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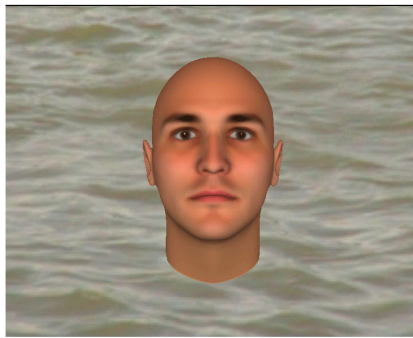
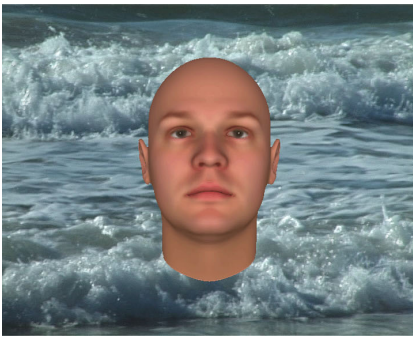
We have tested whether natural dynamic backgrounds affect perceived facial dominance. Facial evaluation is based on just two fundamental dimensions of facial appearance: valence and dominance. Perceived facial valence has been shown to be biased towards background valence. However, it is currently unknown, if the perception of facial dominance is also context dependent. In this study, participants rated the perceived dominance of neutral faces superimposed on everyday dynamic backgrounds that were either classified as low (weak) or high (strong) in dominance. Neutral faces were perceived as significantly more dominant when seen on a strong dynamic background than on either a weak or neutral background. Thus, background dominance enhances perceived facial dominance. Since dynamic textures are ubiquitous this finding is relevant for the design and experience of both our daily environment and multimedia content.

