

## Who's got the global advantage?

### Visual field differences in processing of global and local shape

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### Abstract

Much evidence suggests that we first perceive the overall layout of a scene or object followed later by the details. This coarse-to-fine temporal dynamic in visual processing is also found in Navon's classical paradigm where information at the global level of compound stimuli is processed faster than information at the local level (global precedence effect), and where information at the global level has larger effects on local level responses than local level information has on global level responses (asymmetric interference effects). Traditionally, global shape primacy in Navon's paradigm has been linked with a right hemisphere preference (left visual field advantage) for global shape processing, and a left hemisphere preference (right visual field advantage) for local shape processing. This link, however, has been based on measures which confound global precedence and interference effects. Indeed, when these measures are *de*-confounded, we find no evidence for larger global precedence effects in the left compared with the right visual field in a large sample of participants (N = 337). In comparison, global-to-local interference effects are found to be stronger in the left than in the right visual field. We argue that these findings can be accounted for by assuming that the right hemisphere plays a special role in integrating shape information across spatial scales, that is, without assuming the existence of a right hemisphere preference for global shape processing per se.

*Keywords:* Compound letters, global shape processing, laterality, local shape processing, hemispheric specialization, Navon's paradigm, visual field differences.

## Who's got the global advantage?

### Visual field differences in processing of global and local shape

#### 1. Introduction

The idea that the cerebral hemispheres perform different functions was expressed already in 1865 when Paul Broca concluded that “We speak with the left hemisphere”. It took longer to appreciate the right hemisphere’s modus operandi, and for many years it was simply considered minor or non-dominant (Ivry & Robertson, 1998). Even though the notion of major/minor hemisphere is abandoned today, the division of labor between the hemispheres is still debated. A functional difference that has caught on since it was first introduced in the 1960ties (Levy-Agresti & Sperry, 1968) is the global/local (holistic/analytical) dichotomy according to which the right hemisphere (RH) is specialized for processing of global information, e.g. the overall layout of a scene, and the left hemisphere (LH) for processing of local information, e.g. details/parts.

A paradigm that has become central to studies of the global/local dichotomy is the one that Navon used in 1977 to answer the question: “*Do we perceive a visual scene feature-by-feature? Or is the process instantaneous and simultaneous as some Gestalt psychologists believed?*” (p. 353). Navon’s paradigm is based on presentation of compound stimuli (Asch, 1962); usually a large letter (global level) composed of smaller letters (local level) in which the global and the local letters can be the same (consistent) or different (inconsistent) (see also Kinchla (1974) and Pomerantz and Sager (1975)). Navon made two observations with this paradigm which he argued supported “*..the notion that global processing is a necessary stage of perception prior to more fine-grained analysis*” (p. 371): (i) responses were faster to the global than the local level, and (ii) when the levels were inconsistent, information at the global level interfered with (slowed down) responses to the local level, but not the other way around.

Not long after, Martin (1979) used compound letters in a divided visual field paradigm to examine: (i) if global level responses were more efficient when stimuli were presented in the left visual field (VF) (RH)

than when presented in the right VF (LH), and (ii) whether local level responses were more efficient when stimuli were presented in the right compared with the left VF. She found evidence for both propositions but argued that the right VF advantage for local level responses was stronger than the left VF advantage for global level responses. Martin's findings with normal subjects were soon confirmed in split-brain patients (Delis, Kramer, & Kiefner, 1988; Robertson, Lamb, & Zaidel, 1993), in patients with unilateral brain damage (Robertson & Lamb, 1991), and in functional imaging with normal subjects (Fink et al., 1996). Despite this convergence, VF differences in normal subjects have nevertheless proven rather flimsy being reported in some studies but not others (Blanca & Lopez-Montiel, 2009; Van Kleeck, 1989; Yovel, Levy, & Yovel, 2001), and it is still debated what might be the cause of these inconsistencies (Aiello et al., 2018; Flevaris & Robertson, 2016).

One obvious explanation may be that the VF effects captured with Navon's paradigm are small, and that failures to find them could reflect low statistical power (Lamb & Yund, 1996; Martens & Hübner, 2013). Given that most studies in this area are based on small samples ( $N < 30$ ) this is not unlikely, and the magnitude of the effects when observed may thus also have been overestimated (Button et al., 2013; Open Science Collaboration, 2015). Another explanation is that different indexes can be derived from Navon's paradigm, and that these indexes do not necessarily measure the same aspects of global/local processing (Gerlach & Krumborg, 2014). Hence, there is ample evidence suggesting that what Navon originally referred to as *global precedence* actually reflects two independent effects: a global precedence effect and a global-to-local interference effect (Hübner & Volberg, 2005; Lamb & Yund, 1996; Robertson et al., 1993). More specifically, it has been suggested that the magnocellular pathway is responsible for the global precedence effect (Poirel, Pineau, & Mellet, 2008; Poirel et al., 2011), whereas the global-to-local interference effect rests upon automatic identification processes: Interference is observed as soon as a different identifiable stimulus is present at the global level during local level processing (Beaucousin et al., 2011). Consequently, during a global-local paradigm with compound letters such as the one used by Navon (1977), the identifiable

distractor present at the global level is automatically processed and must be inhibited to perform correctly at the local level, leading to the global-to-local interference effect (Poirel et al., 2014).

