Distributional Analyses reveal the Polymorphic Nature of the Stroop Interference Effect: It's about (Response) Time.

Léa M. Martinon[1,2*], Ludovic Ferrand[2], Mariana Burca[1], Nabil Hasshim[3], Dounia Lakhzoum[2], Benjamin A. Parris[4], Laetitia Silvert[2], and Maria Augustinova[1*]

[1]Normandie Université, UNIROUEN, CRFDP, Rouen, France

[2]Université Clermont Auvergne, CNRS, LAPSCO, Clermont-Ferrand, France

[3]Department of Psychology, University of Salford, Salford, UK

[4]Department of Psychology, Bournemouth University, Poole, UK

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***Corresponding authors:**

Léa M. Martinon

Université de Rouen Normandie

Le Centre de Recherches sur les Fonctionnements et Dysfonctionnements Psychologiques (CRFDP, EA 7475) and Université Clermont Auvergne

Laboratoire de Psychologie Sociale et Cognitive (LAPSCO, CNRS UMR 6024),

UFR PSSSE - 34 avenue Carnot - TSA 60401 - 63001 Clermont-Ferrand Cedex,

France

E-mail: lea.martinon@gmail.com

or

Maria Augustinova

Université de Rouen Normandie

Le Centre de Recherches sur les Fonctionnements et Dysfonctionnements Psychologiques (CRFDP, EA 7475),

UFR SHS – Bâtiment Freinet, Place Emile Blondel, 76821 Mont Saint Aignan Cedex, FRANCE

E-mail: maria.augustinova@univ-rouen.fr

Abstract

The study addressed the still-open issue of whether semantic (in addition to response) conflict does indeed contribute to Stroop interference (that along with facilitation contributes to the overall Stroop effect also known as Congruency effect). To this end, semantic conflict was examined across the entire response time distribution (as opposed to mean RTs). Three (out of four) reported experiments, along with cross-experimental analyses revealed that semantic conflict was absent in the participants' faster responses. This result characterizes Stroop interference as a unitary phenomenon (i.e., driven uniquely by response conflict). When the same participants' responses were slower, Stroop interference became a composite phenomenon with an additional contribution of semantic conflict that was statistically independent of both response conflict and of facilitation. While the present findings allow to account for the fact that semantic conflict has not been consistently found in past studies, further empirical and theoretical efforts are still needed to explain why exactly it is restricted to longer responses. Indeed, since neither unitary nor composite models can account for this polymorphic nature of Stroop interference on their own, the implications for the current state of theory are outlined.

Keywords

Stroop effect; distributional analyses, response speed; response conflict; semantic conflict

Declarations

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Code availability: Programs used for running the experiments have been made publicly available on the Open Science Framework (OSF) and can be accessed at https://osf.io/8sazr/?view_only=bc6d4ddf2f0a4e629a1c14ea43806d9c (file "Stroop tasks")

Open Practices Statements: None of the experiments was preregistered but the data and materials for all experiments are available at https://osf.io/8sazr/?view_only=bc6d4ddf2f0a4e629a1c14ea43806d9c

INTRODUCTION

In the *Stroop task* (Stroop, 1935), it is particularly difficult to identify the ink color of a word when it denotes a different color (e.g., "BLUE" presented in green ink, hereafter *BLUE*$_{\text{green}}$). In line with Stroop's original idea, this difficulty is largely attributed to the fact that the unintentional reading of *color-incongruent* trials interferes with the identification of their ink color. Despite this consensus, a disagreement persists regarding the processing level(s) at which this *interference* occurs (see e.g., Henik et al., 2018; Parris et al., 2019, 2022 for the most recent discussions). Therefore, the present paper aimed to shed some additional light on the locus of this *interference*, considered – along with *facilitation* – as the driving force behind *the overall Stroop effect* (also known as Congruency effect, see Figure 1).

Locus vs. loci of Stroop interference

The vast majority of models assume that Stroop interference occurs during response selection (e.g. Cohen et al., 1990; Glaser & Glaser, 1989; Logan, 1980; Melara & Algom, 2003; Phaf et al., 1990; Roelofs, 2003). Indeed, whenever the irrelevant word dimension of Stroop trials prompts a response that is included in the response set (e.g., blue for *BLUE*$_{\text{green}}$), a conflict between two eligible responses occurs (e.g., blue vs. green for *BLUE*$_{\text{green}}$). As a result of this *response conflict*, the selection of a correct color response for color-incongruent trials is significantly delayed and more prone to errors than the one for color-neutral trials (e.g., *DEAL*$_{\text{green}}$).

Only one model (Zhang & Kornblum, 1998; Zhang et al., 1999) proposes that the unintentional reading of color-incongruent words causes an additional conflict to occur at the level of the stimulus. The assignment of two color-responses to the same response-key (e.g., responses to blue- and red-colored stimuli to 'f' key and those to green- and yellow-colored stimuli to ‘j’ key), allowed De Houwer (2003 in this journal) to test this alternative in a particularly elegant way. Indeed, this stimulus-response mapping causes some color-incongruent trials (e.g., $BLUE_{\text{green}}$) to prompt eligible responses toward two different response keys (hence termed *different-response trials*), thereby causing response conflict. Other color-incongruent trials (e.g., $BLUE_{\text{red}}$) however, do not generate this type of conflict, as the two eligible responses converge toward the same response-key (‘f’ here). Therefore, according to one-conflict (or *unitary*) models, these *same-response trials* should not produce any interference. Conversely, Zhang and colleagues’ two-conflict model still expects these same-response trials to interfere, since it assumes *stimulus* or *semantic conflict* to occur whenever two closely related semantic representations are simultaneously active (i.e., two color-concepts here).

In line with the idea that different-response trials generate both semantic and response conflict, whereas same-response trials only generate semantic conflict, the participants in De Houwer’s (2003) study responded more slowly to different- than to same-response trials (e.g., reaction times (RTs) to $BLUE_{\text{green}}$ > RTs to $BLUE_{\text{red}}$). They also responded more slowly to both of these color-incongruent trials than to baseline trials (e.g., RTs to $BLUE_{\text{red}}$ > RTs to $BLUE_{\text{blue}}$). Consequently, the *two-to-one Stroop paradigm* has become a popular way of distinguishing the contribution of semantic conflict from the one of response conflict (e.g., A. Chen et al., 2011, 2013; Z. Chen et al., 2013; Hershman & Henik, 2019, 2020; Jiang et al., 2015; Šaban & Schmidt, 2021; Schmidt et al., 2018; Schmidt & Cheesman, 2005; Shichel & Tzelgov, 2018; Van Veen & Carter, 2005).

It is however important to understand that in all of these studies – including De Houwer’s (2003) original study – , the interference induced by same-response trials was measured against *color-congruent* (or identity) trials (e.g., $BLUE_{\text{blue}}$) that are known to produce *facilitation* (i.e., faster responses to color-congruent than to *color-neutral* trials (e.g., *DEAL*$_{\text{green}}$); see e.g., Dalrymple-Alford & Budayr, 1966 for the first demonstration, see Figure 1 and 2 for a graphical representation). Since the one-conflict (or unitary) models often consider facilitation to be the flip side of interference[1], they can therefore easily explain the abovementioned positive difference in RTs between same-response and color-congruent items as resulting from *facilitation* on color-congruent trials rather than from *interference* on same-response trials (i.e., prima facie evidence for semantic conflict).

To test this alternative interpretation, Hasshim and Parris (2014) used an additional baseline consisting of color-neutral word trials (e.g., *DEAL*$_{\text{green}}$) that are free of facilitation (e.g., T. L. Brown, 2011; MacLeod, 1991). They reported longer RTs for same-response trials than for color-congruent trials, but no difference between same-response trials and additional color-neutral trials, which clearly runs counter the contribution of semantic conflict in the two-to-one Stroop paradigm (see also RTs from pupillometric studies of Hasshim & Parris, 2015 and of Hershman & Henik, 2020). As a result of this line of research and because of difficulties associated with alternative ways to induce semantic conflict (see section Present study here below), Parris et al. (2022) argued that it has not been shown to be an independent form of conflict in the Stroop task.

However, this conclusion does not consider results of Burca et al. (2022) published later that year. Indeed, in complete contrast to Hasshim and Parris (2014, see also Hasshim & Parris, 2015; Hershman & Henik, 2020), they were able to isolate a robust contribution of semantic conflict (same-response – color-neutral trials; e.g., RTs to *BLUE*$_{\text{red}}$ > RTs to *DEAL*$_{\text{red}}$) to the overall Stroop effect (different-response – color-congruent trials; e.g.,

[1] This is because facilitation and interference are considered as underpinned by a common mechanism (i.e., converging vs. diverging information from the word and its color; see, e.g., Cohen et al., 1990; Roelofs, 2003; but see, e.g., T. L. Brown, 2011 for arguments against this idea; see also Parris et al., 2022 for a discussion).

BLUE$_{green}$ > RTs to *BLUE*$_{blue}$). Importantly, this contribution was clearly independent of both response conflict (different-response – same-response trials; e.g., RTs to *BLUE*$_{green}$ > RTs to *BLUE*$_{red}$) and of facilitation (color-congruent – color-neutral trials; e.g., RTs to *BLUE*$_{blue}$ < RTs to *DEAL*$_{blue}$, see Figure 2 for a graphical representation of these results). Since unitary models can account for facilitation produced by color-congruent trials but not interference produced by same-response trials (see above), they seem unable to account for Burca et al. (2022)' findings.

However, in addition to the fact that these latter findings were observed in a single experiment and therefore need to be replicated, it remains unclear why Burca et al. (2022) observed semantic conflict in the two-to-one Stroop paradigm, when other studies did not (Hasshim & Parris, 2014, see also RTs from pupillometric studies of Hasshim & Parris, 2015; and of Hershman & Henik, 2020). Consequently, the aim of the present study was to address these issues.

Present study

To this end, the present study was designed to inspect the contribution of semantic conflict across the entire range of response times (as opposed to mean RTs reported in all the studies outlined above). Indeed, distributional analyses have been instrumental in documenting that the magnitude of the overall Stroop effect increases proportionally to the slow-down in response speed (see e.g., Faust et al., 1999; Jackson & Balota, 2013; Spieler et al., 1996) and that this proportional increase results from growing contributions of both interference and facilitation (Roelofs, 2010). Given this relationship between response speed and magnitudes of the overall Stroop effect and of its components (i.e., interference vs.

facilitation), it seems plausible that larger magnitudes of Stroop interference in slower responses could be due to the contribution of an additional (i.e., semantic) conflict.

This is precisely what several – more recent Stroop studies – suggest. In fast responses, Scaltritti and colleagues (2022) found no evidence of semantic conflict induced by semantic-associates (e.g., the word SKY that is associated to blue) presented in an incongruent color (*SKY*$_{\text{green}}$). Semantic conflict was however found in slower responses and increased proportionally as the speed of participants' responses slowed down (see also Labuschagne & Besner, 2015; Sulpizio et al., 2022). Similarly, Hasshim et al. (2019) only reported semantic conflict – induced by non-response set incongruent trials (e.g., *PURPLE*$_{\text{green}}$) – with the slowest responses, whereas response conflict contributed over a wider range of response times. While taken together, these studies suggest that semantic conflict could indeed be restricted to slower responses, it is important to note that only Hasshim and colleagues (2019) had actually induced and measured both semantic and response conflict (as opposed to Labuschagne & Besner, 2015; Scaltritti et al., 2022; Sulpizio et al., 2022 that induced and measured semantic conflict alone). More importantly, since it has been induced by semantic-associates (*SKY*$_{\text{green}}$) or non-response set trials (*PURPLE*$_{\text{green}}$), neither study has unambiguously demonstrated that what varies across the range of response times is semantic (and not response) conflict. Indeed, it has been argued – including by ourselves – that since these items prompt irrelevant responses that are not part of the response-set (e.g., sky and purple), they do not generate response conflict (e.g., Augustinova & Ferrand, 2014; Hasshim et al., 2019; Quétard et al., 2023). However, this is not the point of view shared by unitary models. In Roelofs' model (2003) for instance, the amount of a single (i.e., response) conflict is determined by the strength of semantic connections between the irrelevant responses and the response-set colors. Because these connections undeniably exist for both semantic-associates and non-response set trials (unlike for color-neutral ones), they are still expected to interfere at the response (as opposed to stimulus) level. Consequently, the presence of semantic conflict solely in the tail of RT distribution still remains to be demonstrated with trials that are unambiguously free of response conflict – as is the case for same response trials. Indeed, for these trials, the two eligible responses converge toward the same response-key thereby removing the conflict that arises when selecting between response effectors (De Houwer, 2003, see also above and Figure 2). If these trials indeed induce semantic conflict – as anticipated by two-conflict model (Zhang et al., 1999; Zhang & Kornblum, 1998) –, it should be found in slow as opposed fast responses (Hasshim et al., 2019; Labuschagne & Besner, 2015; Scaltritti et al., 2022; Sulpizio et al., 2022). This a priori expected pattern of results – putting the emphasis on the role of response speed – would then explain why semantic conflict induced by same-response trials has not been systematically found in past studies considering *mean* RTs only. Indeed, since distributional analyses provide information that is not necessarily reflected in analyses of mean RTs (see above and see Balota & Yap, 2011 for a general discussion of this issue), the presence of semantic conflict in the tail of the RT distribution is likely to be detected independently of whether it is (Burca et al., 2022, see also Burca et al., 2021) or is not reflected in mean RTs (Hasshim & Parris, 2014, see also RTs from pupillometric studies of Hasshim & Parris, 2015; Hershman & Henik, 2020).

EXPERIMENT 1

Method

To examine the abovementioned hypothesis, the existing data from two unpublished experiments were merged. The first (with eighty-seven participants) used a single within-participant factor (i.e., Stimulus-Type: different-response vs. same-response vs. neutral vs.

congruent) for data collection. The initial design also included a within-participants variation in Response Stimuli Intervals (RSI, 2000ms vs. 200ms) that was administered in a fixed order such that the first block with a 2000ms RSI was always presented first. The data from this first block (including randomly intermixed 96 different-response (DR) trials, 48 same-response (SR)[2] trials, 48 color-neutral word (N) trials, and 48 color-congruent (C) trials, see Figure 2) were merged with those from another experiment conducted under virtually identical conditions (see *Apparatus, Stimuli and Procedure* section here below) with eighty-two participants. Together, the data of one hundred and sixty-nine French-speaking psychology undergraduates (142 females and 27 males; M_{age}=19.97; *SD*=4.14) from Université Clermont Auvergne, all volunteers with normal or corrected-to-normal color-vision[3], were analyzed in the present experiment. This sample size therefore largely exceeded a total sample size of 13 participants recommended by G*Power (Faul et al., 2009) to detect the 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 5 (Response-speed: Bin 1-5) interaction in fully within-participants ANOVA (for an effect size of 0.25, power of 0.95, and type 1 error rate of 0.05; i.e., the interaction effect size found by similarly designed studies) that was used to further analyze the entire distributions of RTs. Five levels of the latter quasi-experimental variables – resulting from the fact that each participant's RT data were sorted into 5 quantiles or bins, ranging from their fastest to their slowest responses – were based on Scaltritti et al. (2022). In this work, five bins for each condition were computed – each comprising about 1296 observations. Merging the two data sets enabled the present study to exceed this number as recommended by Brysbaert and

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[2] If each color-word is presented in all the incongruent colors an equal number of times (to control for contingency), it generates twice as much DR than SR trials.

