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# Development of the Red-Negative Association: Motivation-based behaviors

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## ABSTRACT

The color red has been seen to correspond to different emotion-based motivational behaviors in adults, depending on the context (i.e., achievement vs. romance). Given that red-meaning associations may result – at least in part – from background experience, we tested this effect in 51 children. First ( $M_{\text{age}} = 6.42$ ,  $SD = 0.60$ ) and fifth ( $M_{\text{age}} = 10.71$ ,  $SD = 0.43$ ) graders were asked to choose between sheets of paper with red or green borders to carry out two kinds of activities (i.e., evaluative vs. recreational). Analysis of the results showed that the older children tended to avoid the red-bordered paper for the evaluative tasks, whereas the younger children chose red for both kinds of activities. These findings suggest that context-driven red-meaning associations develop across grades.

## 1. Introduction

“Color expresses something in itself. One can’t do without it.”

(Vincent Van Gogh, 28 October 1888, in a letter to his brother Theo)

Color is not just a physical element of the environment; it also conveys something subjective, as artists and philosophers have long known. Experimental research has specifically shown that red has an impact on psychological responding via emotion-based associations, and that this effect is context dependent (for a review, see Elliot & Maier, 2014). The literature has so far focused on adults, but the fact that people’s experience of the environment can determine their color-emotion associations raises the issue of how these associations develop in childhood. Schools already use color coding to indicate whether students’ answers are right (i.e., green) or wrong (i.e., red). The aim of the present study was thus to experimentally investigate color-emotion associations in context, for the first time comparing children in the first and last years of primary education.

The *color-in-context theory* is the latest model to have been developed to account for the link between color and psychological functioning (Elliot & Maier, 2012, 2014). It puts forward two main notions: 1) color conveys meaning; and 2) that meaning is determined by context. Regarding the first notion, because they carry meaning, colors can influence behaviors and underlying cognition, resulting in emotion-based associations. Key experimental evidence has been yielded by research based on the *congruency effect* (e.g., Kuhbandner & Pekrun, 2013; Mammarella, Di Domenico, Palumbo, & Fairfield, 2016; Moller, Elliot, & Maier, 2009). For instance, studies using emotional faces as focal stimuli have shown that red 1) is viewed as the color most consistent with angry faces (Palmer, Schloss, Xu, & Prado-Leon, 2013), 2) facilitates the categorization of angry faces (Young, Feltman, & Ambady, 2013), and 3) leads to ambiguous faces being seen as expressing a negative emotion (Gil & Le Bigot, 2015). In other words, red can convey a specific

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message: it is negatively valenced, and associated with danger, threat and failure.

Insofar as red provides emotional information, researchers have studied whether this color influences behaviors in an evaluative context. They have shown that individuals do less well in an achievement situation when exposed to the color red, rather than a control color (e.g., green, blue or achromatic). This has been demonstrated in contexts of intellectual achievement (e.g., cognitive or cultural test; see, for examples, Bertrams, Baumeister, Englert, & Furley, 2015; Elliot, Maier, Moller, Friedman, & Meinhardt, 2007; Gnambs, Appel, & Batinic, 2010; Thorstenson, 2015; see also Richards & Fink, 2017, for the color red affecting evaluative attributions toward both a student-author's work and instructor, in academic context), as well as competition sport (e.g., Hill & Barton, 2005; Recours & Briki, 2015; see also Feltman & Elliot, 2011, for the red effect in terms of dominance or threat perception).

Concerning the second notion, color-in-context-theory hypothesizes that color meaning varies according to context. In a general context of affiliation, as opposed to achievement, red encourages approach motivation behaviors. For example, wearing red enhances a potential intimate partner's sexual attraction (e.g., Elliot & Niesta, 2008; Roberts, Owen, & Havlicek, 2010); and the color red on women dating websites was related to their sex interest (Elliot & Pazda, 2012).