Even though the global-local dichotomy has typically been associated with hemispheric differences, it has also been suggested that global information may be processed more efficiently in the lower than the upper VF whereas the reverse may be true for local information (Previc, 1990). Upper/lower VF differences have been found in many domains (Thomas & Elias, 2011), and may be linked to ventral and dorsal stream processing respectively (Milner & Goodale, 2006). Specific support for the notion that global/local processing may differ between the upper and lower VFs was reported by Christman (1993) who found a lower VF advantage for global level responses and an upper VF advantage for local level responses to inconsistent compound letters (experiment 1). Despite being larger than the left/right VF differences also found, the lower VF advantage for global level responses could not be replicated in his second experiment. Nevertheless, we concur with Christman (1993) "...that researchers studying left-right visual field differences in perceptual processing will need to address their relation to similar upper-lower visual field differences" (p. 278). Thus, the objective of the present study was to examine differences in global/local processing in all VFs (left/right & upper/lower) using compound letters. To address the shortcomings of previous studies, we examined a large sample (N = 337) by means of two indexes which tap global precedence and global-to-local interference effects reliably and independently. Based on the literature considered above both indexes were expected to yield higher values in the left than the right VF and in the lower compared with the upper VF.

## 2. Method

### 2.1. Participants

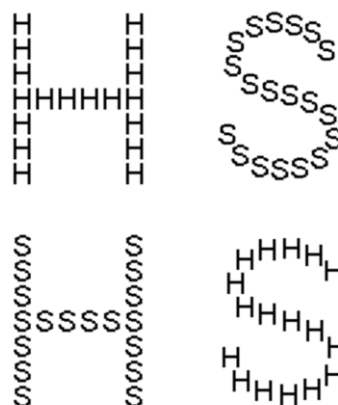
400 first-year psychology students, naïve to the specific hypotheses tested, took part in the study as part of their course in cognitive psychology. The course is approved by the study board at the Department of Psychology, University of Southern Denmark, and the experiments conducted do not require formal ethical

approval/registration according to Danish Law and the institutional requirements. Prior to participation the students were informed that data collected in the experiments might be used in an anonymous form in future publications. Participants were free to opt-out if they wished, and participation in the experiments was taken as consent. Hence, the sample size was determined by the number of students who took the course in the period 2015-2018 and were present at the test dates. Two previous reports have been made with subsamples from this group (Gerlach & Poirel, 2018; Gerlach & Starrfelt, 2018).

Although language functions are usually lateralized to the left hemisphere, a small percentage of people –of which most are left-handed– have a right language lateralization. As is custom in studies of laterality we thus limited all analyses to individuals who reported themselves right-handed. This led to the exclusion of 54 left-handed and nine ambidexters. The final sample thus comprised 337 individuals (261 females; mean age = 23 years, SD = 4.6 years).

## 2.2. Procedure and Stimuli

The participants were presented with large letters, either ‘H’ or ‘S’, that could consist of either smaller ‘H’s or ‘S’s (Figure 1).



**Figure 1.** *The compound letters used. Upper row: Consistent stimuli. Lower row: Inconsistent stimuli.*

Each participant was presented with four experimental blocks presented in an ABBA design. The participants were required to report the identity of the global letter in two of the blocks and the identity of the local letters in the others. Half of the participants began with global identity judgements.

The large letters subtended  $3.91^\circ \times 5.25^\circ$  and the small letters  $0.47^\circ \times 0.67^\circ$  of visual angle. The fixation cross presented before stimulus onset subtended  $0.95^\circ \times 0.95^\circ$  of visual angle. All stimuli were black presented on a white background on a computer screen.

The participants performed a total of 80 trials in each block (40 consistent/40 inconsistent). Stimuli were shown at four different positions (top, bottom, left, and right) relative to the fixation cross. An equal number of stimuli within each block (10 consistent/10 inconsistent) were presented at the four locations and the centre of the global shape was positioned  $3.34^\circ$  of visual angle from the fixation cross. The order of position and consistency was randomized.