[3] To ensure that this was the case, the participants were asked to name the color of four colored stickers, as color-blindness, along with uncorrected normal version and late acquisition of French, constituted the three exclusion criteria.

Stevens (2018)[4]. Therefore, the analyses conducted in the present experiment can be considered as appropriately powered.

Apparatus, Stimuli and Procedure

Participants were seated approximately 50 cm from a 15-inch color monitor. For 87 of the participants, E-prime 2.0 software (Psychology Software Tools, Pittsburgh) was used for data presentation and recording while, for the other 82, PsychoPy software (Pierce, 2007) was used for data presentation and recording. The participants were instructed to identify the color of the stimulus presented in the center of the screen as quickly and accurately as possible by pressing the appropriate color button and ignoring everything else in the display. They were asked to stare at a fixation cross ("+"), which appeared in the center of the screen before each trial and remained there for 2000ms. The word stimulus then appeared and remained on the screen until the participants responded or until 3500ms had elapsed.

Stimuli were presented in lowercase, 18-point Times New Roman bold font on a black background if displayed using E-prime or on a gray background if displayed using PsychoPy, and subtended an average visual angle of 0.9° high × 3.0° wide. They consisted of four color-words: rouge [red], jaune [yellow], bleu [blue], and vert [green]; and four non-color counterparts: plomb [lead], liste [list], page [page], cave [basement], that were paired in length and frequency via Lexique 3.38 (New et al., 2004). Participants answered manually on an AZERTY keyboard; the "d" key was used for "blue" and "red" responses and the "k" key

[4] Brysbaert and Stevens (2018) recommend 1600 trials which reinforces our decision of using 5 bins (as in Scaltritti et al., 2022; see also Sulpizio et al., 2022) and not more (see e.g., Hasshim et al., 2019; Labuschagne & Besner, 2015).

for “green” and “yellow” responses. Color stickers were placed on the response keys as a reminder of the assigned colors for 87 of the participants but not for the other 82.

Two training blocks were administered to familiarize participants with the response set colors and their locations on the keyboard. The first consisted of 48 strings of asterisks (***) or hashes (###) that were randomly presented in the four response set colors. For 87 of the participants only, this first block was followed by a second block comprising 12 trials consisting of the four color words and three color-neutral words (i.e., balcon [balcony], pont [bridge] and chien [dog]) that were presented in the response set colors in such a way that participants encountered each condition of the Stimulus-Type factor (i.e., different-response vs. same-response vs. neutral vs. congruent) three times. The accuracy rate for all the practice blocks was over 80% for all participants. Altogether, it took about 25 minutes to complete the entire experiment.

Results and Discussion

Considering correct trials only, a cut-off of 3*SD*s above or below mean latency for each of the four conditions of Stimulus-Type factor in each participant was applied to the RTs, and all RTs under 200ms (i.e., 3 trials) were removed (i.e., a total of 2% of the data were excluded). RTs observed for each participant as a function of Stimulus-Type were then ordered from fast to slow trials and subsequently analyzed in a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 5 (Response-speed: Bin 1-5) ANOVA (see Table 1 for descriptive statistics and Supplementary Materials, SM including Table S1 for additional results). These analyses revealed the main effect of Stimulus-Type

[$F(3,504)=116.00$, $p<.001$, $\eta_p^2=0.408$, $BF_{10}=1.09e+6$ (i.e., $BF_{10}>100$)[5]], Response-speed [$F(4,672)=1532.91$, $p<.001$, $\eta_p^2=0.901$, $BF_{10}=+\infty$], and Stimulus-Type × Response-speed interaction [$F(12,2016)=75.21$, $p<.001$, $\eta_p^2=0.309$, $BF_{incl}>1$ for the interaction alone (i.e., BF_{10} for the interaction and both main effects divided by BF_{10} of both main effects); see Table S2 in SM for models generated by JASP 0.14.1.0 ; JASP Team, 2017[6]].

To decompose this interaction, we first computed the simple main-effect of Stimulus-Type for each Bin (see results in SM, pp.2-3) and a Bayesian one-tailed t-test for pairwise comparisons was further applied, whenever sensible (see Table 1 for all such comparisons). The overall Stroop effect (i.e., contrast between Different Response and Congruent trials, M_{DR}–M_C) emerged clearly in Bin 1 (+10ms, $p<.001$, $BF_{10}=5002.06$) but was entirely driven by facilitation (i.e., contrast between Neutral and Congruent trials, M_N–M_C; -10ms, $p<.001$, $BF_{10}=44921.54$, see Table 1). In Bin 2, overall Stroop effect (M_{DR}–M_C $p<.001$, $BF_{10}=2.27e+13$ (i.e., $BF_{10}>100$) was driven by both facilitation (-14ms, $p<.001$, $BF_{10}=951117.25$) and interference (i.e., contrast between Different Response and Neutral trials, M_{DR}–M_N; +14ms, $p<.001$, $BF_{10}=65228.90$) and this remained the case up to Bin 5. As can also be seen in Table 1 and Figure 3, in Bin 2 and 3, Stroop interference (M_{DR}–M_N) was entirely driven by a unique (i.e., response) conflict (i.e., contrast between Different and Same Response trials, M_{DR}–M_{SR}), as the contribution of semantic conflict (i.e., contrast between Same Response and Neutral trials, M_{SR}–M_N) started to be reliable from Bin 4 (+22ms,

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[5] BF_{10} corresponds to the Bayesian probability of the occurrence of a hypothesis (H1) and the likelihood of another null hypothesis (H0). It was calculated with JASP 0.14.1.0 (JASP Team, 2017, default priors were used to this end) and interpreted according to Lee and Wagenmakers (2014 adjusted from Jeffreys, 1961).

[6] One obvious limitation of JASP is that it does not generate all the models. Thus, to obtain Bayes factor for the interaction alone – so the direct comparison with standard frequentist ANOVA can be established – BF_{10} value for the interaction and both main effects needs to be divided by BF_{10} of both main effects. This additionally implies that whenever the evidence in favor of the main effects is close to infinity, the Bayesian evidence in favor of the Stimulus-Type × Response-speed interaction alone (without main effects) cannot be estimated more precisely than reported above (i.e., $BF_{incl}>1$).

p<.001, BF_{10}=5476.40). Finally, as Table 1 shows (see also Figure 3), Stroop interference (M_{DR}–M_N) continued to reveal its composite nature in Bin 5. In sum, taking the entire distribution of RTs into account, revealed a more complex pattern of results than the one usually reflected in mean RTs. As expected, in slower responses, the significant contribution of semantic conflict was indeed independent of both response conflict and of facilitation, whereas in faster responses, semantic conflict failed to contribute significantly. Still, given that this pattern was observed in a single experiment that additionally merged two preexisting data sets, the following experiment attempted to replicate this pattern further in a study that was a priori designed to this end.

EXPERIMENT 2

Method

One hundred English-speaking participants (65 females and 35 males, M_{age}=26.07, SD=4.53), including 45 students, were recruited online using Prolific (www.prolific.co) and received £5.50 for their participation. All participants reported having normal or corrected-to-normal color-vision, being right-handed and not having been diagnosed with any language-related disorder. The study used 4 levels of Stimulus-Type (different-response vs. same-response vs. neutral vs. congruent) for data collection. Again, due to the planned distributional analysis, and as in Experiment 1, the aforementioned sample size largely exceeded the minimum sample size of 13 participants recommended by G*Power (Faul et al., 2009) to detect the 4 (Stimulus-Type) × 5 (Response-speed) interaction in fully within-participants ANOVA (for an effect size of 0.25, power of 0.95, and type 1 error rate of 0.05). Given that this analysis was based on at least 2880 observations per Stimulus-condition in each of the five bins (see Results section), it can be considered as appropriately powered.

Procedure and stimuli

This experiment was completed online. Qualtrics (www.qualtrics.com) software was used to present the information sheet and Pavlovia (www.pavlovia.org) for data presentation and recording. The procedure was generally the same as in Experiment 1, except that Hasshim and Parris (2014, Exp.2)' stimuli were used (i.e., English color-words: red, yellow, blue, and green; and non-color words: top, along, marvel and past) and were presented in 3 blocks of 240 experimental trials (instead of one bloc in Experiment 1).

Results and Discussion

Applying the same cutoff as in Experiment 1 resulted in the exclusion of 2.2% of the total data, including 14 trials below 200ms. Remaining RTs were then ordered and analyzed as in Experiment 1 (see SM for additional results). This analysis revealed the main effect of Stimulus-Type [$F(3,297)=81.25$, $p<.001$, $\eta_p^2=0.451$], however, with no Bayesian evidence ($BF_{10}=0.933/BF_{01}=1.07$); the main effect of Response-speed [$F(4,396)=1012.36$, $p<.001$, $\eta_p^2=0.911$, $BF_{10}=+\infty$] and Stimulus-Type × Response-speed interaction [$F(12,1188)=33.16$, $p<.001$, $\eta_p^2=0.251$, $BF_{incl}>1$ for interaction alone; see Table S4 in SM for models generated by JASP 0.14.1.0 ; JASP Team, 2017[6]]. The decompositions of this interaction (see Table 2, Figure 4, and results in SM) showed that across the entire range of responses, the overall Stroop effect (M_{DR}–M_C) resulted from a significant contribution of both facilitation (M_C–M_N) and interference (M_{DR}–M_N, Roelofs, 2010). However, unlike in Experiment 1, and as in Hasshim and Parris (2014), interference was solely driven by response conflict (M_{DR}–M_{SR}), as the contribution of semantic conflict (M_{SR}–M_N) remained nonsignificant in all bins and computing ten bins has not changed this result.

EXPERIMENT 3

So far, Experiment 1 (using stimuli of Burca et al., 2022) revealed semantic conflict in slower responses, whereas semantic conflict was absent across the entire distribution in Experiment 2 (using stimuli of Hasshim and Parris, 2014, Exp.2). While binned RTs were comparable across the two experiments (see Tables 1 and 2), it should be noted that Experiment 1 was conducted in person, while Experiment 2 was conducted online. Therefore, the present experiment was again conducted online while controlling for the type of stimuli used (French vs. English words as used by Burca et al., 2022 and Hasshim and Parris, 2014 respectively).

Method

One hundred and sixty participants were recruited using Prolific (www.prolific.co) and received £5.50 for their participation. Eighty of them were native French speakers, including 44 students (41 females, 38 males and 1 preferred not to say, M_{age}=24.63, SD=4.26), and eighty were native English speakers, including 31 students (54 females and 26 males, M_{age}=25.91, SD=5.06). All participants reported having normal or corrected-to-normal color-vision, being right-handed and not having been diagnosed with any language-related disorder. The study used a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (Stimuli: French vs. English) design for data collection, with the former factor being within-participant. To detect this within-between interaction, that was not a priori expected, a minimum sample size of 36 participants was recommended by G*Power (Faul et al., 2009) for an effect size of 0.25, power of 0.95, and type 1 error rate of 0.05. To detect a within-between interaction with an additional within participants 5-levels factor of Response-speed (that again was not a priori expected), a minimum sample size dropped to 14 participants. As in previous experiments, the sample size was substantially increased in order to conduct planned analysis of the entire RT distribution, namely to detect the a priori expected 4 (Stimulus-Type) × 5 (Response-speed: Bin 1-5) within-participants interaction and analyze it with a substantial number of observations for each level of Stimulus-Type in all five bins.

Procedure and Stimuli

Qualtrics (www.qualtrics.com) software was used to present the information sheet and Pavlovia (www.pavlovia.org) for data presentation and recording. The procedure and stimuli were generally the same as in Experiments 1 and 2. The present experiment used one block of 240 randomly presented experimental trials, with 96 different-response (DR), 48 same-response (SR), 48 color-neutral (N) and 48 color-congruent (C) trials. For French-speaking participants, the same stimuli as in Experiment 1 were used. For English-speaking participants, the same stimuli as in Experiment 2 were used.

Results and Discussion

Applying the same cutoff as in the previous experiments resulted in the exclusion of 2 % of the total data, including 6 trials below 200ms. Remaining RTs were then analyzed in a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (Stimuli: French vs. English) × 5 (Response-speed: bins 1-5) ANOVA. As expected, the only interaction supported by the evidence from both standard ANOVA and Bayesian ANOVA was the Stimulus type × Response-speed interaction [$F(12,1896)=34.29$, $p<.001$, $\eta_p^2=0.178$, $BF_{incl}>1$ for interaction alone; see Table S6 in SM for models generated by JASP 0.14.1.0 ; JASP Team, 2017[6] and Table S7 in SM for descriptive results of a non-significant 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (Stimuli:

French vs. English) interaction]. This interaction – based on at least 1536 observations per Stimulus-condition in each of the five bins – was further decomposed as in the previous experiments. As can be seen in Table 3 (see also Figure 5), an overall Stroop effect (M_{DR}–M_C) emerged in Bin 1. It resulted from a significant contribution of both facilitation (M_N–M_C; up to Bin 4) and interference (M_{DR}–M_N, up to Bin 5). The contribution of response conflict (M_{DR}–M_{SR}) to Stroop interference became reliable in Bin 2 (and remained significant up to Bin 5) and that of semantic conflict (M_{SR}–M_N) in Bin 3 (and remained significant up to Bin 5). In sum, overall, the present experiment replicated the results of Experiment 1 (see Figures 3 and 5).

EXPERIMENT 4

So far, two (Experiment 1 and 3) of the three experiments revealed semantic conflict on slow RTs only. However, none of these experiments has manipulated response speed. To this end, the following experiment employed a response-stimulus interval (RSI) manipulation that has been shown to modify participants' response speed (Augustinova et al., 2018; De Jong et al., 1999; Jackson & Balota, 2013; Parris et al., 2012; Parris, 2014). Specifically, the 2000ms (henceforth long RSI) that elapsed between the individual's response on trial N and the presentation of a new stimulus on trial N+1 in all experiments reported above, were shortened to 200ms (henceforth short RSI) for half of the participants. This latter shortening was expected to increase response speed and subsequently result in the reduced magnitude of the overall Stroop effect compared to that observed with long RSI (De Jong et al., 1999 for the initial demonstration). These a priori predicted differences in magnitudes were also expected to result from differences in semantic conflict, such that it was predicted to occur with long but not short RSI.

