Local visual processing in high obsessive compulsive disorder (OCD) scorers.

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Abstract

Reaction times for big and small letters (global and local levels) were compared and examined to see whether differences would occur between a low scoring and high scoring Obsessive-Compulsive Disorder (OCD) group. OCD patients have been shown to notice and pay more attention to small details (local bias) compared to most other populations (Shapiro, 1965; Yovel et al. 2006; Caberea et al., 2001). Although there is research supporting a local bias in OCD patients, it is unclear whether the bias occurs in the early stages of visual processing or in a later memory stage (Moritz & Wendt, 2006; Hermans et al, 2008). The study specifically examined a potential local bias for high OCD scorers in the early visual stage by manipulating perceptual and attentional mechanisms in two hierarchical letter tasks (Navon, 1977; Miller, 1981a, Plaisted et al. 1999).

In Experiment 1, participants were told which level (the big or small letter) to respond to, results showed that high OCD scorers responded faster to local letters, showing support for a local processing advantage. Conversely, the low OCD group responded quicker to the global level. The finding of a local advantage in Experiment 1 suggests that the local advantage may be due to perceptual mechanisms as attention was already directed to the relevant level. However, in Experiment 2 where attention was not directed and the image quality was manipulated, local and global advantage effects were not replicated for the high and low OCD groups respectively. This showed that attentional and perceptual mechanisms did not make one level easier to process over the other. Therefore, it is possible that any local bias for OCD patients occurs in a later processing stage.
Introduction

Our visual world is hierarchically organised, with global and local levels found in most natural objects and scenes. Both levels contain important information. The global level contains the bigger structures and outlines (e.g. a forest) and the local levels contain smaller parts and intricate details (e.g. the trees). Over the last four decades there has been much research devoted to understanding how these hierarchical objects and scenes are recognised and processed. A particular focus has been on whether we interpret the global feature before the local features (or vice versa) or whether we recognise all aspects at once.

Early research has suggested that the global level is processed faster than the local level (Navon, 1977). For instance, when participants are shown hierarchical (Navon) letters (global letters composed of small local letters) they typically recognise the bigger letter before the small letters. This finding occurs even when the letters are blurred (Schyns & Olivia, 1994) or presented to the participant’s peripheral vision (Pomerantz, 1983). However, the reason behind faster global processing still needs further examination. For instance, global precedence does not necessarily mean that the global letters are recognised before the local letters. The global level could produce a faster response rate for a number of reasons other than being recognised first. It could be that the global and local levels are processed at the same time with the difference being that the global level is more salient and thus available earlier, or that it is easier to produce a response to the global level. Finally, the global level could simply be more interesting and therefore habitually preferred (Navon, 1981a, 1983).

The above reasons aside, processing from the global to the local levels appears to be the most functional way to process visual information. Because a visual scene can change rapidly, there is often only time for a quick glance. A general (global) idea of the whole structure may be more valuable than just a few isolated (local) details. Certain types of visual information in particular may benefit from processing information from the global to the local level. For example, it appears that processing the general structure before the small details is important in
recognising faces. Macrae and Lewis (2002) demonstrated that face recognition can be disrupted by requiring participants to spend ten minutes processing only local details of a scene. Processing only the small details and ignoring the bigger picture arguably encourages participants to temporarily process subsequent visual material with a ‘local bias’, through which they tend not to see the whole picture. This type of induced local bias has led participants to poorer performance on subsequent face recognition tasks. Conversely, processing only the global part of a scene prior to a face recognition task enhances performance (Macrae & Lewis, 2002; Goffaux, Hault, Michel, Vuong, & Rossion, 2005).

While most people process information from the global to the local levels, some populations such as those with an Obsessive-Compulsive Disorder (OCD) tend to process visual information starting with the local details, followed by the global whole (Cabrera, McNally, & Savage, 2001; Savage, Baer, Keuthen, Brown, Rauch, & Jenike, 2000; Mataix-Cols et al 2003; Penadés, Catalán, Andrés, Salamero & Gastó, 2005). Research has also shown that visual processing in OCD patients is more intensely focused on small details than most other populations (Shapiro, 1965). In addition, Derryberry and Read (1998) found that trait anxiety in threat oriented situations was related to attention to local details. While local to global processing may have some advantages, such as seeing important details that others miss, it also has some disadvantages. For instance, by perceiving their environment in a local manner, OCD patients run the risk of missing the “bigger picture”.