A trial began with a fixation cross presented in the middle of the screen for 1 s, which the participants were instructed to look at whenever present. They were also informed that stimuli over the course of the task would appear at each of the four locations with equal probability but in random sequence. The fixation cross was followed by stimulus onset which was replaced after 180 ms by a blank screen which remained until response. RTs were recorded by means of the keyboard (1 = 'H' and 2 = 'S' in all conditions). Before each block, the participants performed 16 practice trials. Feedback (accuracy) was provided on the practice but not the experimental trials. The participants were free to use either hand they pleased. This departs from some divided VF studies where the responding hand is often balanced over participants to avoid a right VF advantage being mediated by LH motor control of the right hand. Even if such an effect is likely to be rather minor, considering that the interhemispheric transmission time is in the order of 3-4 ms (Iacoboni, Fried, & Zaidel, 1994), this potential confound is nevertheless eliminated in the present context because we analyze the data by means of relative differences between conditions (the indexes described below).

### 2.3 Data analysis

As demonstrated by Gerlach and Krumborg (2014), many formerly used indexes derived from Navon's paradigm have low reliability and may confound different aspects of global/local processing; in particular contrasts involving responses to local inconsistent and global inconsistent trials. To see why consider the following. If interference effects are absent, a contrast between local vs. global *inconsistent* trials should theoretically yield precisely the same results as a contrast between local vs. global *consistent* trials. When this is not the case [local vs. global inconsistent  $\neq$  local vs. global consistent], contrasts between local vs. global inconsistent trials could reflect a combination of global-local precedence effects (global vs. local consistent) and interference effects. Thus, an observed difference between local vs. global inconsistent trials could reflect any combination of global precedence + (global-to-local interference  $\pm$  local-to-global interference) effects.

To avoid these problems, we use two indexes which can be expected to be independent and reliable (Gerlach & Krumborg, 2014). The first index, the *Global-Local Precedence index*, is based on the difference in RT to local and global identity judgements on consistent trials only. Positive values on this index reflect faster processing of global compared with local shape information. The second index, the *Global-to-Local Interference index*, is based on the difference in RT to local identity judgements on inconsistent and consistent trials. Positive values on this index reflect that global shape information interferes with local shape information when information from both levels are present and affect the response. Both indexes are computed for each participant as a standardized mean difference (Cohen's *d*), that is, as the difference between the two means of interest divided by their pooled standard deviations. As we have shown previously, using such standardized measures yield more reliable estimates than measures based on only the absolute differences between means (Gerlach & Krumborg, 2014).

Even though the Global-Local Precedence index and the Global-to-Local Interference index are the primary variables of interest here, we also computed two other indexes: (i) a Local-to-Global Interference

index, based on the difference in RT to global identity judgements on inconsistent and consistent trials, and (ii) a Composite index based on the difference in RT to local and global identity judgements on inconsistent trials. The Composite index taps the difference that have shown the largest/most consistent VF effects in previous studies (Van Kleeck, 1989; Volberg & Hubner, 2007). These indexes were also computed for each participant as a standardized mean difference (Cohen's *d*).

Prior to computing the four indexes the data for correct trials were trimmed for each participant excluding any RT that fell above or below 2½ SDs from the mean of a given participant for each of the four main conditions comprising the Navon paradigm (global consistent, global inconsistent, local consistent & local inconsistent) for each of the four VFs. This resulted in the removal of 2.6% trials on average from each participant (SD = 0.9, range: 0-5%).

Because the error rates were low (on average 6%, range 0-24%) and did not suggest any speed-accuracy tradeoffs that affected the RT results, we limited the data analyses to the RT based indexes described above (the error rates are provided in the Supplementary Table 1 which also contain the untrimmed RTs. The full dataset can be found at <https://figshare.com/s/2ae1ce1adea7ae25c817> (Gerlach & Poirel, 2019)).

Two main sets of analyses were conducted. In the first set we examined whether our implementation of Navon's paradigm led to the expected findings (a global precedence effect, an effect of consistency, and an interlevel interference effect with greater effects of consistency on local than on global trials). This aspect is important because these effects can depend on exposure duration, masking, letter spacing, attentional demands, salience etc. (Mevorach, Humphreys, & Shalev, 2006; Navon, 2003; Pomerantz, 1983; Pomerantz & Sager, 1975; Yovel et al., 2001). Having established that we got the expected results we checked three central assumptions: (i) that our measures of global primacy (Global-Local Precedence index & Global-to-Local Interference index) were reliable, (ii) that the two measures tapped independent aspects of global/local processing, and (iii) that the Composite index is indeed a composite measure which is affected by both global

precedence and interference effects. The latter aspect was examined by means of a hierarchal three-step regression analysis with the Composite index as the independent variable and the Global-Local Precedence index, the Global-to-Local Interference index, and the Local-to-Global Interference index as predictor variables.

In the second main set of analyses we performed the four planned contrasts examining differences in global-local precedence and global-to-local interference effects in the four VFs.