Method

One hundred and seven psychology undergraduates (93 females and 14 males; M_{age}=19.37; *SD*=3.73) from Université Clermont Auvergne volunteered to take part in this experiment (interrupted by the COVID-19 pandemic). None of them had taken part in Experiment 1. They were all native French-speakers with normal or corrected-to-normal color-vision. The study used a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (RSI: long vs. short) design for data collection, with the former factor being within-participant. To detect this within-between interaction, a minimum sample size of 36 participants was recommended by G*Power (Faul et al., 2009) for an effect size of 0.25, power of 0.95, and type 1 error rate of 0.05 (i.e., the interaction effect size found by similarly designed studies). In order to additionally conduct distributional analysis as in Experiments 1-3 (for the sake of comparison with these latter experiments), the sample size was again increased substantially such that 53 individuals were randomly assigned to the long-RSI condition and 54 individuals to the short-RSI condition. Beyond detecting the a priori expected 4 (Stimulus-Type) × 5 (Response-speed: Bin 1-5) within-participants interaction, this increase namely allowed to analyze it with a substantial number of observations for each level of Stimulus-Type in all five bins.

Apparatus, Stimuli and Procedure

The Apparatus, Stimuli and Procedure were identical to those of Experiment 1 except that the participants used the same custom device as in Burca et al. (2021; 2022) to respond[7] instead of a keyboard and that the present experiment used 8 blocks of 120 experimental

[7] One handle was used for responses to "blue" and "red" and the other for responses to "green" and "yellow". Color stickers were placed on each handle to remind participants of the response mapping. The use of handles by the right vs. left hand was counterbalanced across participants.

trials, resulting in a total of 960 trials per participant (i.e., more than in Experiment 1 and 2). In each block, 48 different-response (DR), 24 same-response (SR), 24 color-neutral (N) and 24 color-congruent (C) trials were randomly presented.

Results and Discussion

Applying the same cutoff as in previous experiments resulted in the exclusion of 2.1% of the total data, including 35 trials below 200ms. Remaining mean RTs and errors (see Table 4) were then analyzed in a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (RSI: long vs. short) ANOVA, with the latter factor being between-participants. This analysis revealed a main effect of Stimulus-Type [$F(3,315)=70.93$, $p<.001$, $\eta_p^2=0.403$, $BF_{10}=1.27e+31$ (i.e., $BF_{10}>100$)]. The effect of RSI [$F(1,105)=4.27$, $p=.041$, $\eta_p^2=0.039$] was only supported by anecdotal Bayesian evidence ($BF_{10}=1.32/BF_{01}=0.759$) although numerically faster-responding ($M=534$, $SE=11$) was observed in short RSI as compared to long RSI (M=566, $SE=11$). The Stimulus Type × RSI interaction was significant [$F(3,315)=3.23$, $p=.026$, $\eta_p^2=0.030$] and supported by moderate evidence ($BF_{incl}=3.82$ for interaction alone, see Table S7 in SM for models generated by JASP 0.14.1.0 ; JASP Team, 2017[6]).

This interaction was further decomposed by testing the simple main effect of Stimulus-Type at each level of RSI. In line with this significant effect with long [$F(3,103)=37.21$, $p<.001$, $\eta_p^2=0.520$] and short RSI [$F=(3,103)=16.41$, $p<.001$, $\eta_p^2=0.323$], the overall Stroop effect (M_{DR}–M_C) resulted from a significant contribution of facilitation (M_N–M_C) and interference (M_{DR}–M_N) in both RSIs (see Table 4). However, as predicted, Stroop interference observed with short-RSI was driven only by response conflict (M_{DR}–M_{SR}; $p<.001$, $BF_{10}=531.30$), whereas it resulted from a significant contribution of both response

(p<.001, BF_{10}=27744.87) and semantic (M_{SR}–M_N; p=.004, BF_{10}=5.33) when the long RSI was used (see SM for the analysis of errors). Therefore unsurprisingly, when the entire distribution of RTs was additionally analyzed in the Stimulus type × RSI × Response-speed ANOVA, Stimulus type × Response-speed ANOVA – reported here for the sake of direct comparison with the results of Experiments 1-3 – was significant (while the omnibus ANOVA was not). Its further decomposition showed that the contribution of semantic conflict to the Stroop interference effect was again only reliable in slower RTs (from Bin 4 to 5[8]), whereas that of response conflict was reliable for a wider range of RTs (from Bin 2 to 5; see Table 5 and Figure 6 for the detailed results and see SM for the full description of these additional analyses).

CROSS-EXPERIMENTAL (POST-HOC) ANALYSES

Given that results of Experiment 2 are at odds with those observed in the remaining experiments, a Stimulus-Type × Response-speed ANOVA was additionally conducted on RTs from all four experiments (i.e., 482 participants) collected with a typical (i.e., 2000ms) RSI (see SM for detailed analyses and results). The decompositions of the significant Stimulus-Type × Response-speed interaction it showed (see Table 6), suggest that in Bin 1 and up to Bin 5, the overall Stroop effect (M_{DR}–M_C), was driven by both facilitation (M_N–M_C) and interference (M_{DR}–M_N), as in Roelofs (2010). Up to Bin 2, Stroop interference (M_{DR}–M_N) was itself entirely driven by response conflict (M_{DR}–M_{SR}). From Bin 3, semantic conflict (M_{SR}–M_N) started to contribute reliably (see Figure 7). The additional Linear Mixed Modelling (see SM for description and results) suggests that this Stimulus-Type × Response-

[8] There were at least 2035 observations per Stimulus-condition in each of the five bins.

speed interaction also best accounted for the hierarchical structure of the cross-experimental data (see Table S12 in SM for all models). This idea is further reinforced by the non-significant intercept of the experiments (see Table S13 in SM for estimate values) suggesting that the pattern of results in Experiment 2 does not deviate from the general pattern observed across the remaining experiments. At this point therefore, it is the most likely a false negative. In light of results observed in Experiment 3, the lack of semantic conflict in Experiment 2 is neither due to the fact that this latter experiment was run online, nor to the use of English words as stimuli (as compared to French ones). While more cross-language studies are needed to address this latter possibility in a more direct and systematic way than it was done in Experiment 3, it is important to note that French is characterized by greater print-to-sound transparency. As a result, one could expect semantic conflict generated by French stimuli to be of a smaller and not a greater magnitude as the one observed in English (see also Sulpizio et al., 2021 for a discussion of this issue).

General Discussion

While semantic conflict was absent in Experiment 2 in both mean RTs (replicating Hasshim & Parris, 2014, see Table S3 in SM) and across the entire distribution, the remaining three experiments and additional cross-experimental (post-hoc) analyses revealed the presence of semantic conflict in slow-response trials. In a similar way to response conflict, the contribution of semantic conflict increased proportionally as a function of response speed. But while the contribution of response conflict was present across the entire distribution, that of semantic only became reliable in the tail of the RT distribution – as already suggested by the data of Hasshim and colleagues (2019). This presence of two conflicts is also in line with various event-related potential studies suggesting that there are two interference-related components (Appelbaum et al., 2009). The first – centro-medial and occurring from 350 to 500 ms after the presentation of the Stroop stimulus – is believed to arise from generators in the anterior cingulate cortex (ACC) and is thought to reflect the detection and/or resolution of response conflict. The second component – occurring from 500 to 900 ms post stimulus and maximal over the left parietal cortex – is "possibly related to the need for additional processing of word meaning" (Liotti et al., 2000, p. 701). Although the examination of response vs. semantic conflict across the entire distribution (see Figure 7, see also Table 6) strongly coincides with the aforementioned onsets, it is important to remember that the RT distribution cannot be interpreted as a timeline. Most models – including those mentioned above – assume that response conflict is determined by the activation of the underpinning semantic information (i.e., information flows from the semantic level to the response level). But the automatic processing of the word-dimension of incongruent trials is also thought to trigger semantic conflict, at least within models anticipating this conflict – occurring at the level of stimulus (in addition to Zhang and colleagues' two-conflict model, see also so-called *early selection models* that anticipate a unique (i.e., semantic) conflict, e.g., Seymour, 1977). Under this view, semantic conflict reflects a slowdown that occurs whenever two distinct yet closely related semantic representations are simultaneously activated in an amodal semantic network (see, e.g., Seymour, 1977, for discussion, but see e.g., Hock & Egeth, 1970 for the idea of perceptual rather than conceptual/semantic interference at the stimulus level). This means that while semantic and response conflict might be detected and/or resolved with different time courses, they are both likely to have an early functional processing locus.

Finally, the fact that semantic conflict is only apparent in slower responses could be interpreted as indicating that this type of conflict only emerges in trials involving larger lapses of selective attention (as initially reasoned by Scaltritti et al., 2022). This is precisely what the results of Experiment 4 suggest. In agreement with past studies, a larger overall Stroop effect was observed with long RSI compared to short RSI (e.g., Augustinova et al., 2018; De Jong et al., 1999; Jackson & Balota, 2013; Parris, 2014). Experiment 4 specifically revealed that this larger magnitude was due to the contribution of an additional (i.e., semantic) conflict[9]. These results are therefore consistent with De Jong et al. (1999)' idea that faster responding (induced by RSI of 200 ms) significantly reduces lapses in the maintenance of the task goal and therefore optimizes participant's focus on the relevant color-dimension. Still, it should be noted that this latter causal chain (i.e., response speed influencing attention) is not warranted, as lapses of attention occurring at long RSI might as well lead to longer RTs.

Therefore, it seems important to underlie at this point that the changes in goal maintenance anticipated by De Jong et al. (1999) might not be necessary and that any factor that – exactly like RSI – changes response speed can consequently modify the nature of the Stroop effect. Indeed, factors such as response repetition from trial N-1 are also known to influence the speed of responses. To illustrate, Stroop studies – including the present one – do not usually control for associative-priming confounds (Henson et al., 2014; Hommel, 2004; Schmidt & Weissman, 2016), which can substantially impact response speed and therefore – as shown here – impact the type of conflict that is subsequently experienced on a given trial (response conflict alone or response conflict followed by semantic conflict). In sum, any factor that modifies response speed should determine how much semantic conflict is observed.

[9] The present findings are therefore incompatible with the idea that RSI affects response conflict but leaves semantic conflict unaffected - as previously argued by Augustinova et al. (2018). Our results are also incompatible with the idea that a short RSI reduces task conflict (i.e., a more general conflict that derives from the simultaneous activation of two task sets: word-reading vs. color-naming, e.g., Bench et al., 1993; Goldfarb & Henik, 2007; Hershman & Henik, 2020 for PET, behavioral and pupillometric evidence; but see also Parris et al., 2023 for another perspective) as opposed to other types of conflict. In the present study, and unlike in Parris (2014), shortening the RSI failed to boost the magnitude of Stroop facilitation (while simultaneously reducing interference).

Despite the fact that the factors capable of influencing response speed in the Stroop task are not all known at present (as these are likely to range from the aformentioned sequence effects up to higher-order variables such as motivation) and other unresolved issues discussed above, this study has at least two important implications. First, it allows to account for the existing contradictory findings which suggest that the contribution of semantic conflict in the Stroop task may be fragile. Indeed, in fast responses, semantic conflict failed to contribute significantly, as in mean RTs reported by Hasshim and Parris (2014; see also RTs from pupillometric studies of Hasshim & Parris, 2014 and of Hershman & Henik, 2020). In slower responses, on the other hand, the significant contribution of semantic conflict was indeed independent of both response conflict and of facilitation – as in mean RTs reported by Burca et al. (2022). Second, the present study adds to those showing that the overall Stroop effect increases proportionally as response speed gets slower (e.g., Jackson & Balota, 2010; Roelofs, 2010; Spieler et al., 1996). While this proportional increase is due, in part, to the fact that both facilitation and interference increase at similar rates (as showed by Roelofs, 2010), the present study allowed to identify that larger magnitudes of Stroop interference in slower responses are specifically due to the contribution of an additional (i.e., semantic) conflict. Said differently, the distributional analyses conducted in the present study were unique in revealing the polymorphic nature of Stroop interference.

CONCLUSION

While it still needs to be extended to vocal response modality[10], it is important to understand that neither unitary (e.g., Cohen et al., 1990; Logan, 1980; Roelofs, 2003) nor

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[10] Although it should be noted that phonological processing of the irrelevant word in the Stroop task clearly occurs

composite models (Zhang et al., 1999; Zhang & Kornblum, 1998) can account for this polymorphic nature of Stroop interference on their own. Therefore, these latter models might need to be amended to effectively incorporate semantic conflict (see e.g., Kalanthroff et al.'s, 2018 for amending Cohen et al.,1990's initial model to incorporate task conflict[9] that is also likely to occur in the Stroop task). Additionally, as neither class of models is very precise in predicting time-related aspects of the Stroop effects, these models also need to explain why exactly semantic conflict is restricted to longer responses. Finally, since all currently available models hold that any conflicts that are present are resolved at the level of response selection (i.e., before the actual motor action is initiated), future modelling efforts might also want to explain findings showing that Stroop effects can occur in part (Kello et al., 2000; Exp.2) or even entirely (Bundt et al., 2018; Quétard et al., 2023) after the response has been initiated (i.e., during the response execution phase). In sum, while the present study constitutes a considerable step toward understanding the loci of the Stroop effect, this issue is still far from being solved. Further empirical and theoretical work is therefore still needed.

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with manual response modality (Parris et al., 2019) suggesting that the Stroop task administered with manual responses is not necessary qualitatively different from the one administered with vocal responses. If anything, semantic conflict – induced via color-associated items at least (e.g., SKY_{blue}) – tends to be smaller (and not bigger) with manual as opposed to vocal responses (see e.g., Sharma & MacKenna, 1998; and Augustinova & Ferrand, 2014 for a broader discussion).