Although there is research supporting a local bias in OCD patients, the nature of this bias is still unclear. In particular, it is not clear at which stage in processing a local bias occurs. For instance, it could occur in an early perceptual or attentional stage or later in memory retrieval (Moritz & Wendt, 2006; Hermans, Engelen, Grouwels, Joos, Lemmens, & Pieters, 2008). This study will specifically examine whether the local level is processed first in individuals with higher than normal scores on OCD or whether they process the global level first, but find the local details more distracting than the global details. For instance, the local or the global level could be
recognised first but certain local details may slow down its recognition. Knowing that OCD patients focus on details more than global patterns will not explain all of their obsessive behaviours, but it will help explain some behaviour, such as why they notice a bit of dirt or some other minor inaccuracy that most people would miss.

At present there is a limited body of literature on visual processing of Navon hierarchical letters in individuals with OCD. Therefore, this study will review the findings in the global-local processing literature focussing on the general population, and discuss its relevance to OCD. Further, the commonly used paradigm for studying global/local properties will be examined, empirical findings and the effects of task demands will be discussed, along with how different spatial frequencies (image quality) effect global precedence (the finding that the global level is processed quicker than the local). Finally, population differences in global precedence will be reviewed. A particular focus here will be on whether those with higher levels of OCD have a different hierarchical order than normal when visually processing an object or scene.

**Literature Review**

**Empirical Evidence for Global to Local Visual Processing**

Empirical investigations into global/local processing often employ Navon’s (1977) hierarchical letters (Navon letters). These letters consist of small (local) letters arranged to form the shape of a larger (global) letter. The local letters are either congruent with the global letter (e.g. a large S made up of smaller S’s) or they are incongruent (e.g. a large S made up of smaller H’s). When presented with a Navon letter participants typically recognise the global letter before the local letters (as determined by reaction times) (Navon, 1977). Furthermore, when asked to report the local letters (e.g. small H’s) of an incongruent Navon letter, conflicting information at the global level (e.g. a large S) slows down the participant’s local processing. This is known as the
global interference effect. Conversely, local letters rarely interfere with processing the global level of an incongruent Navon letter; further evidence that the global level has precedence over the local.

Global precedence refers to instances when the following two findings are both present, 1) global advantage where global letters are processed more quickly than local letters and 2) global interference, where local congruent letters produce a faster response than local incongruent. These can occur together or independently. Although not as common, some individuals show a local bias. This can manifest by 1) faster reaction times to local letters compared to global letters and 2) by local interference, where global congruent letters produce a faster response than global incongruent. Looking only at congruent letters is a good way to check global/local advantages without having effects of interference from the non-attended level influence reaction time (RT) Pomerantz (1981).

In Navon’s seminal study (Navon, 1977, experiment 3), participants were presented with Navon letters (both congruent and incongruent) and were told before each trial which hierarchical level to identify. The main objective of Navon’s Experiment 3 was to see whether participants could control where they visually processed by focusing on the instructed level and ignoring the irrelevant (or non-attended) level for each trial. The assumption was that, if participants were aware of the non-attended level that awareness would slow down their reaction times to the attended level. Results showed that despite being told which level to attend to, participants were still slower at responding to the local letters. The local incongruent letters produced the slowest response times while the congruency of letters had no effect at the global level. This showed in local trials despite being told to attend to the local level, the non-attended global letter still had an effect on the processing of local letters. Interestingly the reverse (non-attended local letters) had no effect on processing of the attended global letters. However, under certain situations or in some populations a local interference effect is shown (Miller, 1981a; Pomerantz & Sager, 1975; Plaisted, Swettenham & Rees, 1999). This will be discussed in more
detail further on. According to Navon, his finding that the congruency of letters affected only the local level is evidence that the global level is processed first. In other words, people automatically process the global shape without interference from the local details, but cannot process the local details without being aware of the global shape.