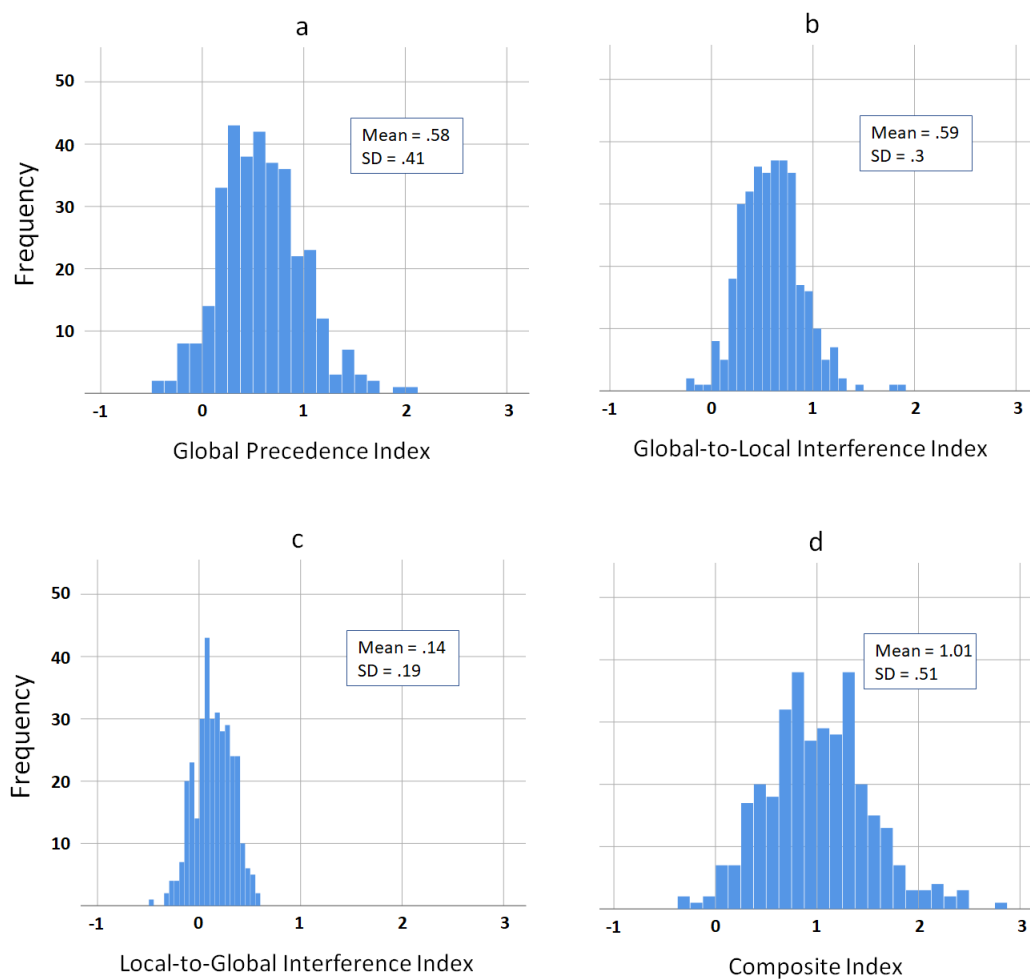
### 3. Results

#### 3.1. Check of effects and assumptions

As can be seen from Table 1, both the global precedence effect and the global-to-local interference effect were credible (their 95% CI did not contain 0) and of similar magnitudes (average  $d = .58$  and  $d = .59$ ). In comparison, the local-to-global interference effect was much smaller (average  $d = .14$ ) albeit also credible. Hence, the typical global precedence, interference and interlevel interference effects were obtained. However, as can be seen from the histograms presented in Figures 2a, b, c, and d, the effects differed considerably across subjects. If a cut-off of  $d \geq .2$  is set for distinguishing between a small effect and no effect of interest, 83% showed a positive global precedence effect (Fig 2a), 91% a global-to-local interference effect (Fig 2b), and 37% a local-to-global interference effect (Fig 2c).

**Table 1.** Mean values (Cohen's  $d$ ) and 95% confidence intervals for the four indexes derived from Navon's paradigm. Also shown is the Spearman-Brown-corrected split-half reliability associated with the indexes, and in (brackets) the corresponding reliability when computed on the absolute RT difference between means alone.

|                                    | <b><i>M (d)</i></b> | <b><i>95% CI</i></b> | <b><i>Reliability</i></b> |
|------------------------------------|---------------------|----------------------|---------------------------|
| Global-Local Precedence index      | .58                 | .54, .63             | .82 (.73)                 |
| Global-to-Local Interference index | .59                 | .56, .62             | .69 (.30)                 |
| Local-to-Global Interference index | .14                 | .12, .16             | .20 (.10)                 |
| Composite index                    | 1.0                 | .95, 1.1             | .89 (.75)                 |