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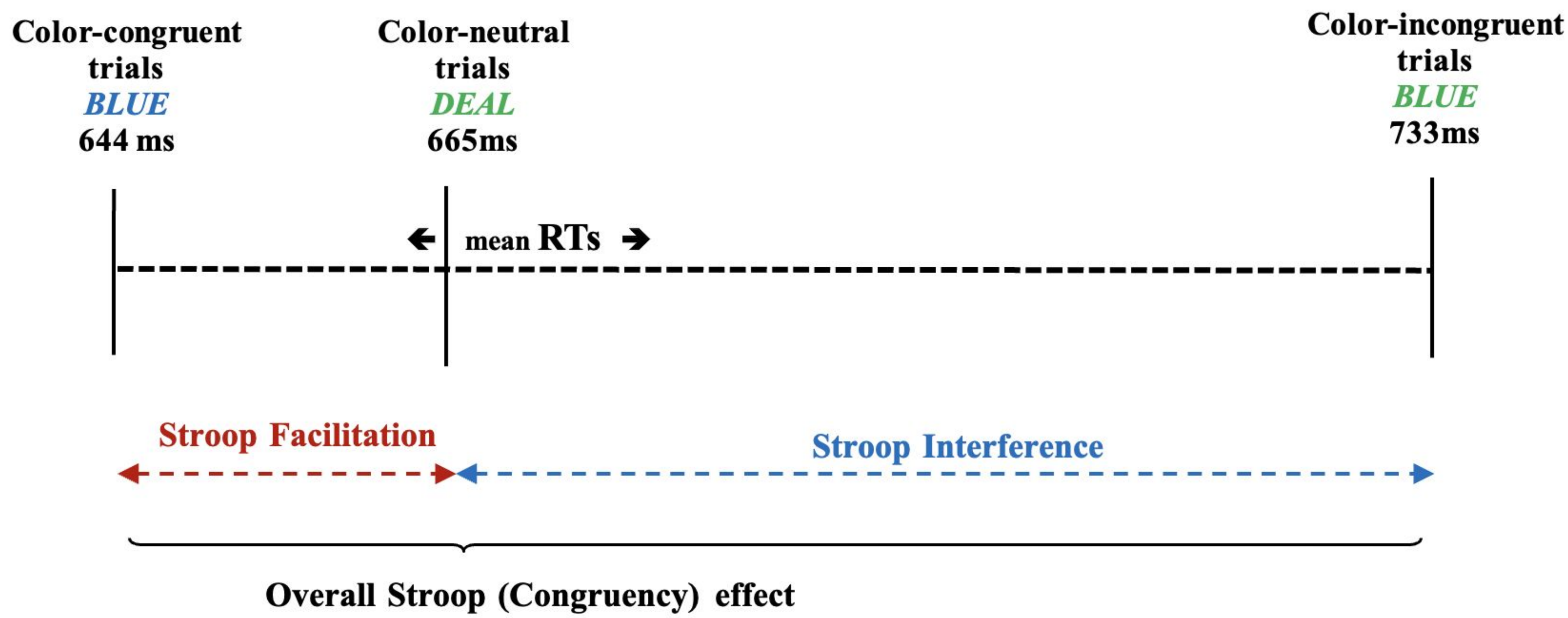
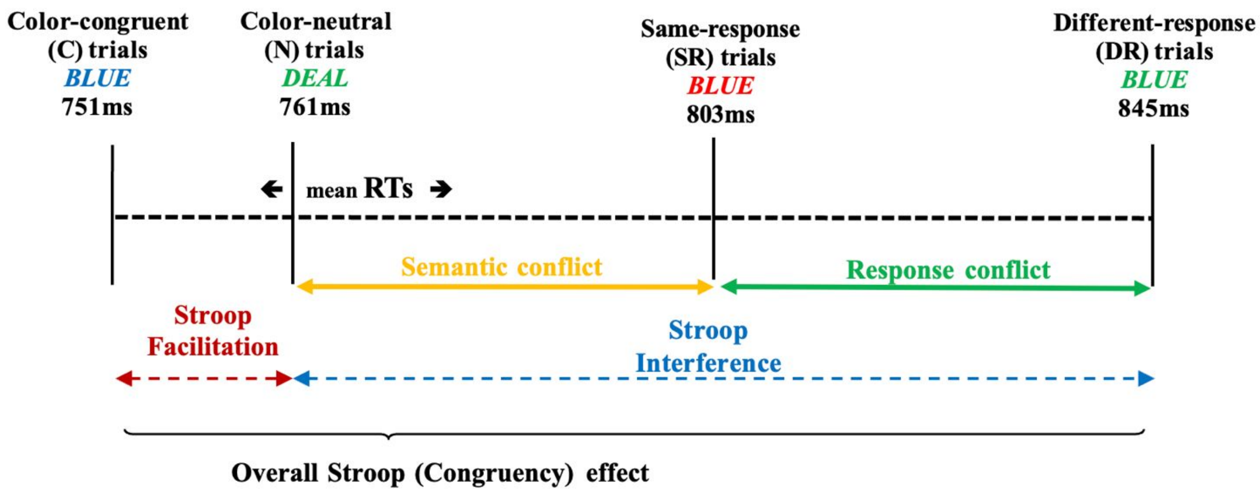


Figure caption

Figure 1. Diagrammatic representation of how the contribution of Stroop facilitation (i.e., faster mean RTs to color-congruent than to color-neutral trials) vs. Stroop interference (i.e., slower mean RTs to color-incongruent than to color-neutral trials) to the overall Stroop (Congruency) effect is typically derived from mean RTs (data from Experiment 2 of Augustinova et al., 2019).



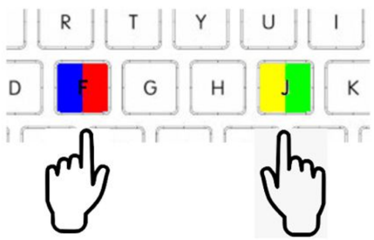


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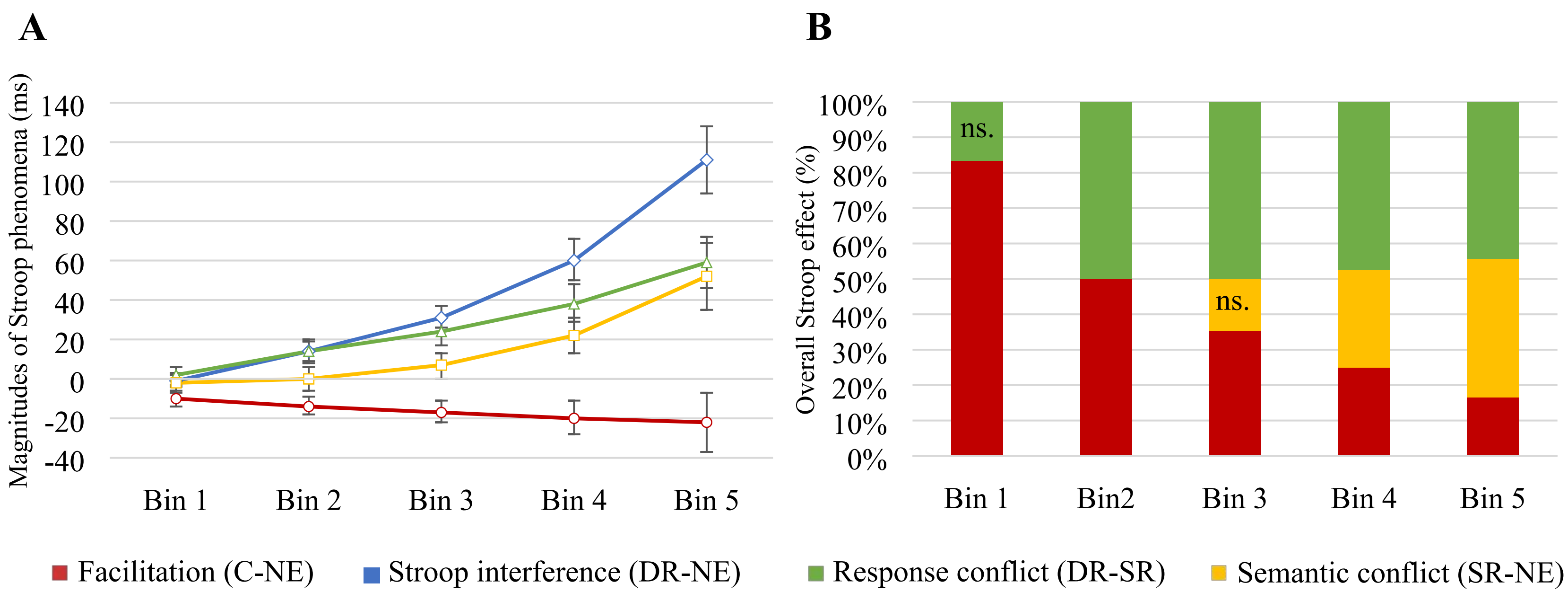
Figure 2. Diagrammatic representation of how the contribution of semantic conflict (i.e., faster mean RTs to same-response than to color-neutral trials) to Stroop interference effect – contribution that is independent of both response conflict (i.e., faster mean RTs to different-response than to

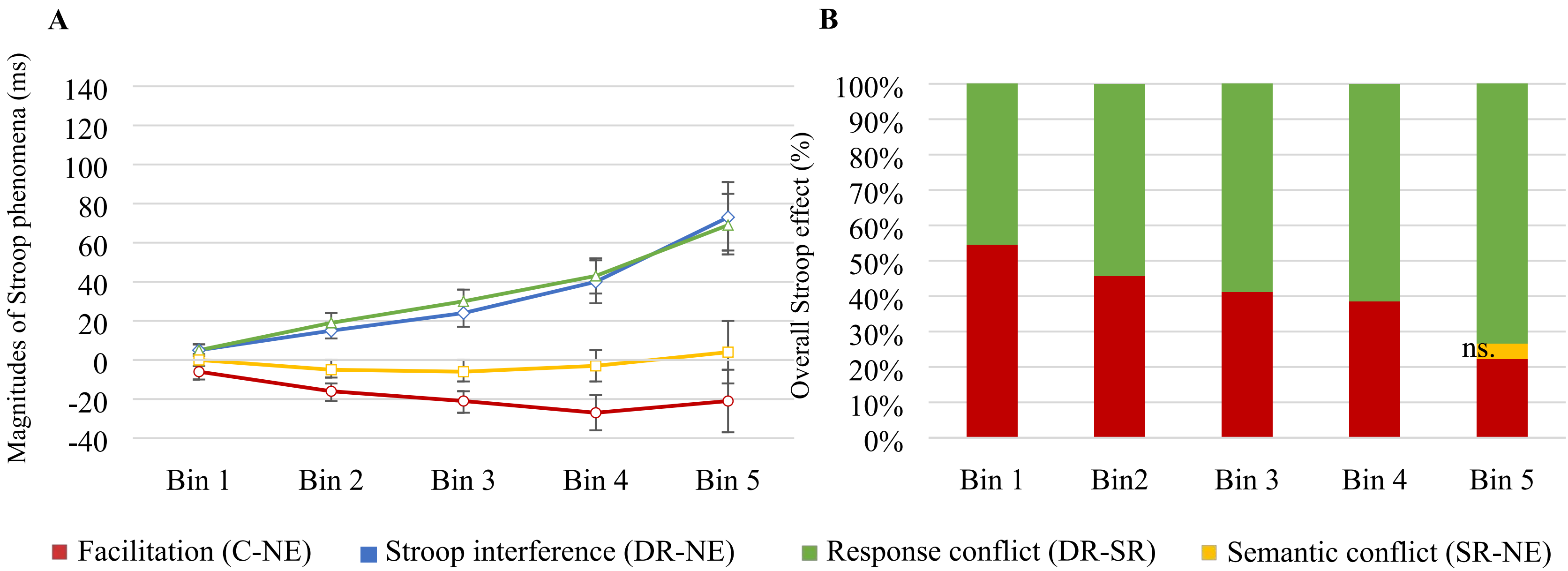
same-response trials) and of Stroop facilitation – is derived from mean RTs collected in the two-to-one Stroop paradigm with an additional color-neutral baseline (data from Burca et al., 2022 collapsed across older and younger participants).



Note: Experiment 1. Error bars in panel A represent 95%-Confidence Intervals; Sum of Response and Semantic conflicts represented in panel B corresponds to Stroop interference.

Figure caption

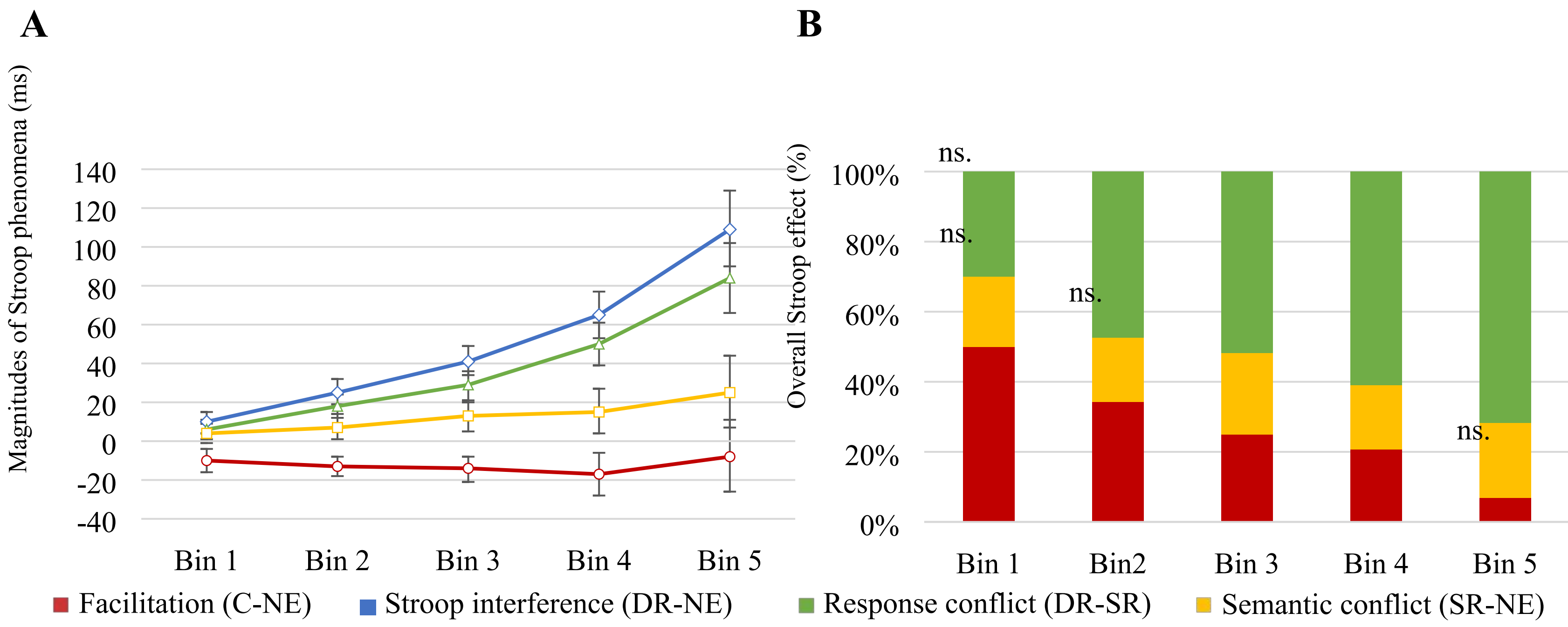
Figure 3. Magnitudes of each Stroop effect (panel A) and composition of the overall Stroop (congruency) effect in percentages (panel B) observed as a function of response speed in Experiment 1.