Since Navon’s seminal work, there have been numerous other studies conducted, which have demonstrated global precedence using Navon letters (or similar hierarchical stimuli) (e.g. Boer & Keuss, 1982; Grice, Canham, & Boroughs, 1983; Hoffman, 1980; Hughes, Layton, Baird, & Lester, 1984; Kinchla & Wolfe, 1979; Martin, 1979; McLean, 1979; Miller, 1981; Navon & Norman, 1983; Paquet, 1987; Paquet & Merikle, 1984; Pomerantz, 1983). Although global precedence is a well replicated finding, it also appears to be highly task and stimulus dependent. As will be explained in the following sections, new theories have emerged suggesting that the global and the local levels are processed in parallel with certain task and stimulus manipulations effecting one level more than the other.

**Task and stimulus dependent**

While there is substantial evidence supporting a global processing advantage, many findings also show global precedence as being highly stimulus and task dependent (see Kimchi, 1992 for a review). Factors such as the sensory quality of the stimulus (e.g. retinal location, relative size of each level, visual angles) and task demand factors (e.g., divided vs. selective attention conditions, spatial uncertainty, task instructions) have all shown to affect global precedence in some way.

Various studies have shown that both the comparable size of the global and local letters and the number of local elements have an impact on global precedence (Kimchi, 1998; Antes & Mann, 1984; Kinchla & Wolfe, 1979). Kimchi (1988) used hierarchical stimuli made of shapes rather than letters. Her findings showed that the number of local parts making up the global shape interfered with the strength of global precedence. Specifically, when there were fewer local parts global processing was faster whether or not local and global shapes were congruent. Martin
(1979) also showed that the strength of global precedence was influenced by the relative density or sparcity of the local letters. Looking at the visual angles, Kinchla and Wolfe (1979) showed that angles larger than 6˚ produced a local advantage. Whereas, McLean (1979) found that the global advantage does not hold for letters larger than about 10˚.

It has also been suggested that because of its larger size, the global letter is more salient thus, easier to recognise. While size is certainly a relevant factor, the issue, according to Navon and colleagues (Navon, 1977, 1981a, Navon & Norman, 1983), is whether size alone is sufficient to account for global advantage. Reaction times to various single letter control conditions have shown that participants react as fast to single letter presentations (of equivalent size as a small local letter of a typical Navon letter) as they do to the global level of a Navon letter. This result was taken as evidence by Navon and Norman that it is the global structure rather than the actual size of the stimulus that has the advantage over its local parts.

The effect of task demand factors on global precedence has also been widely demonstrated. In an experiment using Navon letters, Pomerantz (1983) demonstrated the effects of spatial uncertainty (random distribution of the stimuli on the screen). Pomerantz had half the participants respond to uncertain trials, where the stimulus appeared at randomized locations on the screen. Results showed that in the remaining participants, presentation was always at the centre of the screen. For both certain and uncertain trials, global letters were identified quicker than local ones, but the difference was greater for uncertain compared to certain locations. In a similar experiment, Lamb and Robertson (1988) had found that the global letter was identified more quickly in peripheral (than in central) presentations.

Parallel Processing Theories

The effect of task demands and stimulus quality on RT to Navon letters has led many researchers to propose that both hierarchal levels are processed in parallel and that certain task and stimulus factors make one level easier to process than the other. For instance, Navon and others (Navon, 1977, 1981; Navon & Norman, 1988; Hughes, Layton, Baird, & Lester, 1984;
Navon & Norman, 1983; Schulman & Wilson, 1987) have argued that perceptual processes (processes to do with the extraction of features from a visual form) give the global level an advantage leading to global precedence. Whereas on the other hand, Miller (1981a,b) and others (Kahneman & Henik, 1981; Boer & Keuss, 1982; Miller, 1981a; Kinchla, Solis-Macias, & Hoffman, 1983; Lamb & Robertson, 1987; Lamb & Yund, 1996; Robertson, 1996; Robertson, Egly, Lamb, & Keith, 1993; Robertson, Lamb, & Knight, 1988; Ward, 1982) have argued that it is attentional processes (saliency, decision and response selection) that cause global precedence.

Attention versus perceptual explanations can be examined more closely by looking at the two main Navon letter tasks, selective and divided attention. Each task assesses different aspects of early visual processing. Therefore, an understanding of the findings of both the selective and divided conditions is important for painting a complete picture of hierarchical visual processing.