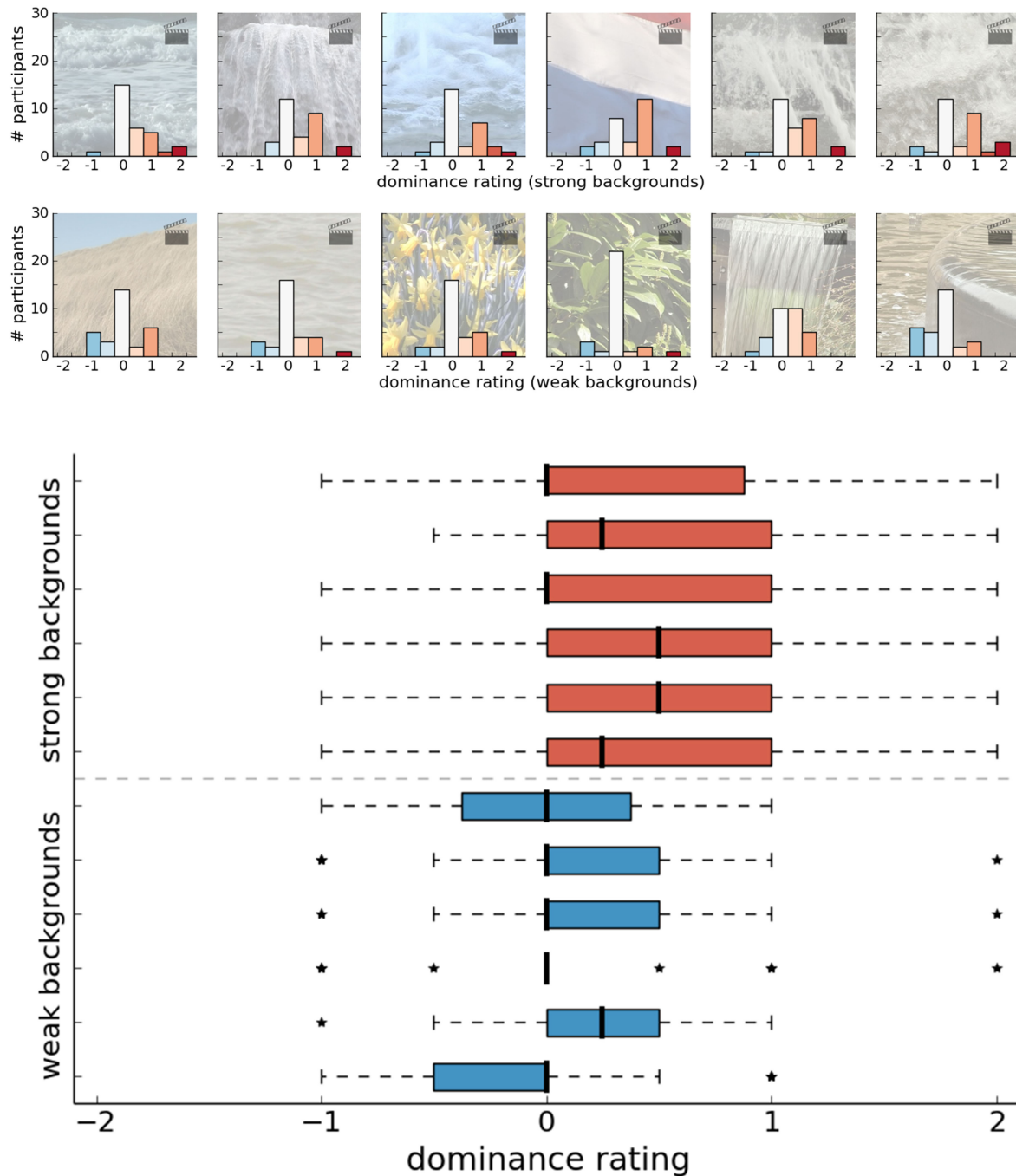
Objective

The objective of this study was to investigate whether perceived facial dominance is biased by the dominance of everyday dynamic backgrounds.

Introduction

People are typically unaware that the context in which they see a face influences their affective judgment, even when this context has absolutely no relevance for their assessment (Barrett 2011^[4])(Koji 2010^[5])(Lee 2012^[6])(RIGHART 2008^[7])(Wieser 2012^[8]). Associations between context and faces are routinely established and modulate face perception already at the early stages of facial feature processing, such that the affective quality of the context transfers to the perceived affective state of a face (Barrett 2011^[4])(Wieser 2012^[8]). As a result, identical facial configurations may convey strikingly different emotions and dimensional values depending on the context in which they are perceived (Koji 2010^[5]). Previous studies shown that perceived facial valence is biased towards background valence; faces perceived in negative (positive) contexts are judged more negative (positive) than in a neutral context (Koji 2010^[5])(Lee 2012^[6]). However, it is currently unknown if the perception of facial dominance is also context dependent. Environmental psychology has shown that the dominance is one of the principle affective qualities of backgrounds and environments. The dominance (sometimes also called strength or potency) of a background is defined as the degree to which it affects the observer (Author B. 2016^[9])(Author B. 2016^[10]). An observer may feel overwhelmed by and unable to control a strong background, while (s)he may feel in control of- and able to- influence a weak background media. We hypothesized that background dominance may also biased perceived facial dominance. To test this hypothesis, we performed an experiment in which observers judged the dominance of neutral faces presented on natural dynamic textures (spatially repetitive, time-varying visual patterns that repeat or seems to repeat themselves over time; (Doretto 2003^[11]) that were classified as either neutral, low (weak) or high (strong) in dominance (Fig. A).





A) The 12 neutral faces from the Princeton faces database(Oosterhof 2008^[1]) overlaid on dynamic textures from the Dyntex database(P teri_2010^[2]) that are classified as either strong (upper 2 rows) or weak (lower 2 rows)(Toet 2011^[3]). B) Median dominance ratings for neutral faces shown on the dynamic textures from the Dyntex database(P teri_2010^[2]) that are classified as either strong (upper row) or weak (lower row)(Toet 2011^[3]). In this figure, the background images are shown in lighter shades than those actually used in the experiment. C) Tukey boxplot of the median dominance ratings for neutral faces shown on respectively the strong (upper six; top-down corresponding to left-right in Fig. B) and weak (lower six) backgrounds. Thick line denotes the median, stars denote outliers (values more than 1.5 IQR below the first quartile or above the third quartile).