Note: Experiment 2. Error bars in panel A represent 95%-Confidence Intervals; Sum of Response and Semantic conflicts represented in panel B corresponds to Stroop interference.

Figure caption

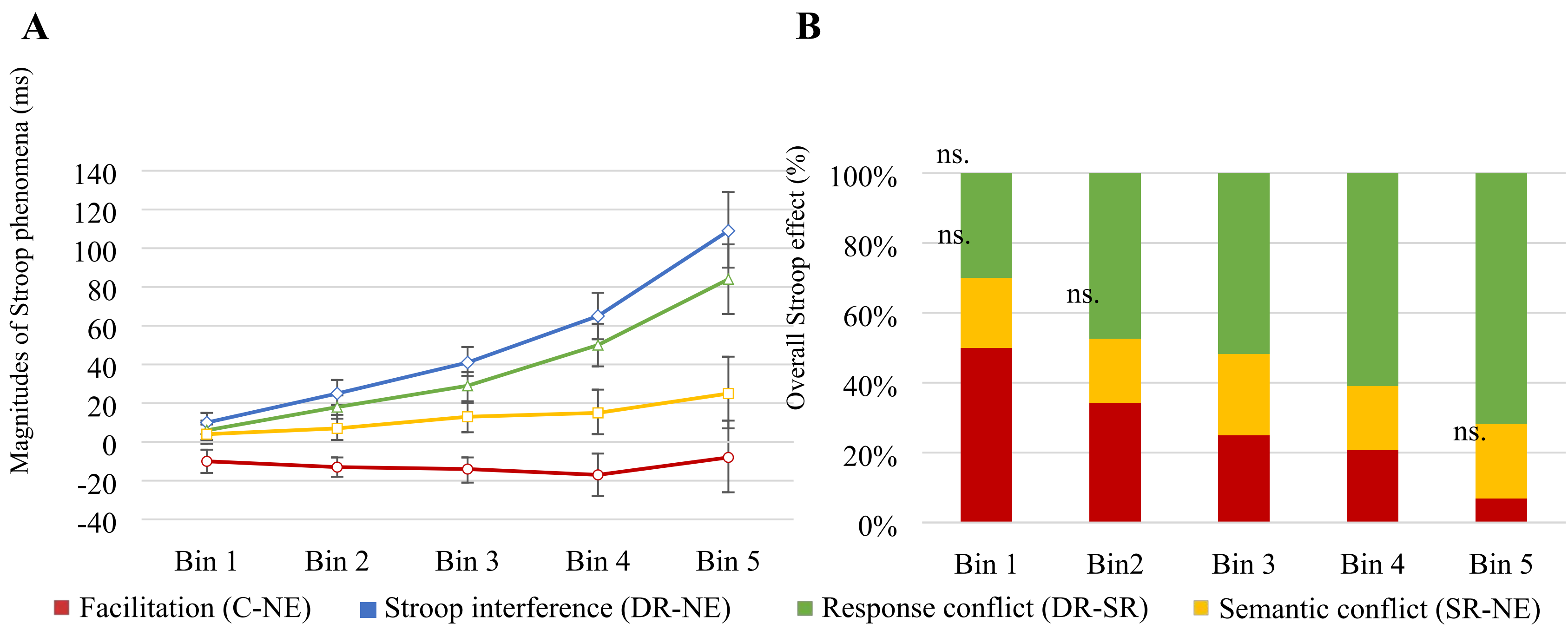
Figure 4. Magnitudes of each Stroop effect (panel A) and composition of the overall Stroop (Congruency) effect in percentages (panel B) observed as a function of response speed in Experiment 2.



Note: Experiment 3. Error bars in panel A represent 95%-Confidence Intervals; Sum of Response and Semantic conflicts represented in panel B corresponds to Stroop interference.

Figure caption

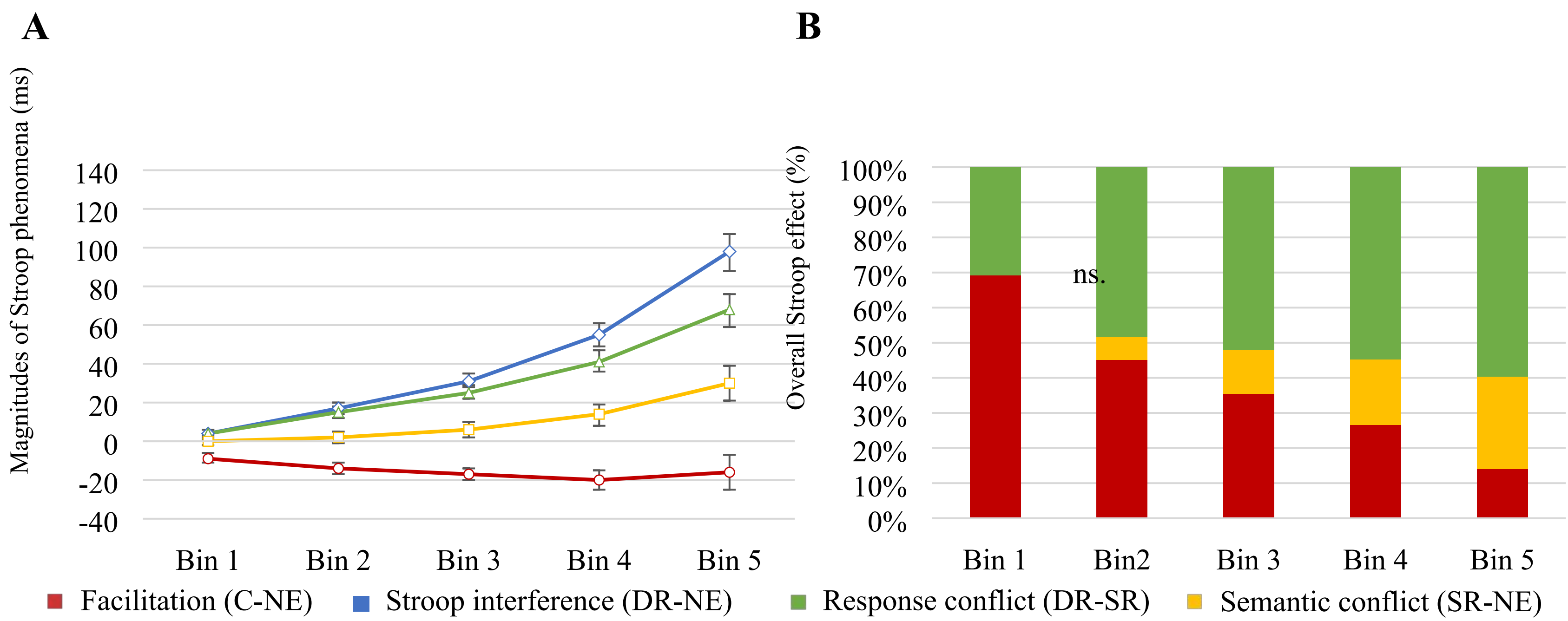
Figure 5. Magnitudes of each Stroop effect (panel A) and composition of the overall Stroop (Congruency) effect in percentages (panel B) observed as a function of response speed in Experiment 3.



Note: Experiment 4. Error bars in panel A represent 95%-Confidence Intervals; Sum of Response and Semantic conflicts represented in panel B corresponds to Stroop interference.

Figure caption

Figure 6. Magnitudes of each Stroop effect (panel A) and composition of the overall Stroop (Congruency) effect in percentages (panel B) observed as a function of response speed in Experiment 4.



Note: Experiments 1-4. Error bars in panel A represent 95%-Confidence Intervals; Sum of Response and Semantic conflicts represented in panel B corresponds to Stroop interference.

Figure caption

Figure 7. Magnitudes of each Stroop effect (panel A) and composition of the overall Stroop (Congruency) effect in percentages (panel B) observed as a function of response speed in Experiments 1-4 (cross-experimental post-hoc analysis).

Table 1. *Color-Identification Performance (Mean Response Times, Standard Errors, and 95%-Confidence Intervals) observed as a Function of Stimulus- or Effect-Type and Response Speed in Experiment 1.*

	Bin 1		**Bin 2**		**Bin 3**		**Bin 4**		**Bin 5**	
Stimulus-type	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI
Different-Response (DR) Color-Incongruent Items	428 (6)	[417, 440]	527 (8)	[511, 543]	616 (10)	[595, 636]	738 (14)	[711, 766]	1005 (18)	[969, 1041]
Same-Response (SR) Color-Incongruent Items	427 (6)	[415, 438]	513 (7)	[498, 528]	592 (9)	[573, 610]	700 (13)	[675, 725]	946 (17)	[912, 980]
Color-Neutral items	429 (5)	[419, 439]	513 (7)	[500, 526]	585 (9)	[568, 602]	678 (11)	[656, 700]	894 (15)	[865, 923]
Color-Congruent items	419 (5)	[409, 429]	499 (7)	[486, 513]	568 (9)	[551, 586]	658 (11)	[636, 681]	872 (15)	[842, 902]
Magnitudes of effects	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI
Overall Stroop (Congruency) Effect (DR – Congruent)	$10^{\dagger / \dagger\dagger}$ (2)	[6, 14]	$28^{\dagger / \dagger\dagger}$ (3)	[22, 34]	$47^{\dagger / \dagger\dagger}$ (4)	[39, 55]	$80^{\dagger / \dagger\dagger}$ (6)	[69, 91]	$133^{\dagger / \dagger\dagger}$ (8)	[117, 149]
Facilitation Effect (Congruent – Neutral)	$-10^{\dagger / \dagger\dagger}$ (2)	[-14, -6]	$-14^{\dagger / \dagger\dagger}$ (2)	[-18, -9]	$-17^{\dagger / \dagger\dagger}$ (3)	[-22, -11]	$-20^{\dagger / \dagger\dagger}$ (4)	[-28, -11]	$-22^{** / *}$ (8)	[-37, -7]
Stroop Interference Effect (DR – Neutral)	$-1^{ns / ns}$ (2)	[-4, 3]	$14^{\dagger / \dagger\dagger}$ (3)	[9, 19]	$31^{\dagger / \dagger\dagger}$ (3)	[24, 37]	$60^{\dagger / \dagger\dagger}$ (5)	[50, 71]	$111^{\dagger / \dagger\dagger}$ (9)	[94, 128]
Response Conflict (DR – SR)	$2^{ns / ns}$ (2)	[-3, 6]	$14^{\dagger / \dagger\dagger}$ (3)	[8, 20]	$24^{\dagger / \dagger\dagger}$ (3)	[17, 31]	$38^{\dagger / \dagger\dagger}$ (5)	[29, 48]	$59^{\dagger / \dagger\dagger}$ (7)	[46, 72]
Semantic Conflict (SR – Neutral)	$-2^{ns / ns}$ (2)	[-7, 2]	$0^{ns / ns}$ (3)	[-6, 6]	$7^{* / ns*}$ (3)	[0, 13]	$22^{\dagger / \dagger\dagger}$ (5)	[13, 31]	$52^{\dagger / \dagger\dagger}$ (8)	[35, 69]

Note. Standard frequentist inference (presented before the slash used as separator): ^{ns}non-significant; *significant at $p<.05$; **significant at $p<.01$; †significant at $p<.001$; Bayesian inference (presented after the slash used as separator): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Table 2. *Color-Identification Performance (Mean Response Times, Standard Errors and 95%-Confidence Intervals) observed as a Function of Stimulus- or Effect-Type and Response Speed in Experiment 2.*

	Bin 1		**Bin 2**		**Bin 3**		**Bin 4**		**Bin 5**	
Stimulus-type	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI
Different-Response (DR) Color-Incongruent Items	478 (7)	[463, 492]	584 (10)	[564, 604]	673 (13)	[648, 698]	796 (16)	[764, 828]	1107 (23)	[1061, 1153]
Same-Response (SR) Color-Incongruent Items	472 (7)	[458, 487]	565 (9)	[546, 584]	643 (12)	[620, 667]	754 (15)	[723, 784]	1037 (22)	[993, 1082]
Color-Neutral items	473 (7)	[458, 487]	569 (10)	[550, 589]	649 (12)	[625, 673]	756 (15)	[726, 787]	1033 (23)	[988, 1078]
Color-Congruent items	466 (7)	[452, 480]	553 (9)	[535, 571]	628 (11)	[605, 650]	730 (15)	[700, 760]	1012 (23)	[967, 1057]
Magnitudes of effects	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI
Overall Stroop (Congruency) Effect (DR – Congruent)	11$^{\dagger / \dagger\dagger}$ (2)	[8, 15]	31$^{\dagger / \dagger\dagger}$ (3)	[26, 36]	45$^{\dagger / \dagger\dagger}$ (4)	[38, 53]	66$^{\dagger / \dagger\dagger}$ (5)	[56, 77]	94$^{\dagger / \dagger\dagger}$ (8)	[79, 109]
Facilitation Effect (Congruent – Neutral)	-6$^{\dagger / \dagger}$ (2)	[-10, -3]	-16$^{\dagger / \dagger\dagger}$ (2)	[-21, -12]	-21$^{\dagger / \dagger\dagger}$ (3)	[-27, -16]	-27$^{\dagger / \dagger\dagger}$ (5)	[-36, -18]	-21$^{* / *}$ (8)	[-37, -5]
Stroop Interference Effect (DR – Neutral)	5$^{\dagger / \dagger}$ (1)	[2, 8]	15$^{\dagger / \dagger\dagger}$ (2)	[11, 19]	24$^{\dagger / \dagger\dagger}$ (3)	[17, 30]	40$^{\dagger / \dagger\dagger}$ (5)	[29, 51]	73$^{\dagger / \dagger\dagger}$ (9)	[56, 91]
Response Conflict (DR – SR)	5$^{** / **}$ (2)	[2, 8]	19$^{\dagger / \dagger\dagger}$ (2)	[15, 24]	30$^{\dagger / \dagger\dagger}$ (3)	[24, 36]	43$^{\dagger / \dagger\dagger}$ (4)	[34, 52]	69$^{\dagger / \dagger\dagger}$ (8)	[54, 85]
Semantic Conflict (SR – Neutral)	0$^{ns / ns}$ (2)	[-3, 3]	-5$^{ns / ns}$ (2)	[-9, 0]	-6$^{* / ns}$ (3)	[-11, 0]	-3$^{ns / ns}$ (4)	[-11, 5]	4$^{ns / ns}$ (8)	[-12, 20]