In divided attention procedures, participants are required to attend to both local and global levels to detect a target shape. For instance participants are asked whether a letter is present or not, and the letter can be presented at either the global or local level. Because participants do not know which level the target letter will be at, natural (or automatic) attentional looking strategies are applied. In this sense, the divided attention procedure is similar to natural visual processing. This means that if a participant shows a (natural) processing bias towards a certain level, the particular bias is more likely to show in a divided attention condition (Plaisted, Swettenham & Rees, 1999). In this procedure a global advantage is seen when responding to global trials is faster than responding to local letter trials. In addition, an interference effect is seen when responding on incongruent trials is slower or less accurate, than responding on congruent trials.

In the selective attention task participants are instructed, before to each trial, as to which hierarchical level to attend to. This task is important for determining whether global precedence is still found when attention is focused on one hierarchical level and when the other hierarchical level does not contain any response-relevant information. Therefore, this task is especially
important for looking at global and local interference effects. That is because attention is already
directed to one level; interference should only occur if sensory processes are unable to block the
response irrelevant level. Just as in the divided attention task, a global advantage is seen when
global letters are responded to more quickly (or accurately) than local letters, and the global
interference effect is seen when responding to inconsistent trials is slower and/or less accurate
than consistent trials.

Often the two task designs result in different outcomes for individual participants. This
has been especially interesting when examining populations with a local bias. For instance, studies
using the selective attention procedure have found that individuals with autism show typical
global to local processing by responding more quickly and accurately to the global than the local
level. However, in divided attention procedures, in which participants are required to attend to
both local and global levels to detect a target letter, individuals with autism have shown enhanced
local processing (Plaisted, Swettenham & Rees, 1999; Mottron & Belleville 1993 Bellgrove,
Vance, Bradshaw; 2003). The following section will explain the findings of each task design with
regard to the two prominent arguments for global advantage, namely perceptual and attentional
processes.

I. Perception

Originally Navon argued that processing a visual input begins with the global level, and
that local processing is optional. As mentioned, Navon supported this view with two key
findings. First, in his 1977 study, Navon’s participants recognised the global letter before its local
letters. Second, local information appeared to have little or no effect on global processing. Later,
Navon (see Navon, 1981a) argued that global and local information may be available at the same
time (in the early pre-attentive stage), with the difference that the global level is processed faster
than the local, and thus available earlier. For instance, Navon (1981a) found that local features
were more sensitive to stimulus duration than global ones, suggesting that the local feature needs
more time to process. In his experiment, participants were presented with Navon letters for 150
ms exposures, while concurrently responding to an auditory letter presentation. Local letters were
responded to more slowly than global ones, and were associated with more auditory errors.
Navon argued that during the pre-attentive stage perceptual processes make the global level more
available than the local. So even though both levels might be available or attended to at the same
time, the global level is responded to faster.

Parallel processing of global and local parts in the perceptual early pre-attentive stage has
been supported by other researchers (Hughes, Layton, Baird, & Lester, 1984; Navon & Norman,
1983; Schulman & Wilson, 1987). However, the explanation for global precedence is often said to
be because of attentional rather than perceptual mechanisms (Kahneman & Henik, 1981; Boer &
Keuss, 1982; Miller, 1981a; Kinchla, Solis-Macias, & Hoffman, 1983; Lamb & Robertson, 1987;
Lamb & Yund, 1996; Robertson, 1996; Robertson, Egly, Lamb, & Keith, 1993; Robertson,
Lamb, & Knight, 1988; Ward, 1982).

II. Attention

Miller (1981a) argued that global precedence is best explained by assuming that the non-
attended local level is easier to ignore than the non-attended global level in the selective attention
task. In a divided attention task Miller found that congruent global targets produced faster
reaction times than global incongruent. Therefore, he argued that local letters must be available at
the same time and be facilitating (when congruent) and interfering (when incongruent) in
processing the global letter. The attentional argument essentially states that, although both
hierarchical levels are available to influence responses, global information in both divided and
selective task conditions is more salient, thus it has more influence on visual processes resulting
in quicker RTs.

