmness related words on valence, activity, potency, and aggression. Firstly, these explicit evaluations were meant to provide suitable word stimuli for Experiments 1, 2, and 3 of Part 1, and Experiment 1D of Part 2, as reported in the method section of those experiments (i.e., words that were most strongly associated with aggression and calmness, and differed in terms of evaluation and activity). Secondly, the explicit evaluations were meant to give insight into the dimension distances of the concept pairs aggressive-calm, bright-dim, intense-dim, and therefore the category labels of Experiments 1, 2, and 3 (Part 1) and 1D (part 2). Although the concept pairs were not completely identical to the category labels used in Experiment 2 and 3 (i.e., brighter-dimmer; intense-dimmer), we believe the results of this explicit evaluation task would provide insight into the dimension-distances of the target and attribute category labels. The results of the explicit evaluations of the concept pairs aggressive-calm, bright-dimming, intense-dimming are reported below.

Method

Participants

Forty Dutch participants, students of Technical University of Eindhoven volunteered to participate for a monetary compensation of 3 euros.

Materials

The presentation of the word stimuli and registration of responses were controlled by the online software Qualtrics. Participants were asked to explicitly rate a hundred Dutch words (e.g., on valence, activity, potency, and aggression). The words (i.e., verbs and adjectives) were chosen based on their expected meaning in terms of valence, activity,

potency, and aggression. For each word, participants answered on a 9-point Likert scale how negative/positive, passive/active, weak/powerful, calm/aggressive they thought the word was.

Procedure

Participants completed the pilot test in individual cubicles. Participants were asked to complete an online questionnaire, in which they were asked to rate a hundred Dutch words on valence, activity, potency, and aggression.

Results

Bright (Dutch translation: Helder) is evaluated as more positive ($M = 7.18$, $SD = 1.05$) than dark (donker, $M = 3.95$, $SD = 1.56$), but dark is evaluated as more aggressive ($M = 5.71$, $SD = 1.54$) than bright ($M = 2.71$, $SD = 1.18$). Bright is not significantly evaluated as more active ($M = 4.02$, $SD = 1.75$) than dark ($M = 3.97$, $SD = 1.94$).

On the other hand, intense (fel) was evaluated as more active ($M = 7.54$, $SD = 1.27$) compared to dimming (dimmen, $M = 4.82$, $SD = 1.71$). In addition, intense is evaluated as more aggressive ($M = 6.91$, $SD = 1.44$) than dimming ($M = 3.97$, $SD = 1.22$). Intense is not significantly evaluated as more negative ($M = 4.3$, $SD = 1.82$) than dimming ($M = 4.95$, $SD = 1.43$).

Aggressive (agressief) was evaluated as more negative ($M = 2.15$, $SD = 1.46$) than calm (kalm, $M = 7.18$, $SD = 1.37$). In addition, aggressive was evaluated as more active ($M = 7.87$, $SD = .92$) than calm ($M = 2.69$, $SD = 1.28$), and more aggressive ($M = 8.2$, $SD = 1.43$) than calm ($M = 1.77$, $SD = 1.44$). See Table B1 for a full description of the results.

Table B1

Results of paired-sample t-tests for the difference between evaluations on valence, activity, and aggression for the concept pairs aggressive-calm, bright-dimming, intense-dimming

			t	df	p	Mean difference	SE Difference	95% CI		Hedges g'	95% CI	
								Lower	Upper		Lower	Upper
Valence												
Bright	vs	Dark	9.57	38	<.001	-3.23	.34	-3.91	-2.55	2.39	1.69	3.17
Intense	vs	Dimming	-1.66	38	.105	-.64	.39	-1.42	.14	-.38	-.86	.08
Aggressive	vs	Calm	-12.57	38	<.001	-5.03	.39	-5.84	-4.22	-3.47	-4.5	-2.57
Activity												
Bright	vs	Dark	-.31	38	.896	-.051	.39	-.84	.74	.03	-.39	.44
Intense	vs	Dimming	7.44	38	<.001	2.72	.37	1.98	3.46	1.8	1.17	2.41
Aggressive	vs	Calm	17.64	38	<.001	5.18	.38	4.59	5.77	4.55	3.47	5.79
Aggression												
Bright	vs	Dark	8.69	34	<.001	3.00	.35	2.29	3.71	-2.14	-2.89	-1.46
Intense	vs	Dimming	9.59	34	<.001	2.94	.31	2.32	3.57	2.15	1.5	2.88
Aggressive	vs	Calm	13.95	34	<.001	6.43	.46	5.49	7.36	4.38	3.24	5.71