Note. Standard frequentist inference (presented before the slash used as a separator): ^{ns}non-significant; *significant at p<.05; **significant at p<.01; †significant at p<.001; Bayesian inference (presented after the slash): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Table 3. *Color-Identification Performance (Mean Response Times, Standard Errors and 95%-Confidence Intervals) observed as a Function of Stimulus- or Effect-Type and Response Speed in Experiment 3.*

	Bin 1		**Bin 2**		**Bin 3**		**Bin 4**		**Bin 5**	
Stimulus-type	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI
Different-Response (DR) Color-Incongruent Items	476 (6)	[463, 488]	582 (9)	[565, 599]	675 (11)	[654, 696]	804 (14)	[776, 832]	1098 (19)	[1059, 1136]
Same-Response (SR) Color-Incongruent Items	470 (6)	[459, 481]	564 (8)	[549, 580]	646 (10)	[626, 666]	754 (13)	[728, 780]	1013 (18)	[978, 1049]
Color-Neutral items	466 (6)	[455, 477]	557 (7)	[542, 572]	633 (9)	[616, 651]	739 (12)	[716, 762]	988 (16)	[956, 1020]
Color-Congruent items	456 (5)	[446, 466]	544 (7)	[530, 557]	619 (9)	[602, 636]	722 (12)	[699, 745]	980 (18)	[945, 1015]
Magnitudes of effects	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI
Overall Stroop (Congruency) Effect (DR – Congruent)	$20^{\dagger\ /\ \dagger\dagger}$ (3)	[14, 25]	$38^{\dagger\ /\ \dagger\dagger}$ (3)	[31, 45]	$56^{\dagger\ /\ \dagger\dagger}$ (4)	[47, 64]	$82^{\dagger\ /\ \dagger\dagger}$ (7)	[68, 95]	$117^{\dagger\ /\ \dagger\dagger}$ (11)	[96, 138]
Facilitation Effect (Congruent – Neutral)	$-10^{\dagger\ /\ \dagger\dagger}$ (3)	[-16, -4]	$-13^{\dagger\ /\ \dagger\dagger}$ (3)	[-18, -8]	$-14^{\dagger\ /\ \dagger\dagger}$ (3)	[-21, -8]	$-17^{\dagger\ /\ **}$ (6)	[-28, -6]	$-8^{ns\ /\ ns}$ (9)	[-26, 11]
Stroop Interference Effect (DR – Neutral)	$10^{\dagger\ /\ \dagger}$ (3)	[4, 15]	$25^{\dagger\ /\ \dagger\dagger}$ (3)	[19, 32]	$41^{\dagger\ /\ \dagger\dagger}$ (4)	[34, 49]	$65^{\dagger\ /\ \dagger\dagger}$ (6)	[53, 77]	$109^{\dagger\ /\ \dagger\dagger}$ (10)	[90, 129]
Response Conflict (DR – SR)	$6^{*\ /\ ns*}$ (2)	[1, 11]	$18^{\dagger\ /\ \dagger\dagger}$ (3)	[12, 24]	$29^{\dagger\ /\ \dagger\dagger}$ (4)	[21, 36]	$50^{\dagger\ /\ \dagger\dagger}$ (6)	[39, 61]	$84^{\dagger\ /\ \dagger\dagger}$ (9)	[66, 102]
Semantic Conflict (SR – Neutral)	$4^{ns\ /\ ns}$ (3)	[-1, 9]	$7^{*\ /\ ns*}$ (3)	[1, 14]	$13^{**\ /\ **}$ (4)	[5, 20]	$15^{**\ /\ *}$ (6)	[4, 27]	$25^{**\ /\ *}$ (9)	[7, 44]

Note. Standard frequentist inference (presented before the slash used as a separator): ^{ns}non-significant; *significant at $p<.05$; **significant at $p<.01$; †significant at $p<.001$; Bayesian inference (presented after the slash): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with $BF_{10} < 100$.

Table 4. *Color-Identification Performance (Mean Response Times, Standard Error, 95%-Confidence Intervals and Percent Errors) observed as a Function of Stimulus- or Effect-Type and RSI in Experiment 4.*

	Long-RSI (2000ms)			**Short-RSI** (200ms)				
Stimulus-type	M (SE)	CI	%ER	M (SE)	CI	%ER	Short RSI effect (RT)	Short RSI effect (ER)
Different-Response (DR) Color-Incongruent Items	587 (12)	[562, 611]	4.3	548 (12)	[524, 572]	5.0	$-39^{*/*}$	$0.7^{ns/ns}$
Same-Response (SR) Color-Incongruent Items	570 (12)	[547, 594]	2.8	536 (12)	[513, 559]	4.2	$-34^{*/ns*}$	$1.3^{**/*}$
Color-Neutral items	561 (11)	[540, 582]	7.7	531 (10)	[511, 552]	8.1	$-30^{*/ns*}$	$0.4^{ns/ns}$
Color-Congruent items	548 (10)	[528, 568]	3.7	523 (10)	[503, 542]	4.8	$-26^{ns/ns*}$	$1.1^{ns/ns*}$
Magnitudes of effects	Diff. (SE)	CI		Diff. (SE)	CI		Short RSI effect (RT)	
Overall Stroop (Congruency) Effect (DR – Congruent)	$+38^{\dagger/\dagger\dagger}$ (4)	[31, 46]		$+25^{\dagger/\dagger\dagger}$ (4)	[18, 33]		$-13^{*/*}$	
Facilitation Effect (Congruent – Neutral)	$-13^{\dagger/\dagger\dagger}$ (3)	[-19, -7]		$-9^{**/\dagger}$ (3)	[-15, -3]		$-4^{ns/ns}$	
Stroop Interference Effect (DR – Neutral)	$+26^{\dagger/\dagger\dagger}$ (3)	[19, 32]		$+17^{\dagger/\dagger\dagger}$ (3)	[10, 23]		$-9^{*/ns*}$	
Response Conflict (DR – SR)	$+16^{\dagger/\dagger\dagger}$ (3)	[10, 22]		$+12^{\dagger/\dagger}$ (3)	[6, 18]		$-4^{ns/ns}$	
Semantic Conflict (SR – Neutral)	$+10^{**/*}$ (3)	[3, 16]		$+5^{ns/ns*}$ (3)	[-2, 11]		$-5^{ns/ns}$	

Note. Standard frequentist inference (presented before the slash used as a separator): ^{ns}non-significant; *significant at $p<.05$; **significant at $p<.01$; †significant at $p<.001$; Bayesian inference (presented after the slash): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Table 5. *Color-Identification Performance (Mean Response Times, Standard Errors and 95%-Confidence Intervals) observed as a Function of Stimulus- or Effect-Type and Response Speed in Experiment 4.*

	Bin 1		**Bin 2**		**Bin 3**		**Bin 4**		**Bin 5**	
Stimulus-type	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI
Different-Response (DR) Color-Incongruent Items	364 (5)	[355, 374]	443 (6)	[431, 456]	515 (8)	[499, 531]	618 (11)	[597, 640]	895 (15)	[865, 926]
Same-Response (SR) Color-Incongruent Items	363 (5)	[354, 372]	439 (6)	[428, 451]	506 (7)	[492, 521]	600 (10)	[580, 620]	857 (15)	[828, 887]
Color-Neutral items	365 (5)	[356, 374]	439 (6)	[428, 450]	502 (7)	[489, 515]	591 (9)	[573, 608]	834 (13)	[808, 859]
Color-Congruent items	360 (4)	[351, 369]	429 (5)	[419, 440]	490 (6)	[477, 503]	574 (9)	[557, 591]	824 (13)	[798, 849]
Magnitudes of effects	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI
Overall Stroop (Congruency) Effect (DR – Congruent)	4$^{†/††}$ (1)	[2, 7]	14$^{†/††}$ (2)	[10, 18]	25$^{†/††}$ (3)	[20, 30]	44$^{†/††}$ (4)	[37, 52]	72$^{†/††}$ (6)	[61, 83]
Facilitation Effect (Congruent – Neutral)	-5$^{†/††}$ (1)	[-8, -3]	-10$^{†/††}$ (1)	[-13, -7]	-12$^{†/††}$ (2)	[-16, -8]	-17$^{†/††}$ (3)	[-22, -11]	-10$^{ns/ns*}$ (6)	[-21, 1]
Stroop Interference Effect (DR – Neutral)	-1$^{ns/ns}$ (1)	[-3, 1]	4$^{*/*}$ (2)	[1, 7]	13$^{†/††}$ (2)	[9, 17]	28$^{†/††}$ (3)	[21, 34]	62$^{†/††}$ (6)	[50, 73]
Response Conflict (DR – SR)	1$^{ns/ns}$ (1)	[-1, 3]	4$^{**/**}$ (1)	[1, 7]	9$^{†/††}$ (2)	[5, 12]	18$^{†/††}$ (3)	[13, 24]	38$^{†/††}$ (6)	[27, 49]
Semantic Conflict (SR – Neutral)	-2$^{ns/ns}$ (1)	[-4, 0]	0$^{ns/ns}$ (1)	[-3, 3]	4$^{*/ns*}$ (2)	[0, 8]	9$^{**/*}$ (3)	[3, 15]	24$^{††/††}$ (6)	[11, 37]

Note. Standard frequentist inference (presented before the slash used as a separator): ^{ns}non-significant; *significant at *p*<.05; **significant at *p*<.01; †significant at *p*<.001; Bayesian inference (presented after the slash): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Table 6. *Color-Identification Performance (Mean Response Times, Standard Errors and 95%-Confidence Intervals) observed as a Function of Stimulus- or Effect-Type and Response Speed in Experiments 1-4 (cross-experimental post-hoc analysis).*

	Bin 1		**Bin 2**		**Bin 3**		**Bin 4**		**Bin 5**	
Stimulus-type	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI	M (SE)	CI
Different-Response (DR) Color-Incongruent Items	449 (4)	[441, 456]	550 (5)	[540, 560]	639 (6)	[627, 651]	762 (8)	[746, 778]	1046 (11)	[1024, 1068]
Same-Response (SR) Color-Incongruent Items	445 (4)	[438, 452]	535 (5)	[526, 544]	614 (6)	[602, 625]	721 (7)	[706, 735]	978 (10)	[958, 999]
Color-Neutral items	445 (3)	[438, 451]	533 (4)	[524, 542]	607 (5)	[597, 618]	707 (7)	[694, 721]	948 (10)	[929, 967]
Color-Congruent items	436 (3)	[429, 442]	519 (4)	[511, 527]	591 (5)	[580, 601]	687 (7)	[673, 701]	933 (10)	[913, 952]
Magnitudes of effects	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI	Diff. (SE)	CI
Overall Stroop (Congruency) Effect (DR – Congruent)	13$^{\dagger / \dagger\dagger}$ (1)	[10, 15]	31$^{\dagger / \dagger\dagger}$ (2)	[28, 34]	48$^{\dagger / \dagger\dagger}$ (2)	[44, 53]	75$^{\dagger / \dagger\dagger}$ (3)	[69, 82]	113$^{\dagger / \dagger\dagger}$ (5)	[104, 123]
Facilitation Effect (Congruent – Neutral)	-9$^{\dagger / \dagger\dagger}$ (1)	[-11, -6]	-14$^{\dagger / \dagger\dagger}$ (1)	[-17, -11]	-17$^{\dagger / \dagger\dagger}$ (2)	[-20, -14]	-20$^{\dagger / \dagger\dagger}$ (3)	[-25, -15]	-16$^{\dagger / \dagger}$ (5)	[-25, -7]
Stroop Interference Effect (DR – Neutral)	4$^{\dagger / **}$ (1)	[2, 6]	17$^{\dagger / \dagger\dagger}$ (2)	[14, 20]	31$^{\dagger / \dagger\dagger}$ (2)	[28, 35]	55$^{\dagger / \dagger\dagger}$ (3)	[49, 61]	98$^{\dagger / \dagger\dagger}$ (5)	[88, 107]
Response Conflict (DR – SR)	4$^{** / *}$ (1)	[1, 6]	15$^{\dagger / \dagger\dagger}$ (2)	[12, 18]	25$^{\dagger / \dagger\dagger}$ (2)	[22, 29]	41$^{\dagger / \dagger\dagger}$ (3)	[36, 47]	68$^{\dagger / \dagger\dagger}$ (4)	[59, 76]
Semantic Conflict (SR – Neutral)	0$^{ns / ns}$ (1)	[-2, 3]	2$^{ns / ns}$ (2)	[-1, 5]	6$^{** / ***}$ (2)	[2, 10]	14$^{\dagger / \dagger\dagger}$ (3)	[8, 19]	30$^{\dagger / \dagger\dagger}$ (5)	[21, 39]

Note. Standard frequentist inference (presented before the slash used as a separator): ^{ns}non-significant; *significant at *p*<.05; **significant at *p*<.01; †significant at *p*<.001; Bayesian inference (presented after the slash): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Supplementary Materials

1. Bayesian ANOVAs models and additional results and analyses conducted in Experiment 1

For the sake of comparison with past studies analyzing mean RTs (as opposed to the entire distribution, see Introduction in the main manuscript, MS for further description of these studies), mean RTs and errors (along with Stroop effects) observed in Experiment 1 are reported in the Table S1 as a function of Stimulus.

Table S1. *Color-Identification Performance in Experiment 1 (Mean Response Times, Standard Errors, 95%-Confidence Intervals and Percent Errors) observed as a Function of Stimulus- and Stroop Effect-Type.*

Stimulus-type	M (SE)	CI	ER%
Different-Response (DR) Color-Incongruent Items	663 (11)	[642, 684]	3.4
Same-Response (SR) Color-Incongruent Items	635 (10)	[615, 655]	1.9
Color-Neutral items	620 (9)	[602, 637]	3.1
Color-Congruent items	603 (9)	[585, 621]	2.1
Stroop effects	Magnitude (SE)	CI	
Overall Stroop (Congruency) Effect (DR – Congruent)	60$^{\dagger/\dagger\dagger}$ (4)	[50, 70]	
Facilitation (Congruent – Neutral)	-17$^{\dagger/\dagger\dagger}$ (3)	[-25, -8]	
Stroop Interference (DR – Neutral)	43$^{\dagger/\dagger\dagger}$ (4)	[34, 53]	
Response Conflict (DR – SR)	28$^{\dagger/\dagger\dagger}$ (3)	[19, 36]	
Stimulus Conflict (SR – Neutral)	16$^{\dagger/\dagger\dagger}$ (3)	[7, 25]	

Note. Standard frequentist inference: **significant at p<.01; †significant at p<.001; Bayesian inference (presented after the slash): **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Table S2. *Analysis of RTs in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 5 (Response speed: bin 1-5) Bayesian Repeated Measures ANOVA in Experiment 1.*

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.200	0.000	0.000	1.000	
stim + Bin + stim ∗ Bin	0.200	1.000	3.588e +33	∞	2.527
stim + Bin	0.200	1.115e −33	4.460e −33	∞	0.379
Bin	0.200	8.537e −94	3.415e −93	∞	0.232
stim	0.200	0.000	0.000	1.085e +6	0.278

Note. All models include subject

BF_{10} corresponds to the Bayesian probability of the occurrence of a hypothesis (H1) and the likelihood of another null hypothesis (H0). It was calculated with JASP 0.14.1.0 (JASP Team, 2017) and interpreted according to Lee and Wagenmakers (2014 adjusted from Jeffreys, 1961). Default JASP priors were used to this end. One obvious limitation of JASP is that it does not generate all the models (see Table 2S). Thus, to obtain Bayes factor for the interaction alone – so the direct comparison with standard frequentist ANOVA can be established – BF10 value for the interaction and both main effects needs to be divided by BF10 of both main effects. This was done for all interaction reported in Supplementary Materials (and as in the main MS). This additionally implies that whenever the evidence in favor of the main effects is close to infinity, the Bayesian evidence in favor of the Stimulus-Type × Response-speed interaction alone (without main effects) cannot be estimated more precisely than reported above (i.e., BF_{incl}>1).