In the divided attention experiment, Miller (1981) asked participants to detect whether a
certain letter was present (or not) at either hierarchical level. Particular interest was given to
congruent Navon letters (global A, local A), because it was hypothesised that if global
information was sufficient by itself to produce a response, these letters would be no faster than
incongruent letters at the global level. If congruent global letters were faster than incongruent letters, it would show that local elements also have an influence in global precedence, thus supporting a parallel processing theory. Only the target present trials were analysed.

The results indeed demonstrated that local information had a large influence on reaction time. For instance, responses were slowest when the target letter was presented at the local level, faster when presented at the global level, and significantly faster when presented at both levels. The finding of significantly faster RTs to the congruent global letter conditions relative to the incongruent global letter condition supports the hypothesis that both global and local information become available at approximately the same time and that attentional mechanisms cause the global letter to be more salient. Miller (1981a,b) also argued that the letter recognition task involves both perceptual and attentional mechanisms. The perceptual processes make the information available and the attentional processes determine whether or not the information is used (Miller, 1981a,b).

In response to Miller (1981a), Navon (1981b) claimed that the idea of attentional mechanisms underlying the global precedence is not a satisfactory argument. Instead, he argued it is a loose way of stating what his perception argument comes to explain. Navon continued saying that it is perceptual processes that cause the global level to be more "attention grabbing" in the first stages of processing. Therefore, perceptual processes cause the global level to be processed first.

Navon and Norman (1983) argued that if the global level attracts more attention by being more salient, then global advantage should be greater in a divided attention task than in a selective attention task. Navon and Norman reasoned that the attention given to the global or local level in selective attention conditions is controlled by the instructions of the task. Whereas in divided attention conditions, where task instructions are less specific, participants have greater latitude to use natural attentional strategies. Therefore, if global advantage is larger in the selective attention condition, it must have some perceptual component to it. If global advantage is larger
in the divided attention condition, then it must have an attentional component to it. Confirming their predictions, Navon and Norman (experiment 1) found a larger advantage to global stimuli in the selective condition.

However, one of the main criticisms of Navon’s (1977) hypothesis is that global precedence appears to only be apparent in attended objects. Navon’s argument is that the global advantage takes place in the very early (pre attentive) stage in processing, where local information is available but not perceived. However, in their review, Kahneman and Henik (1981) found that both global and local aspects of a Navon letter are perceived and identified prior to responding. Their findings therefore support those in Miller (1981) and are compatible with the idea that both levels are initially available at the same time but that it is in the later attentional stage that the differences in responding emerge. However, looking again at Navon’s hypothesis, it might be possible that the local level is not perceived in the non-attended hierarchical objects.

To explore this further, Paquet and Merikle (1988) examined whether in non-attended stimuli, the global letter was processed before the local or whether a global processing advantage occurred in a later or different stage. They used a similar design to Navon (1977); however, they used pairs of Navon letters rather than a single set. One of the Navon letter pairs was surrounded by a circle, and the other a square. Half the participants were required to attend to the Navon letter with a circle around it, the other half were asked to attend to the Navon letter in the square. Therefore, one Navon letter was the attended stimulus, the other was the non-attended stimulus. The purpose of this experiment was to evaluate whether the global aspect of a non-attended object influences response rates to the attended letter. They reasoned that if early visual processing involved mainly global processing, then only the global level of a non-attended letter should influence the recognition of the attended Navon letter. Furthermore if non-attended global information affected response rates, then any effect would be observed independently of whether the participants were instructed to respond to the global or the local aspect of the attended Navon letter.
Results confirmed previous global precedence findings (Navon, 1977; Kinchla & Wolfe, 1979; Hoffman, 1980; Martin, 1979), with the global attended letters being identified faster and with more global than local interference. Results from the non-attended letters also confirmed predictions that non-attended stimuli have an effect on global processing. For instance, when the non-attended global letter was incongruent to the attended global letter, reaction times were slower. These results provided evidence for global precedence in non-attended objects. However, beyond this confirmation, Paquet and Merikle (1988) actually found that both the global and the local aspects of the non-attended letter influenced reaction times. That is, the local non-attended letters interfered with (or facilitated) the recognition of local features for the attended letter. This finding suggests that both local and global information can affect early visual processing and both levels are available and perceived at the same time. Therefore, the reason why global precedence is often found is likely to be because of attentional mechanisms making the global level more salient.