Appendix C

Robust Statistics

Appendix C includes the description of the robust statistics of Experiments 1 to 3. For each experiment, we report the robust statistics, using the Yuen-Welch method (Wilcox, 2012; Wilcox & Tian, 2011). The raw data and script files can be found on OSF <https://osf.io/agvz3/>.

Experiment 1

Experiment 1A: Bright-dark vs aggressive-calm

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = -228.42$, 95% CI [-300.14, -156.7]) was statistically different from zero, $t(12) = -6.94$, $p < .001$, $\xi = -1.31$. This can be considered a large effect.

Experiment 1B: Saturated-unsaturated vs aggressive-calm (Version 1)

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = -244.36$, 95% CI [-325.18, -163.53]) was statistically different from zero, $t(17) = -6.38$, $p < .001$, $\xi = -1.94$. This can be considered a large effect.

Experiment 1B: Saturated-unsaturated vs aggressive-calm (Version 2)

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = -154.16$, 95% CI [-155.67; -152.65]) was statistically different from zero, -6.46 , $p < 0.001$, $\xi = 0.67$. This can be considered a large effect.

Experiment 2

Experiment 2A: Bright-dark vs aggression - calm Screen brightness

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = -152.66$, 95% CI [-195.47, -109.84]) was statistically different from zero, $t(26) = -7.33$, $p < .001$, $\xi = -1.11$. This can be considered a large effect.

Experiment 2B: Bright-dark versus aggression-calm Light fixture

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = -69.98$, 95% CI [-128.66, -11.31]) was statistically different from zero, $t(23) = -2.47$, $p = .02$, $\xi = -.37$. This can be considered a medium effect.

Experiment 3

Experiment 3A: Intense-dim vs aggression-calm Screen brightness

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = -126.69$, 95% CI [-194.88, -58.5]) was statistically different from zero, $t(24) = -3.83$, $p < .001$, $\xi = -0.7$. This can be considered a large effect.

Experiment 3B: Intense-dim versus aggression-calm Light fixture

Using the Yuen-Welch method for comparing 20% trimmed means showed the mean difference in reaction times between conditions ($M = 86.73$, 95% CI [41.57, 131.89]) was statistically different from zero, $t(26) = 3.95$, $p < .001$, $\xi = 0.66$. This can be considered a large effect.

Figure titles

Figure 1. Schematic illustration of the concepts aggression, calmness, brightness, aggression in a two-dimensional space consisting of the activity and evaluation dimension. When the activity dimension (vertical) is salient, aggression and brightness (the two top concepts), and calmness and darkness (the two bottom concepts) will become associated. However, when the evaluation dimension (horizontal) is salient, aggression and darkness (the two left concepts) and calmness and brightness (the two right concepts) will become associated.

Figure 2. An illustration of the process to predict context-dependent cross-modal associations with dimension-specific polarity attributions.

Figure 3. Mean reaction times in milliseconds for the critical blocks of the brightness IAT of Experiment 1A (left) and the saturation IAT of Experiment 1B (right). Error bars represent standard errors of the mean.

Figure 4. Photograph of the setup of the bright-dark, aggressive-calm IAT with brightness and darkness presented in a light fixture (Experiment 2B).

Figure 5. Mean reaction times in milliseconds of Experiments 2 and 3 for the critical blocks of the screen brightness IATs (left) and the light fixture IATs (right) in an evaluation (above) and activity context (below). Error bars represent standard errors of the mean.

Figure A1. Means for the evaluation scores on valence, activity, potency, and aggression for screen brightness (white and black) and a light fixture (dark and light grey). Error bars represent standard error of the mean.