Results & Discussion

The results of the experiment were first accumulated by calculating the median dominance rating per background across all 12 faces for each of the 30 participants (Fig. B and C). Next, these median dominance ratings were accumulated across the six strong backgrounds and across the six weak backgrounds individually (again, by using the median). These ratings were then compared with each other and with neutrality (i.e., zero). A Friedman test revealed a significant effect of background on dominance rating $\chi^2(2) = 13.972, p = 0.001$. Next, a post-hoc analysis was performed using multiple Wilcoxon signed rank tests, which were conducted using Bonferroni adjusted alpha levels of 0.0167 per test (0.05/3). The results shows a significant difference between perceived dominance ratings of faces on strong and on weak backgrounds respectively ($Z = 3.033, p = 0.002$). Also, perceived dominance ratings for faces on strong backgrounds are significantly different from neutral ($Z = 3.305, p = 0.001$). However, perceived dominance ratings for faces on weak backgrounds are not significantly different from neutral ($Z = 2.230, p = 0.026$). Neutral faces are perceived as significantly more dominant when seen against a strong background than on either a weak or neutral (dark) background. A Mann-Whitney U-test was performed to test for gender difference. For neutral faces shown on strong backgrounds this test revealed no significant difference between dominance ratings by males ($Md = 0.32, N = 18$) and females ($Md = 0.23, N = 12$), $U = 86.5, Z = -0.911, p = 0.368, r = -0.16$. For neutral faces shown on weak backgrounds there was also no significant difference between males ($Md = 0.08, N = 18$) and females ($Md = 0.12, N = 12$), $U = 92.0, Z = -0.678, p = 0.518, r = -0.12$.

Our current finding that even everyday dynamic textures, such as streaming water, swirling leaves, moving clouds, waving flags or traffic streams can influence perceived facial dominance agrees with the growing body of evidence that background context modulates perceived facial emotions (Koji 2010^[5])(Lee 2012^[6])(RIGHART 2008^[7]). The current results also agree with recent brain studies showing that contextual information influences activities in the extended neural network of face processing and thereby alters the perception and evaluation of facial expressions (Schwarz 2012^[12])(Van den Stock 2013^[13])(Wieser 2012^[8])(Wieser 2014^[14]). In particular, it was recently observed that the amygdala integrates facial expression with salient motion information (Hindi Attar 2010^[15]). This indicates that the amygdala is not only responsive to facial expressions (Harris 2012^[16]) but also incorporates the overall perceptual context of a stimulus. Hence, it appears that facial evaluation is context dependent and not automatic, hard-wired, effortless and universal as previously proposed (Ekman 1992^[17]).

In addition to their high prevalence in our daily environment, dynamic textures are also increasingly applied in animation (Lockyer 2012^[18]) and video synthesis (Doretto 2003^[11]), and are deployed on large-scale digital billboards and electronic wallpaper (Huang 2005^[19]). Because of this ubiquity of dynamic textures, our current findings may be relevant for the design and experience of both our daily environment and multimedia content.

Conclusions

Everyday dynamic background textures such as streaming water, swirling leaves, moving clouds, waving flags or traffic streams can bias perceived facial dominance.

Limitations

A limitation of this study is the small number of stimuli (faces and backgrounds) that were tested. Future studies should use a larger number of dynamic background textures with widely varying content and motion patterns, covering the entire dominance range, to allow a closer investigation (correlation) of the relation between background dominance and perceived facial dominance. In addition, artificial affective motion textures with well specified path curvature, speed and texture layout (Lockyer 2012^[18]) may serve to systematically investigate the relation between different spatio-temporal texture parameters and perceived facial dominance.

Conjectures

We expect that visual background dominance may also bias the affective appraisal of non-face objects with no evident semantic affective connotation. Moreover, it is also likely that this effect may carry over to other sensory modalities (Schreuder 2016^[20]). Hence, a dominant visual background may bias the perception of certain smells, tastes or sounds. We plan to investigate these issues in a follow-up study.

Additional Information

Methods and Supplementary Material

Please see <https://sciencematters.io/articles/201610000018>.

Ethics Statement

The participants read and signed an informed consent prior to the experiment. The experimental protocol was reviewed and approved by the TNO Ethics Committee and was in accordance with the Helsinki Declaration of 1975, as revised in 2013(2013^[21]).

Citations

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