However, according to Robertson and Lamb (1991), global precedence is due to both attentional and perceptual processes. For instance, both processes can be disrupted independently by lesions centred in different parts of the brain. Furthermore, while global advantage may indeed occur because of attentional mechanisms, their research has shown that the global interference effect may operate under entirely different mechanisms (Robertson & Lamb, 1991). In their experiment, Robertson and Lamb employed a task similar to Navon (1977). As expected, findings replicated Navon’s (1977) results. However, participants with lesions centred in the superior temporal gyrus, whether right or left, showed no global or local interference, while groups with inferior parietal damage showed global interference. They concluded that a global advantage in responding to Navon letters does not necessarily lead to global interference and that local advantage need not lead to local interference. Therefore, despite not knowing which properties of the stimulus are responsible for the interaction between global
and local levels, global (or local) advantage is not necessarily based on the same mechanisms that produce a global (or local) interference.

One way to explore the different mechanism responsible for global/local advantage and global/local interference might be to examine the effects of different spatial frequencies. Consider, again, the results of Paquet and Merikle (1988) who found that non-attended stimuli affected reactions to attended stimuli. Because both the global and local aspects of the non-attended letter would primarily be viewed in the peripheral vision, it is possible that the type of spatial frequency perceived in peripheral visual processing, rather than global or local processing per se, that affected the response times to the attended letter. The global and local interference effect could result from different spatial frequencies again. One way of testing this is to manipulate the given spatial frequencies in a Navon letter by removing either the high or low frequencies contained in that stimulus.

**Spatial Frequency**

Spatial frequencies (SF) are essentially a measure of how detailed an image is. All natural objects and scenes have both high and low spatial frequency patterns. High spatial frequencies (HSF) capture fine details and sharp edges and low spatial frequencies (LSF) capture soft and blurrier aspects (Morrison & Schyns, 2001). See figures 4 for an illustration of frequencies used in the current experiment. Global information is argued to be represented by low spatial frequencies; therefore the global precedence finding may be due to people finding low frequencies more salient or easier to process. If the reason for global advantage is because of the LSF represented in the global image then removing LSF should reduce the global advantage effect. Several studies have indeed found that removing low spatial frequencies eliminates the global advantage (Badcock Whitworth, Badcock, & Lovegrove, 1990; LaGasse 1993; Lamb & Yund 1993, 1996; Boeschoten et al. 2005).

Shulman, Sullivan, Gish and Sakoda (1986) first demonstrated a relationship between global and local processing and low and high spatial frequencies. They measured reaction times to
global and local letters after manipulating the amounts of low and high spatial frequencies contained in each image. They found that LSF was most disruptive to the global level rather than the local level. Further, Shulman and Wilson (1987a,b) showed that high spatial frequencies were easier to detect during identification of local forms. These results suggest that low spatial frequencies play a key role in processing information at the global level of hierarchical stimuli whereas high spatial frequencies are important for information processing at the local level.

With regard to global and local interference, Hughes et al. (1990) showed that removing low SFs reduced global interference and increased local interference. However, Lamb and Yund (1993, 1996) found that interference between local and global letters was little affected by the removal of LSF, suggesting that interference does not depend on the type of spatial frequency, although, they found that HSF was detrimental to global advantage. For instance, response times to global forms were slowed for HSF hierarchical letters, supporting the argument that low spatial frequencies facilitate the analysis of the global level.

As mentioned, processing from the global level before the local level appears to be more functional, since low frequencies appear to facilitate processing of the global level, presumably processing the low frequency first is also functionally important. While processing from low to high may be automatic and indeed easier for most people, individuals with a local processing bias may find low frequencies harder (or slower) to recognise. Research on spatial frequency and populations with a local bias, such as those with an autistic spectrum disorder (ASD), have indeed shown abnormalities in responses to spatial frequencies. For instance, by manipulating spatial frequencies, Deruelle, Rondan, Gepner, and Tardif (2004) investigated possible abnormal face processing strategies in children with ASD. Children with autism were compared to typically developing children on a range of tasks designed to explore face recognition and processing. Results demonstrated that all aspects of face processing, except for identity matching, were lacking in the autistic population compared to controls. In a second experiment, children had to match faces on either high or low–spatial frequency information. In contrast to the control
subjects, children with autism showed better performance when using high rather than low spatial frequency. Deruelle et al. reasoned that performance of the autistic children indicated that they relied more on local (HSF) than on global (LSF) cues when processing faces. While spatial frequency has not specifically been examined among OCD patients, evidence of abnormalities in processing global and local stimuli in those with an ASD suggests that there may also be peculiarities in processing spatial frequency among this population. Further, some research has shown local interference with no local processing advantage in those with high OCD traits (Yovel et al. 2005). Therefore, studying the effects of SF in this population might tell us something about the relationship or differences between a global or local processing advantage and global or local interference. Before addressing this issue further the characteristics of OCD will be discussed.