To decompose the Stimulus-Type × Response speed interaction reported with standard frequentist ANOVA (see main MS for further description), the simple main-effect of Stimulus-Type for each Bin was computed. It was significant for all bins: [$F(3,166)=10.75$, $p<.001$, $\eta_p^2=0.163$] in Bin 1, [$F(3,166)=27.09$, $p<.001$, $\eta_p^2=0.329$] in Bin 2, [$F(3,166)=46.35$, $p<.001$, $\eta_p^2=0.456$] in Bin 3, [$F(3,166)=72.14$, $p<.001$, $\eta_p^2=0.566$] in Bin and [$F(3,166)=96.53$, $p<.001$, $\eta_p^2=0.636$] in Bin 5.

2. Bayesian ANOVAs models and additional results and analyses conducted in Experiment 2

For the sake of comparison with past studies analyzing mean RTs (as opposed to the entire distribution, see Introduction in the main MS for further description of these studies), mean RTs and errors (along with Stroop effects) observed in Experiment 2 are reported in the Table S3 as a function of Stimulus.

Table S3. *Color-Identification Performance in Experiment 2 (Mean Response Times, Standard Errors, 95%-Confidence Intervals and Percent Errors) observed as a Function of Stimulus- and Stroop Effect-Type.*

Stimulus-type	M (SE)	CI	ER%
Different-Response (DR) Color-Incongruent Items	727 (13)	[701, 754]	3.8
Same-Response (SR) Color-Incongruent Items	694 (13)	[669, 720]	2.6
Color-Neutral items	696 (13)	[671, 722]	3.4
Color-Congruent items	678 (13)	[653, 703]	3.2
Stroop effects	Magnitude (SE)	CI	
Overall Stroop (Congruency) Effect (DR – Congruent)	49[†/††] (4)	[40, 59]	
Facilitation (Congruent – Neutral)	-18[†/††] (3)	[-27, -10]	
Stroop Interference (DR – Neutral)	31[†/††] (4)	[22, 41]	
Response Conflict (DR – SR)	33[†/††] (3)	[25, 42]	
Stimulus Conflict (SR – Neutral)	-2[ns/ns] (3)	[-10, 6]	

Note. Standard frequentist inference:[**]significant at p<.01; [†]significant at p<.001; Bayesian inference (presented after the slash): [**]strong evidence in favor of H1, with BF_{10} value between 10–30; [†]very strong evidence in favor of H1, with BF_{10} between 30-100; [††]extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Table S4. *Analysis of RTs in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 5 (Response speed: bin 1-5) Bayesian Repeated Measures ANOVA in Experiment 2.*

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.200	0.000	0.000	1.000	
bin + StimType + bin ✻ StimType	0.200	1.000	9265.386	∞	3.559
bin + StimType	0.200	4.315e −4	0.002	∞	0.365
bin	0.200	1.068e −27	4.272e −27	∞	0.234
StimType	0.200	0.000	0.000	0.933	0.279

Note. All models include subject

As in Experiment 1, to decompose the significant Stimulus-Type × Response speed interaction, on RTs, reported in the main MS, the simple main-effect of Stimulus-Type for each Bin was first computed. It was significant for all bins: [$F(3,97)=13.39$, $p<.001$, $\eta_p^2=0.293$] in Bin 1; [$F(3,97)=43.79$, $p<.001$, $\eta_p^2=0.575$] in Bin 2; [$F(3,97)=50.45$, $p<.001$, $\eta_p^2=0.609$ in Bin 3; [$F(3,97)=53.22$, $p<.001$, $\eta_p^2=0.622$] in Bin 4; and [$F(3,97)=53.35$, $p<.001$, $\eta_p^2=0.623$] in Bin 5 (see main MS for further description).

3. Bayesian ANOVAs models and additional results and analyses conducted in Experiment 3

For the sake of comparison with past studies analyzing mean RTs (as opposed to the entire distribution, see Introduction in the main manuscript, MS for further description of these studies), mean RTs and errors (along with Stroop effects) observed in Experiment 3 are reported in the Table S5 as a function of Stimulus.

Table S5. *Color-Identification Performance in Experiment 3 (Mean Response Times, Standard Errors, 95%-Confidence Intervals and Percent Errors) observed as a Function of Stimulus- and Stroop Effect-Type.*

Stimulus-type	M (SE)	CI	ER%
Different-Response (DR) Color-Incongruent Items	727 (11)	[705, 749]	5.0
Same-Response (SR) Color-Incongruent Items	689 (10)	[669, 710]	2.9
Color-Neutral items	676 (10)	[658, 695]	3.5
Color-Congruent items	663 (9)	[646, 683]	3.2
Stroop effects	Magnitude (SE)	CI	
Overall Stroop (Congruency) Effect (DR – Congruent)	62†/†† (5)	[50, 75]	
Facilitation (Congruent – Neutral)	-12**/† (4)	[-22, -3]	
Stroop Interference (DR – Neutral)	50†/†† (4)	[39, 61]	
Response Conflict (DR – SR)	37†/†† (4)	[27, 48]	
Stimulus Conflict (SR – Neutral)	13**/** (4)	[2, 23]	

Note. Standard frequentist inference:**significant at p<.01; †significant at p<.001; Bayesian inference (presented after the slash): **strong evidence in favor of H1, with BF_{10} value between 10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

To inspect semantic conflict across the entire distribution, vincentized RTs were analyzed in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (Language: French vs. English) × 5 (Response speed: Bin 1-5) ANOVA. It showed a main effect of Stimulus type [$F(3,474)=87.38$, $p<.001$, $\eta_p^2=0.356$, $BF_{10}=131947.60$, see Table S6 for the models], as well as a main effect of Response speed [$F(4,632)=1565.20$, $p<.001$, $\eta_p^2=0.908$, $BF_{10}=+\infty$]. The main effect of language remained not significant [$F(1,158)=1.65$, $p=.200$, $\eta_p^2=0.010$, $BF_{10}=0.227/BF_{01}=4.41$] and at least with Bayesian analyses, it was not included in either Stimulus-Type × Language [$F(3,474)=.678$, $p=.566$, $\eta_p^2=0.004$, $BF_{incl}=0.002$ for the interaction alone (i.e., $BF_{01}=508.83$) but see the Table S7 for descriptive purposes], Response speed × Language interaction [$F(4,632)=.204$, $p=.936$, $\eta_p^2=0.001$, $BF_{incl}<1$ for the interaction alone] or Stimulus type × Language × Response speed interaction

[F(12,1896)=2.82, p=.019, η_p^2=0.018, BF_{incl}<1 for the interaction alone, see Table S6 bellow for a comparison of models].

Table S6. *Analysis of RTs in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (Stimuli: French vs. English) × 5 (Response speed: bin 1-5) Bayesian Repeated Measures ANOVA in Experiment 3.*

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.053	0.000	0.000	1.000	
Bin + Stim + Bin ⁎ Stim	0.053	0.661	35.105	∞	3.674
Bin + Stim + Language + Bin ⁎ Stim	0.053	0.337	9.145	∞	0.755
Bin + Stim + Language + Bin ⁎ Stim + Stim ⁎ Language	0.053	0.002	0.028	∞	4.274
Bin + Stim + Language + Bin ⁎ Stim + Bin ⁎ Language	0.053	4.807e −4	0.009	∞	4.274
Bin + Stim + Language + Bin ⁎ Stim + Bin ⁎ Language + Stim ⁎ Language	0.053	2.116e −6	3.810e −5	∞	1.015
Bin + Stim + Language + Bin ⁎ Stim + Bin ⁎ Language + Stim ⁎ Language + Bin ⁎ Stim ⁎ Language	0.053	6.493e −10	1.169e −8	∞	0.937
Bin + Stim	0.053	4.679e −15	8.422e −14	∞	0.364
Bin + Stim + Language	0.053	2.520e −15	4.535e −14	∞	4.247
Bin + Stim + Language + Stim ⁎ Language	0.053	1.073e −17	1.932e −16	∞	0.911
Bin + Stim + Language + Bin ⁎ Language	0.053	3.282e −18	5.908e −17	∞	0.852
Bin + Stim + Language + Bin ⁎ Language + Stim ⁎ Language	0.053	1.468e −20	2.642e −19	∞	4.277
Bin	0.053	2.973e −70	5.352e −69	∞	0.232
Bin + Language	0.053	1.483e −70	2.670e −69	∞	0.291
Bin + Language + Bin ⁎ Language	0.053	1.826e −73	3.287e −72	∞	2.047
Stim	0.053	0.000	0.000	131947.600	0.278
Stim + Language	0.053	0.000	0.000	29927.317	0.603
Stim + Language + Stim ⁎ Language	0.053	0.000	0.000	58.186	10.518
Language	0.053	0.000	0.000	0.227	0.513

Note. All models include subject

Table S7. *Color-Identification Performance (Mean Response Times, Standard Errors 95%-Confidence Intervals) observed as a Function of Stimulus- or Interference-Type and Stimuli (French vs. English) – interaction that was non-significant in Experiment 3.*

	French			English				
Stimulus-type	M (SE)	CI	%ER	M (SE)	CI	%ER	French effect (RT)	French effect (ER)
Different-Response (DR) Color-Incongruent Items	715 (16)	[684, 747]	4.6	738 (16)	[707, 770]	5.3	-23$^{ns/ns}$	0.7$^{ns/ns}$
Same-Response (SR) Color-Incongruent Items	676 (15)	[647, 705]	2.8	702 (15)	[673, 731]	3.1	-26$^{ns/ns}$	0.4$^{ns/ns}$
Color-Neutral items	666 (13)	[639, 692]	3.4	687 (13)	[660, 713]	3.5	-21$^{ns/ns}$	0.1$^{ns/ns}$
Color-Congruent items	647 (13)	[620, 673]	2.8	679 (13)	[653, 706]	3.6	-33$^{ns/ns}$	0.8$^{ns/ns}$
Amplitudes of effects	Diff. (SE)	CI		Diff. (SE)	CI			
Stroop Effect (DR – Congruent)	+68$^{\dagger / \dagger\dagger}$ (6)	[55, 81]		+59$^{\dagger / \dagger\dagger}$ (6)	[46, 71]		10$^{ns/ns}$	
Facilitation Effect (Congruent – Neutral)	-19$^{\dagger / \dagger\dagger}$ (5)	[-29, -9]		-7$^{ns / ns}$ (5)	[-17, 3]		-12$^{ns/ns}$	
Stroop Interference Effect (DR – Neutral)	+49$^{\dagger / \dagger\dagger}$ (6)	[37, 61]		+51$^{\dagger / \dagger\dagger}$ (6)	[39, 63]		-2$^{ns/ns}$	
Response Conflict (DR – SR)	+39$^{\dagger / \dagger\dagger}$ (5)	[28, 50]		+36$^{\dagger / \dagger\dagger}$ (5)	[26, 47]		3$^{ns/ns}$	
Stimulus Conflict (SR – Neutral)	+10$^{ns / ns*}$ (6)	[-1, 21]		+15$^{** / *}$ (6)	[4, 26]		5$^{ns/ns}$	

Note. Standard frequentist inference: ^{ns}non-significant; *significant at p<.05; **significant at p<.01; †significant at p<.001; Bayesian inference (presented after the slash): ^{ns}no evidence of an effect, with BF_{10} value between 0–1; ^{ns*}anecdotal evidence in favor of H1, with BF_{10} value between 1–3; *moderate evidence in favor of H1, with BF_{10} value between 3–10; **strong evidence in favor of H1, with BF_{10} value between

10–30; †very strong evidence in favor of H1, with BF_{10} between 30-100; ††extreme evidence in favor of H1/of an effect, with BF_{10} <100.

Therefore, only significant Stimulus type × Response speed interaction [$F(12,1896)=34.29$, $p<.001$, $\eta_p^2=0.178$, $BF_{incl}>1$ for the interaction alone] was further decomposed by testing the simple main-effect of Stimulus-Type at each level of Response speed (i.e., at teach of the five bins) (see Table 3 in the main MS). It was significant for all bins: [$F(3,156)=17.51$, $p<.001$, $\eta_p^2=0.252$] in Bin 1, [$F(3,156)=41.93$, $p<.001$, $\eta_p^2=0.446$] in Bin 2, [$F(3,156)=53.80$, $p<.001$, $\eta_p^2=0.508$] in Bin 3, [$F(3,156)=52.53$, $p<.001$, $\eta_p^2=0.503$] in Bin 4, and [$F(3,156)=55.27$, $p<.001$, $\eta_p^2=0.515$] in Bin 5.

4. Bayesian ANOVAs models and additional results and analyses conducted in Experiment 4

Table S8. *Analysis of RTs in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (RSI: long vs. short) Bayesian Repeated Measures ANOVA in Experiment 4.*

Model Comparison ▼

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.200	1.426e −32	5.703e −32	1.000	
Stim + rsi + Stim ∗ rsi	0.200	0.649	7.398	4.552e +31	67.022
Stim	0.200	0.181	0.884	1.270e +31	0.274
Stim + rsi	0.200	0.170	0.819	1.192e +31	5.865
rsi	0.200	1.879e −32	7.514e −32	1.318	4.126

Note. All models include subject

For error-rates (see Table 4 in the main MS for descriptive statistics), the analysis revealed a main effect of Stimulus-Type [$F(3,315)=221.2$, $p<.001$, $\eta_p^2=0.678$, $BF_{10}=6.42e+72$] such that color-neutral items generated the highest error rate. This analysis failed to reveal the main effect of RSI [$F(1,105)=3.04$, $p=.084$, $\eta_p^2=0.028$, $BF_{10}=0.837$] and $BF_{01}=1.20$ revealed anecdotal evidence against this effect. Although Stimulus Type × RSI interaction was significant with this less conservative frequentist analysis [$F(3,315)=2.70$, $p=.046$, $\eta_p^2=0.025$], $BF_{incl}=0.613$ in favor of this interaction alone was inconclusive (see Table S8 bellow for a comparison of models) and $BF_{01}=1.59$ revealed anecdotal evidence against this interaction. Therefore, its further decomposition was not undertaken (but see Table 4 in the main MS for descriptive purposes).