**Figure 2.** Histograms showing the distribution of scores (Cohen's *d* values) for each of the four indexes.

As can be seen in Table 1, the Spearman-Brown-corrected split-half reliability for the two indexes which are of interest here –the Global-Local Precedence index and the Global-to-Local Interference index– can be deemed satisfactory (Cook & Beckman, 2006). It is also clear that these indexes, which are based on standardized differences, are generally superior to measures based on the absolute difference between means (Gerlach & Krumborg, 2014). Furthermore, a correlation analysis found no significant relationship between these measures ( $r_{337} = .03, p = .58$ ) supporting the suggestion that these measures tap independent aspects of global/local processing. In comparison, the regression analysis suggested that most of the variance (92%) associated with the Composite index could be accounted for by variance associated with the Global-

Local Precedence index, the Global-to-Local Interference index, and the Local-to-Global Interference index (see Table 2). It is also clear from Table 2 that the three indexes are independent predictors of Composite index scores. Considered together this suggests that the Composite index is indeed a composite measure because it basically reflects the combined effects of global precedence and interference.

Even if the present results suggest that we succeeded in teasing apart global precedence effects from interference effects, this does not mean that our Global-Local Precedence index is a ‘pure’ index. To the extent that information at the irrelevant level of consistent stimuli facilitate the identification judgement – and such effects are typically small (Van Kleeck, 1989) or not present at all (Martin, 1979)– the Global-Local Precedence index is also confounded. Hence, it is possible that the magnitude of the global precedence effect reported here may have been underestimated. This possibility rests on the assumption that there is little reason to suspect that local level information is derived prior to global level information –with stimuli such as those used by Navon (1977) presented in the periphery– for which reason potential facilitatory effects of congruency could be greater for trials with local than with global identity judgements.

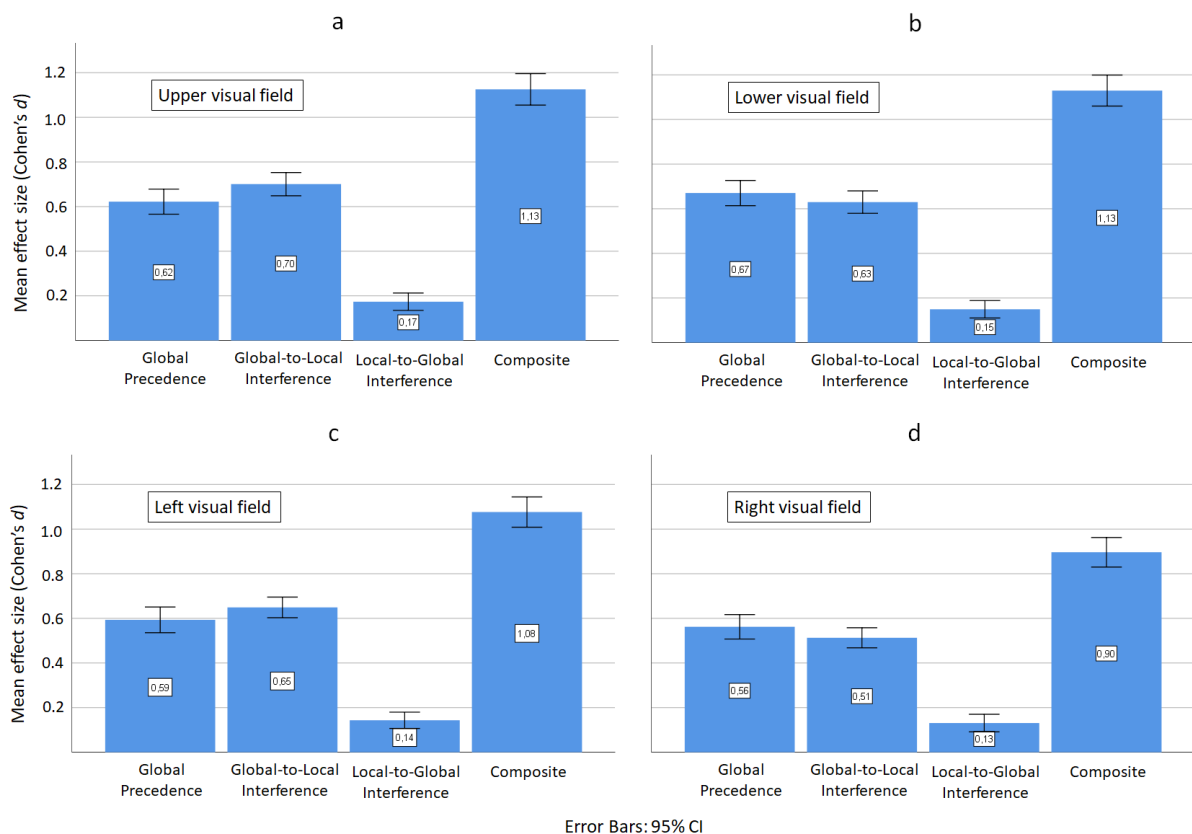
**Table 2.** *Linear model of predictors of Composite index scores.*