**Characteristics and some evidence of a local bias in OCD Patients**

OCD is an anxiety disorder characterised by uncontrollable obsessive thoughts or compulsive behaviours. The obsessions and compulsions cause great distress to the individuals’ life and are not easily ignored. Obsessive thoughts and compulsive actions often involve preoccupations with checking, cleaning, putting things in order, or disturbing thoughts of germs and contamination, violence, and self doubt (Rachman & Hodgson, 1980; American Psychology Association, 2000). Research into the cause and symptomatology of OCD has led to increasing evidence that OCD tendencies are associated with cognitive impairments. Such impairments have been found in nonverbal memory (Hermans et al 2008; Boone, Ananth, & Philpott, 1991; Christensen, Kim, Dysken, & Hoover, 1992; Cohen, Hollander, DeCaria, Stein, et al, 1996; Dirson, Bouvard, Cottraux, Martin, 1995; Savage, Keuthen, Jenike Brown, et al 1996), visual-spatial skills (Aranowitz, Hollander, DeCaria, Cohen 1994; Behar, Rapoport, Berg, Denckla, Mann, Cox, et al 1984; Head, Bolton, Hymas 1989; Hollander Cohen, Richards, Mullen, DeCaria, Stern, 1993), visual attention (Nelson, Early & Haller, 1993; Zielinski, Taylor & Juzwin, 1991), and other executive functions (Hermans et al 2008; Abbruzzese, Bellodi, Ferri & Scarone 1995,
Abbruzzese, Ferri & Scarone, 1997; Harvey, 1986; Malloy 1987; Purcell, Maruff, Kyrios & Pantelis, 1998; Veale, Sahankian, Owen, & Marks, 1996). In addition to the above cognitive difficulties, many studies have found that those with OCD also tend to show a local processing bias. That is, they tend to process information locally and often see the details before the overall picture (Caberea et al., 2001).

Early studies into global and local processing among OCD patients have mainly involved the Rey-Complex figure test (Osterrieth, 1944). This task requires the participant to copy a complex figure and subsequently redraw it from memory. (Savage, Baer, Keuthen, Brown, Rauch, & Jenike, 1999; Savage, et al, 2000; Deckersbach, Otto, Savage, Baer, & Jenike, 2000; Mataix-Cols et al 2003; Penadés, Catalán, Andrés, Salamero, Gastó, 2005). Findings typically show that OCD patients adopt a suboptimal piecemeal approach, where they start drawing the small details, instead of beginning with the overall form. While findings from the Rey-Complex figure test suggests that OCD patients have a local processing preference, there are several limitations to using this figure test. One issue with relevance to the current study is that it is difficult to tell whether the tendency to see small detail first stems from a bias towards local details or a bias against the global whole. Further, it is unclear whether the bias occurs during early perceptual or attentional stages or if it occurs in later stages such as memory recall (Moritz & Wendt, 2006; Hermans et al 2008). One way to get a better understanding of the exact nature of the local bias is to examine OCD patient’s responses to various Navon letters.

Moritz and Wendt (2006) examined the effects of local/global processing in OCD in a Navon letter task. Mortiz and Wendt used a divided attention task similar to Miller (1981a). Despite previous reports of a local bias in OCD patients, Moritz and Wendt were unable to replicate these findings in the Navon letter task. That is, OCD patients showed typical global-to-local processing. However, a limitation to their study was that they did not examine the effects of local interference. As mentioned it is likely that interference (where the non-attended level slows down processing of the attended level) and advantage (where one level is processed faster than
the other) are operated by two separate mechanisms (Robertson & Lamb, 1991). Therefore, it is possible for OCD patients to have a local bias where the local irrelevant level interferes with processing the global whole. Moritz, Wendt, Jelinek, Ruhe, & Arzola, (2008), in a follow up study, examined local interference in a similar study to that of Moritz and Wendt (2006). However, their findings did not support interference at the local level and the OCD patients showed typical global-to-local responding.