Table S9. *Analysis of error percentages in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (RSI: long vs. short) Bayesian Repeated Measures ANOVA in Experiment 4.*

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.200	5.642e −74	2.257e −73	1.000	
Stimulus type + rsi	0.200	0.396	2.618	7.011e +72	2.193
Stimulus type	0.200	0.362	2.269	6.416e +72	0.219
Stimulus type + rsi + Stimulus type ∗ rsi	0.200	0.242	1.281	4.298e +72	0.929
rsi	0.200	4.720e −74	1.888e −73	0.837	0.443

Note. All models include subject

The influence of response speed was examined further by a closer look to the entire RT distribution. To this end, vincentized RTs were analyzed in a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (RSI: long vs. short) × 5 (Response speed: bin 1-5) ANOVA (see Table 5 in the main MS). As in previous experiments, Bayesian evidence in favor of the main effect of Response speed (i.e. Bin) was close to infinity [$BF_{10}=+\infty$, $F(4,420)=1841.56$, $p<.001$, $\eta_p^2=0.946$], whereas that in favor of RSI [$F(1,105)=4.28$, $p=.041$, $\eta_p^2=0.039$, $BF_{10}=5.16$] was moderate. This latter main effect was neither included in Response speed × RSI [$F(4,420)=2.22$, $p=.137$, $\eta_p^2=0.021$, although

BF_{incl}>1 in favor of this interaction alone was promising], nor in Stimulus type × Response speed × RSI interaction [$F(12,1260)=1.61$, $p=.170$, $\eta_p^2=0.015$, $BF_{10}<1$, see Tables S9 bellow for a comparison of models for all reported interactions]. Therefore, only significant Stimulus-type × Response speed interaction [$F(12,1260)=43.84$, $p<.001$, $\eta_p^2=0.295$, $BF_{incl}>1$ with promising evidence in favor of the interaction alone] was further decomposed by testing the simple main-effect of Stimulus-Type at each level of Response speed. This effect was significant for all bins: [$F(3,103)=6.73$, $p<.001$, $\eta_p^2=0.164$] in Bin1, [$F(3,103)=22.76$, $p<.001$, $\eta_p^2=0.399$] in Bin 2, [$F(3,103)=32.52$, $p<.001$, $\eta_p^2=0.486$] in Bin 3, [$F(3,103)=41.87$, $p<.001$, $\eta_p^2=0.549$] in Bin 4 and [$F(3,103)=59.79$, $p<.001$, $\eta_p^2=0.635$] in Bin 5. It was further analyzed as in previous experiments (see Table 5 in the main MS for all comparisons).

Table S10. *Analysis of RTs in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 2 (RSI: long vs. short) × 5 (Response speed: bin 1-5) Bayesian Repeated Measures ANOVA in Experiment 4.*

Model Comparison ▼

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.053	0.000	0.000	1.000	
Bin + Stim + rsi + Bin ∗ Stim + Bin ∗ rsi + Stim ∗ rsi	0.053	0.947	324.151	∞	6.165
Bin + Stim + rsi + Bin ∗ Stim + Bin ∗ rsi	0.053	0.052	0.982	∞	3.110
Bin + Stim + rsi + Bin ∗ Stim + Bin ∗ rsi + Stim ∗ rsi + Bin ∗ Stim ∗ rsi	0.053	8.789e −4	0.016	∞	1.720
Bin + Stim + rsi + Bin ∗ Stim + Stim ∗ rsi	0.053	2.529e −6	4.552e −5	∞	3.114
Bin + Stim + rsi + Bin ∗ Stim	0.053	1.903e −7	3.426e −6	∞	4.147
Bin + Stim + rsi + Bin ∗ rsi + Stim ∗ rsi	0.053	1.513e −7	2.724e −6	∞	3.131
Bin + Stim + Bin ∗ Stim	0.053	2.834e −8	5.100e −7	∞	3.567
Bin + Stim + rsi + Bin ∗ rsi	0.053	1.252e −8	2.254e −7	∞	4.105
Bin + Stim + rsi + Stim ∗ rsi	0.053	8.541e −13	1.537e −11	∞	4.080
Bin + Stim + rsi	0.053	7.504e −14	1.351e −12	∞	3.692
Bin + Stim	0.053	1.111e −14	2.000e −13	∞	0.410
Bin + rsi + Bin ∗ rsi	0.053	2.533e −30	4.560e −29	∞	35.712
Bin + rsi	0.053	3.383e −35	6.090e −34	∞	1.491
Bin	0.053	5.346e −36	9.623e −35	∞	0.287
rsi	0.053	0.000	0.000	5.161	0.515
Stim + rsi	0.053	0.000	0.000	2.428	0.598
Stim	0.053	0.000	0.000	0.472	0.279
Stim + rsi + Stim ∗ rsi	0.053	0.000	0.000	0.022	10.492

Note. All models include subject

These decompositions showed that the overall Stroop effect of +4ms (i.e., contrast between Different Response and Congruent trials, M_{DR}–M_C) difference between that emerged in Bin 1 ($p<.001$, $BF_{10}=114.64$) was entirely driven by facilitation (i.e., contrast between Neutral and Congruent trials, MN–MC; -5ms; $p<.001$, $BF_{10}=779.90$, see Table 8). Both facilitation (-10ms, $p<.001$, $BF_{10}=2.47e+7$) and interference (i.e., contrast between Different Response and Neutral trials, MDR–MN; +4ms, $p=.010$, $BF_{10}=4.50$) started to contribute reliably to the overall Stroop effect (+14ms, $p<.001$, $BF_{10}=2.62e+8$) in Bin 2 (and this was the case up to Bin 5). As of Bin 2 (and up to Bin 5), Stroop interference was driven by response conflict (i.e., contrast between Different and Same Response trials, M_{DR}–M_{SR}; +4ms, $p=.004$, $BF_{10}=11.95$), being present in 80% of DR responses – a proportion that is equivalent to that found in Experiments 1 and 3). Semantic conflict (i.e., contrast between Same Response and Neutral trials, M_{SR}–M_N) started to drive interference in Bin 3, but $BF_{10}=2.14$ ($BF_{01}=0.468$) only provided anecdotal evidence in favor of this +4ms ($p=.027$) effect, which started to be reliable in Bin 4 (+9ms, $p=.005$, $BF_{10}=9.59$). Therefore, as can be seen in Table 5 and Figure 4 (see main manuscript), and in line with the analysis of RSI, the contribution of semantic conflict to the Stroop interference effect was again only reliable in slower responses (from Bin 4 to 5).

5. Cross-experimental (post-hoc) analyses

For the sake of comparison with past studies analyzing mean RTs (as opposed to the entire distribution, see Introduction in the main MS for further description of these studies), mean RTs and errors (along with Stroop effects) observed with RSI of 2000ms for the 482 participants are reported in the Table S10 as a function of Stimulus.

Table S11. *Color-Identification Performance in Overall data (Mean Response Times, Standard Errors, 95%-Confidence Intervals and Percent Errors) observed as a Function of Stimulus- and Stroop Effect-Type.*

Stimulus-type	M (SE)	CI	ER%
Different-Response (DR) Color-Incongruent Items	689 (7)	[676, 702]	4.1
Same-Response (SR) Color-Incongruent Items	658 (6)	[646, 670]	2.6
Color-Neutral items	648 (6)	[636, 659]	3.8
Color-Congruent items	633 (6)	[621, 644]	2.9
Stroop effects	Magnitude (SE)	CI	
Overall Stroop (Congruency) Effect (DR – Congruent)	57[†/††] (2)	[51, 62]	
Facilitation Effect (Congruent – Neutral)	-15[†/††] (2)	[-20, -11]	
Stroop Interference Effect (DR – Neutral)	41[†/††] (2)	[36, 47]	
Response Conflict (DR – SR)	31[†/††] (2)	[26, 36]	
Stimulus Conflict (SR – Neutral)	10[†/††] (2)	[5, 16]	

Note. Standard frequentist inference: †significant at p<.001; Bayesian inference (presented after the slash): ††extreme evidence in favor of H1/of an effect, with BF10 <100.

To examine the extent to which this contribution is present across the entire distribution, RTs observed for each participant and Stimulus-Type were vincentized from fast to slow trials and subsequently analyzed in a 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 5 (Response speed: Bin 1-5) ANOVA. The main effect of Stimulus-type remained significant [$F(3,1443)=290.24$, $p<.001$, $\eta_p^2=0.376$, $BF_{10}=2.65e+17/BF>100$], and, as expected the main effect of Response speed approached infinity [$BF_{10}=+\infty$, $F(4,1924)=4512.26$, $p<.001$, $\eta_p^2=0.904$]. Also and importantly, the Stimulus-type × Response speed interaction was significant [$F(12,5772)=140.04$, $p<.001$, $\eta_p^2=0.225$, $BF_{incl}>1$ for the interaction alone] with promising evidence in favor of the interaction (see also Table S11 bellow for a comparison of models).

Table S12. *Analysis of RTs in 4 (Stimulus-Type: different-response vs. same-response vs. neutral vs. congruent) × 5 (Response speed: bin 1-5) Bayesian Repeated Measures ANOVA in Experiments 1-4 (cross-experimental post-hoc analysis).*

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model (incl. subject)	0.200	0.000	0.000	1.000	
Bin + Stim + Bin ∗ Stim	0.200	1.000	6.915e +64	∞	3.369
Bin + Stim	0.200	5.784e −65	2.314e −64	∞	0.371
Bin	0.200	7.117e −217	2.847e −216	∞	0.228
Stim	0.200	0.000	0.000	2.645e +17	0.278

Note. All models include subject

To examine the effect of response speed further, the simple main-effect of Stimulus-Type for each level of Response speed was first computed. It was significant for all bins: $F(3,479)=36.88$, $p<.001$, $\eta_p^2=0.188$ in Bin 1, $F(3,479)=110.16$, $p<.001$, $\eta_p^2=0.408$ in Bin 2, $F(3,479)=153.20$, $p<.001$, $\eta_p^2=0.490$ in Bin 3, $F(3,479)=175.64$, $p<.001$, $\eta_p^2=0.524$ in Bin 4 and $F(3,479)=199.86$, $p<.001$, $\eta_p^2=0.556$ in Bin 5. Given that this latter type of analysis does not have an equivalent in Bayesian ANOVA, Bayesian one-tailed t-test for pairwise comparisons was further applied to establish, whenever sensible, the extent to which the overall Stroop effect (M_{DR}–M_C) is indeed a composite phenomenon. An overall Stroop effect of +13ms emerged in Bin 1 ($p<.001$, BF_{10}=2.91e+19) was driven by facilitation (M_N–M_C; -9ms; $p<.001$, BF_{10}=1.64e+9, see Table 6 in the main MS) and Stroop interference (M_{DR}–M_N; +4ms, $p<.001$, BF_{10}=25.59), with the latter being driven by response conflict (M_{DR}–M_{SR}; +4ms, $p=.003$, BF_{10}=8.97). The same pattern was observed up to Bin 5. However, semantic conflict (M_{SR}–M_N) started to reliably contribute to Stroop interference from Bin 3 (+6ms, $p=.001$, BF_{10}=20.17). Therefore, as can be seen in Table 6 and Figure 5AB (see the main MS), from this latter Bin 3 up to Bin 5, the interference (M_{DR}–M_N) continued to reveal its composite nature, such that the contribution of both semantic (M_{SR}–M_N) and response conflict (M_{DR}–M_{SR}) remained reliable across longer response times. In sum, the overall Stroop effect (M_{DR}–M_C) is a composite phenomenon driven by facilitation (M_N–M_C) and Stroop interference (M_{DR}–M_N from Bin 1 to 5). Also, and importantly, in line with our initial reasoning, the contribution of semantic conflict (M_{SR}–M_N) to Stroop interference (M_{DR}–M_N) was only reliable in slower RTs (from Bin 3 and 5, i.e., in 60% of SR trials), whereas the reliable contribution of response conflict emerged for faster RTs (from Bin 1 to 5, i.e., in 100% of DR trials).

Linear Mixed Modelling was additionally performed to account for the hierarchical structure of the data. This was implemented using the MIXED procedure in SPSS 25.0 (Peugh & Enders, 2005) with Maximum Likelihood Estimation. All variables, both dependent (RTs) and independent (Stimulus-Type and Response speed), were grand-mean-centered to permit a clear interpretation of the findings. All linear mixed models included two random effects (the intercept for each experiment and the intercept for each participant) to control for dependency resulting from repeated sampling of data within experiments and within subjects. First, a null model was run on the dependent variable, namely RTs, with intercept being allowed to vary randomly across participants and experiments. Then, for model 2, the independent variable Stimulus-Type was added as a fixed factor. For model 3, the independent variable Response-speed was added as a fixed factor. Finally, for model 4, the Stimulus-Type × Response-speed interaction was added. As recommended by Burnham and Anderson (2004), both the Akaike

Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (BIC) were used to guide model selection (see Tables S12 and S13 below).

Table S13. *Summary of linear mixed models computed for Experiments 1-4 (cross-experimental post-hoc analysis) and their BIC and AIC indicators with maximum likelihood estimation.*

Model	No	BIC	Diff.	AIC	Diff
Model 1	4	-2357		-2385	
Model 2	5	-2441	84†	-2477	92†
Model 3	6	-17428	14987†	-17471	14994†
Model 4	7	-17616	188†	-17666	195†

Note: Diff. = corresponds to the difference between the indicators from the previous lowest model and the new model; No. = number of estimated parameters for model; BIC = Bayesian Information Criterion; AIC = Akaike Information Criterion; **p*<.05, ***p*<.01, †*p*<.001.

Table S14. *Estimates of final model computed for Experiments 1-4 (cross-experimental post-hoc analysis).*

Model	Parameters	Estimates (SE)
Model 4	Intercept (Experiments)	.003(.002)
	Intercept (Subjects)	.015(.001) †
	Intercept	-.079(.026) *
	Stimulus-Type	-.014 (.001) †
	Response-Speed (Bins)	.121(.001) †
	Stimulus-Type x Response-Speed (Bins)	-.008(.001) †

Note: **p*<.05, ***p*<.01, †*p*<.001.

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