|        |                                    | <i>B</i> | 95% CI      | <i>SE b</i> | $\beta$ |
|--------|------------------------------------|----------|-------------|-------------|---------|
| Step 1 | Constant                           | .46      | .39, .52    | .03         |         |
|        | Global-Local Precedence index      | .94      | .85, 1.03   | .05         | .74     |
| Step 2 | Constant                           | .01      | -.07, .08   | .04         |         |
|        | Global-Local Precedence index      | .92      | .85, .99    | .04         | .73     |
|        | Global-to-Local Interference index | .78      | .69, .87    | .05         | .45     |
| Step 3 | Constant                           | .09      | .04, .13    | .02         |         |
|        | Global-Local Precedence index      | 1.01     | .97, 1.05   | .02         | .80     |
|        | Global-to-Local Interference index | .83      | .77, .88    | .03         | .48     |
|        | Local-to-Global Interference index | -1.14    | -1.2, -1.05 | .05         | -.41    |

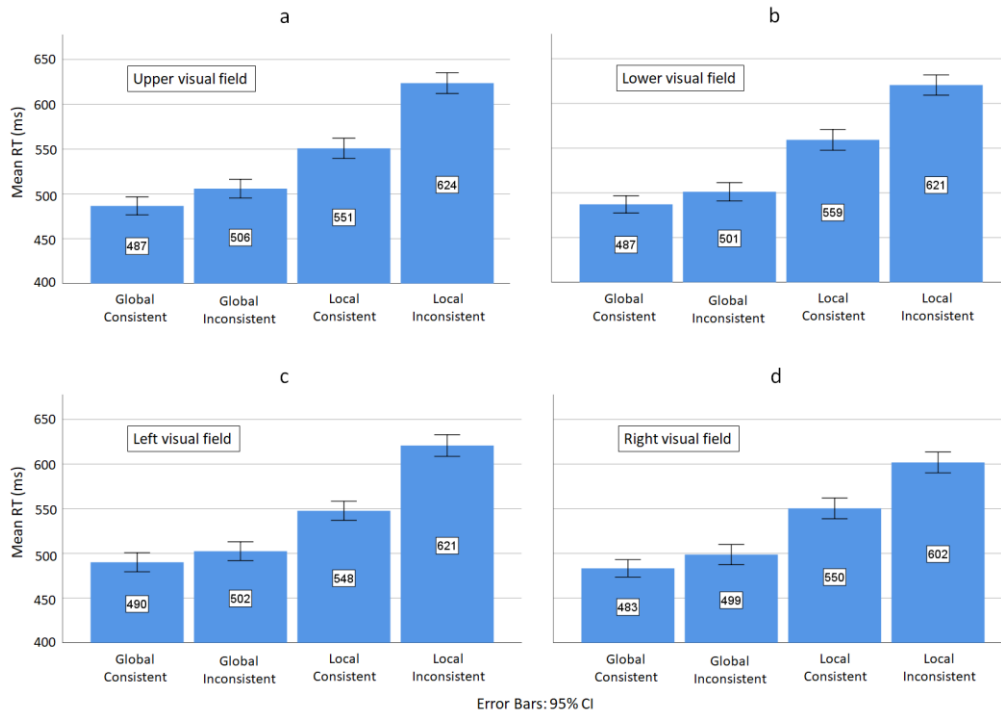
Note.  $R^2 = .54$  for Step 1;  $\Delta R^2 = .75$  for Step 2;  $\Delta R^2 = .92$  for Step 3 (all  $p$ 's < .0001).