Red can therefore be regarded as an *implicit affective cue* (Friedman & Förster, 2010), involving properties linked to emotion-related systems, in particular the motivational system (Frijda, 1986; Lang, 1995). Emotions are action dispositions that result in adaptive behavior. This core function of emotions is triggered by motive states, which in turn depend on the situation's meaning. The motivational-emotional system can be seen as operating along a dimension running from aversion (i.e., defensive or avoidance behavior in negative situations) to appetitiveness (i.e., approach behavior in positive situations) (for reviews, see Eder, Elliot, & Harmon-Jones, 2013; Lang, Bradley, & Cuthbert, 1992; Lang & Bradley, 2013). On the strength of this reasoning, the fact that the red-negative association activates avoidance reactions has been directly shown in some studies. For instance, in Elliot et al. (2007), individuals chose more easy tests than difficult ones (i.e., analogy tests) when exposed to red compared to green or gray. Similarly, participants moved their body away from an IQ test booklet in a greater extent when the test cover was red compared to grey or green (Elliot, Maier, Binser, Friedman, & Pekrun, 2009).

Importantly, Meier, D'Agostino, Elliot, Maier, and Wilkowski (2012) ran the only study to have contrast two colors in the same task with a different context. They showed that, compared with a blue T-shirt condition, participants walked faster to an interviewer wearing red to discuss dating (romance context), and slower to an interviewer wearing red to discuss intelligence (achievement context). In short, color can influence how people perceive an event, in an aversive versus appetitive emotional-motivational system (Thorstenson, 2015). Thus, given that context plays a crucial role, it is legitimate to ask whether these associations change across people's life experiences, and thus development.

Studies investigating the link between color and psychological functioning from a developmental perspective are few and far between. Furthermore, most of those that have so far been conducted with younger participants involved drawings, and generally considered color in terms of children's preferences. In an applied perspective, colors can replace verbalizations in children to express complex or painful emotional states, like during hospitalization (e.g. Crawford, Gross, Patterson, & Hayne, 2012; Unruh, McGrath, Cunningham, & Humphreys, 1983). Burkitt's interesting controlled studies (e.g., Burkitt, Barrett, & Davis, 2003; Burkitt & Sheppard, 2014) provided evidence that school children's use of color in drawing production tasks is related to their color preferences: participants used their favorite colors for positive figures, and least favorite ones for negative ones, while colors with medium preference were used for neutral figures (see also Zentner, 2001, for similar results in preschoolers).

Beyond the color preference issue, to our knowledge only two studies have examined the impact of color-meaning association in children's behavior, replicating two main results obtained with adults. First, using an ambiguous face categorization task in the form of a card-sorting task, Gil and Le Bigot (2016) showed that children aged 5–10 years categorized faces given a red background as feeling bad more than the same faces given a green or achromatic background. Second, Brooker and Franklin (2015) found that 8- to 9-year-old children had poorer cognitive performances (e.g., reading, numeracy) when they were placed in front of a red screen rather than a gray one during the completion of a test booklet. Brooker and Franklin did not seek to examine the development of the red effect, while Gil and Le Bigot looked for, but failed to find, a significant developmental trajectory. A potentially important factor is that color-in-context theory has not yet been tested in children.

The present study was intended to test the red-emotion association from a developmental perspective, and in a within-context experimental design. We examined whether the aversive versus appetitive emotional-motivational system was activated in children through red vs. green colors. Children in their first or fifth year of primary education had to perform two kinds of task: evaluative versus recreational. Before each activity, they had to choose the paper on which to carry it out: red- or green-bordered. Green was chosen because it is usually employed in adult research as the chromatic opposite of red, being associated with positive valence and success in intellectual achievement (e.g., Elliot et al., 2007; Lichtenfeld et al., 2012; Moller et al., 2009). Given the documented link between red and negative emotion, and red and avoidance-oriented behaviors, we predicted that children would choose the red-bordered paper less often than the green-bordered paper to carry out the evaluative tasks, but this would not be the case for the recreational tasks. In addition, we predicted that if the participants' experiential background favored the red-emotion association, the effect would mainly or solely be observed in the older children at the end of their primary education.

## 2. Method

### 2.1. Participants

Participants were 51 children: 26 first graders ( $M_{\text{age}} = 6.42$  years,  $SD = 0.60$ ) and 25 fifth graders ( $M_{\text{age}} = 10.71$ ,  $SD = 0.43$ ). Twenty-one were girls, and they all attended ordinary French mainstream primary schools. All the children had normal or corrected-

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