### 3.2. Visual field differences

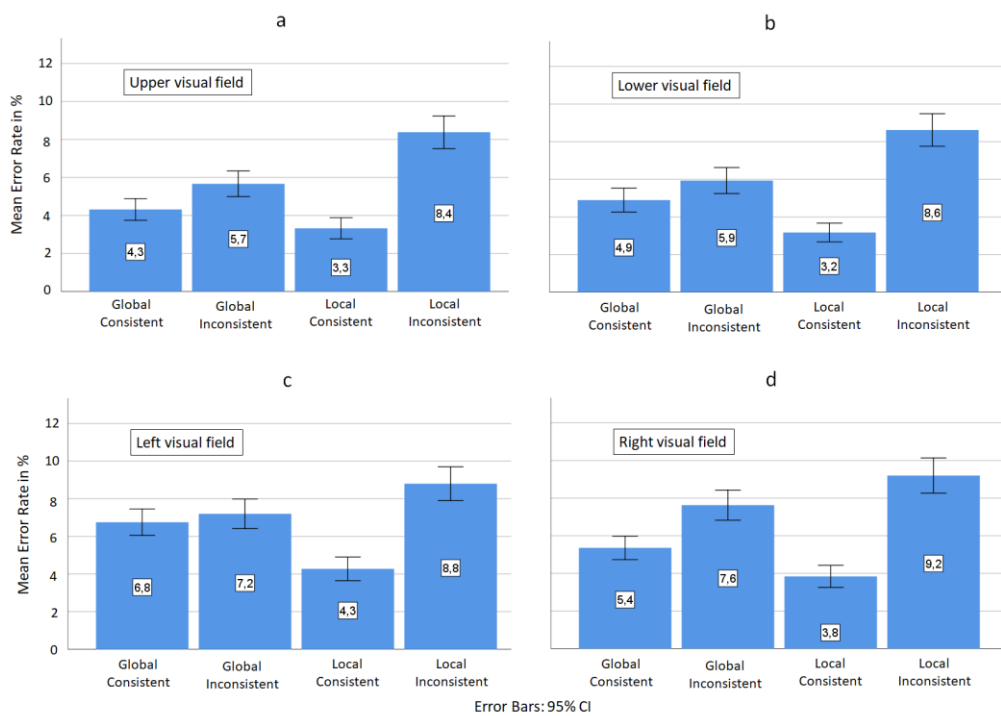
As can be seen from Figure 3, the overall performance patterns in terms of index scores were rather similar across VFs. The same is true for absolute RT differences (see Fig 4) and error rates (see Fig 5). Hence, the classical Navon effects are not limited to a particular VF. Also, there were no credible VF differences associated with the Global-Local Precedence index, and while a slight tendency was observed in the expected direction (scores being higher in the lower than the upper VF), the magnitude of this difference was low ( $d = .1$ , see Table 3). Even though earlier studies have revealed similar null-findings (Aiello et al., 2018; Hübner & Malinowski, 2002; Lamb & Yund, 1996; Van Kleeck, 1989), it is important to point out that the present study had enough power to detect even a modest difference ( $d = .15$  with  $\alpha$ -level = .05/ $\beta$ -level = .8) (Faul, Erdfelder, Lang, & Buchner, 2007).



**Figure 3.** The average score for each of the four indexes in the: (a) upper visual field, (b) lower visual field, (c) left visual field, and (d) right visual field.



**Figure 4.** The mean correct reaction time for each of the four conditions of Navon's paradigm: (a) upper visual field, (b) lower visual field, (c) left visual field, and (d) right visual field.



**Figure 5.** The mean error rate in percentage for each of the four conditions of Navon's paradigm: (a) upper visual field, (b) lower visual field, (c) left visual field, and (d) right visual field.

Contrary to the null-findings associated with the Global-Local Precedence index, the Global-to-Local Interference index yielded larger scores in the left compared with the right VF and in the upper compared with the lower VF (see Table 3).

**Table 3.** *Statistics (paired-sample t-test) associated with the four planned contrasts examining visual field effects.*

|  | <b><i>M<sub>Dif</sub></i></b> | <b>95% CI</b> | <b><i>t</i></b> | <b><i>p</i></b> | <b><i>d<sub>z</sub></i></b> |
|--|-------------------------------|---------------|-----------------|-----------------|-----------------------------|
| Global-Local Precedence index [left VF – right VF]       | .03                           | .02, -.08     | 1.14            | .256            | .06                         |
| Global-Local Precedence index [lower VF – upper VF]      | .05                           | .03, -.005    | 1.79            | .074            | .1                          |
| Global-to-Local Interference index [left VF – right VF]  | .14                           | .08, .19      | 4.87            | .000            | .27                         |
| Global-to-Local Interference index [lower VF – upper VF] | -.07                          | -.13, -.01    | -2.47           | .014            | .13                         |

#### 4. Discussion

The present findings suggest that the most widely used index in laterality studies based on Navon's paradigm –the contrast between global inconsistent and local inconsistent trials– is confounded. Hence, contrary to what has been implicitly assumed, this index does not necessarily reflect interference effects alone. In fact, most of the variance associated with it may, as we show here, originate from global precedence effects. Consequently, use of this contrast should probably be avoided. The good news is that the contrast is not needed because most of the variance associated with it can be captured by other indexes which tap global precedence and global-to-local interference effects independently.

Interestingly, by use of such independent indexes we fail to find a VF difference for the global precedence effect in Navon's paradigm. This is surprising given the widely held view that the RH is biased towards global shape perception and the LH towards local perception; a view that has been heavily influenced by studies using precisely Navon's paradigm (Flevaris & Robertson, 2016). An explanation for this discrepancy may be that it has not really been appreciated that Navon's notion of global primacy reflects two

independent effects –global precedence and global-to-local interference– of which only the latter seems lateralized. Consequently, the present finding of a VF difference for global-to-local interference but not for global precedence is not readily accounted for by theories, such as the Double Filtering by Frequency (DFF) theory (Flevaris & Robertson, 2016; Ivry & Robertson, 1998), which do not ascribe these effects to different mechanisms.

One theory that does discriminate between the two effects is the content-level binding (CLB) theory (Hübner & Volberg, 2005; Martens & Hübner, 2013). According to the CLB-theory, visual information at different spatial levels is initially represented independently of level and only later bound to form an integrated representation at a particular level. The first step is assumed to be accomplished equally well by both hemispheres whereas the second step is hemisphere-dependent: If visual information needs to be bound to a local level, a right VF advantage is expected. In comparison, a left VF advantage is expected if visual information must be bound with global levels. One problem with this account is that it really does not explain why global precedence effects occur at all; at least not in a design like the present where attention cannot be allocated to specific locations because they change unpredictably. If the participants were truly agnostic regarding which spatial level identity information originated from on *consistent* trials, as the CLB-theory implies, they should be just as fast with local as with global level identity judgements. Given that they are not suggest that they do bind visual information with a specific level, and yet there is no VF difference.

To accommodate the present findings of no VF difference for global precedence, but a difference for global-to-local interference, as well as previous findings of VF differences for inconsistent trials in Navon's paradigm, we suggest the following: (i) Each hemisphere derives information at several spatial levels with similar efficiency, but this information is derived faster at global relative to local levels. Consequently, responses will be faster to global than local letters (the global precedence effect), and responses will often be given before identity at the local level has been determined yielding little room for local-to-global interference effects on global trials. (ii) When identity information becomes available at different spatial

scales, this information is integrated *across* spatial scales, and this integration process is more efficient in the RH than in the LH. Information will therefore be more tightly bound, and thus harder to desegregate in cases of inconsistency, following right than left hemisphere processing giving rise to larger interference effects in the RH.

The explanation given above also converges with other observations. Visual integrative agnosia, which is a disorder characterized by difficulties with integration of local and global shape information, can for example arise following unilateral RH ventral lesions. Interestingly, at least two integrative agnosics have shown good global shape perception, and they also exhibited a global precedence effect but no interference effects in Navon's paradigm (Gerlach, Marstrand, Habekost, & Gade, 2005; Humphreys, Riddoch, & Quinlan, 1985). Likewise, global precedence effects in normal subjects correlate with object recognition performance regardless of how much perceptual differentiation the tasks require. In comparison, a correlation between object recognition performance and global-to-local interference effects is only found when the tasks demand that information be integrated across spatial levels (Gerlach & Poirel, 2018). Finally, the finding that the global-to-local interference index yielded higher values in the upper compared with the lower VF is also compatible with the evidence from integrative agnosia given that global/local integration, in the service of object identification, is a ventral stream function.

The interpretation we offer here clearly departs from other accounts in that it is not assumed that the hemispheres differ in local/global processing as such. Indeed, we believe that global shape enjoys a special status in the visual objects processing system as a whole (Gerlach, 2017), and that this is the reason why global precedence effects of similar magnitude are seen across all VFs. When a VF difference is found for global-to-local interference, we thus assume that it reflects a RH advantage for integrating local and global shape information, rather than a RH advantage for global shape processing per se. We also conjecture that this local/global shape integration process under normal circumstances operates preattentively (automatically), because if it did not, the participants should be able to effectively ignore (filter out)

information at irrelevant spatial levels leaving them unsusceptible to interference effects. Clearly, they are not. Indeed, this is why we suggest that the larger global-to-local interference effect in the left VF reflects that the right hemisphere is more efficient than the left in integrating information across different spatial scales making it harder to resolve conflicts when information at different levels is inconsistent.

Even though many previous reports of laterality effects have been based on an index that confounds global precedence and interference effects (global inconsistent vs. local inconsistent trials), it is worth noting that our findings actually do support the (implicit) assumption that the left VF advantage previously obtained with the confounded index does reflect interference effects. At least we were not able to find any significant VF difference for global precedence effects with a large sample and reliable measures, which we should have been if previous reports of VF differences on inconsistent trials should (also) have reflected global precedence effects. Consequently, the inconsistency regarding *VF differences* found with Navon's paradigm does not necessarily reflect the use of indexes that tap different aspects of local/global processing. The inconsistency seems more likely to reflect a combination of (low) measurement reliability, relatively large individual differences in the effects of interest, and small sample sizes; a cocktail that is bound to yield variable results.

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**Figure legends**

Figure 1. The compound letters used. Upper row: Consistent stimuli. Lower row: Inconsistent stimuli.

Figure 2. Histograms showing the distribution of scores (Cohen's  $d$  values) for each of the four indexes.

Figure 3. The average score for each of the four indexes in the: (a) upper visual field, (b) lower visual field, (c) left visual field, and (d) right visual field.

Figure 4. The mean correct reaction time for each of the four conditions of Navon's paradigm: (a) upper visual field, (b) lower visual field, (c) left visual field, and (d) right visual field.

Figure 5. The mean error rate in percentage for each of the four conditions of Navon's paradigm: (a) upper visual field, (b) lower visual field, (c) left visual field, and (d) right visual field.