Perhaps the divided attention task was not sensitive enough to detect any interference effects. As stated, the selective attention task is more appropriate for looking at interference effects. Using the selective attention task design, Yovel, Revelle, and Mineka (2005) showed that the higher OCD participants found the local level more distracting. In their study, Yovel and colleagues used three types of stimuli, congruent Navon letters (same letter at both levels), an incongruent Navon Letters (a different letter at each level) and neutral Navon Letters (where the non-attended level is not letters, rather rectangular shapes). They measured global advantage as being the difference between global neutral and local neutral and interference by comparing the reaction times between incongruent and congruent trials. Their results demonstrated the distracting effects that local small details can have on identification of global information. For instance, among the high OCD group local details were found to be distracting (or facilitating) when recognising the global letter on incongruent and congruent trials respectively. However, no support was found for a local advantage in this group. In other words, the local letter did not produce a faster reaction time compared to the global letter. It is somewhat difficult to make comparisons here as the studies are inconsistent with patients and with High scoring participants. For instance, it is possible that we find trends in the data and not actual hard evidence as it is with high scorers not actual patients. Nevertheless, the finding of local interference but not global advantage supports the idea that interference and advantage are operated by separate mechanisms.
The present study

Experiment 1: Selective Attention

The purpose of experiment 1 was to see whether a higher OCD group would show more local rather than global interference and whether a lower OCD group would show more global rather than local interference. Because specific instructions in the selective attention task are given, participants will be expected to direct their attention to the specified hierarchical level and ignore the other. If the response irrelevant level is distracting, this will manifest itself by slower processing of incongruent than congruent letters. Because previous studies on autistic populations (known to have a local processing bias) have not shown faster RTs to local letters under selective attention tasks we do not expect to find a local advantage here either. However, as OCD traits have been associated with a local processing bias (Savage et al., 1999, 2000; Deckersbach et al, 2000; Mataix-Cols et al 2003; Penadés, et al., 2005) and local interference (Yovel et al 2005), it is expected that there will be a local bias for the high OCD group that will manifest itself in local interference. Therefore, the first hypothesis is that the high OCD group will show local letter interference. This will manifest itself by reaction times being faster for global congruent compared to global incongruent. For the low OCD group, hypothesis one predicts global interference which will manifest itself in faster reaction times for local congruent compared to local incongruent. Local interference is not expected for the low OCD group letters. The second hypothesis predicts that both groups will show a processing advantage to global letters. This will manifest itself by both groups having faster reaction times to global congruent than local congruent.

Method

Design

A two-level mixed-subjects design using both within and between measures was used for experiment 1. Participants were divided into two groups, high OCD scorers and low OCD scorers (between participants factor). All participants received the Navon letter task, where they
participants were required to respond to the Navon letter at both the local and the global level. The dependent measures were reaction time and response accuracy.

Participants

Participants used for the final analysis were 22 (16 females) undergraduate psychology students at Victoria University who participated in the study as part of their research participation requirement and 20 (14 female) participants who voluntarily signed up in response to flyers posted around the university advertising the study. The high anxiety scorers consisted of 20 participants, and the low anxiety group consisted of 22 participants. Ethical approval was granted by the Victoria University research ethics committee. The two groups (low and high OCD) were created from the top and bottom 25%, this resulted in 24 low scorers and 24 high scorers. For the top group scorers were above 40 and for the bottom group scorers were below 14.

Undergraduate Student Participants

The students were given the scale at the beginning of the semester as part of a mass testing session. The second half was again voluntary. All participants received additional course credit for their time.

Other participants

All other participants who voluntarily signed up were invited to do both parts of the experiment in the one session. The experiment had no sign up restrictions and all participants were tested individually by the same experimenter. Participants were not turned down based on their anxiety scores; therefore all participants in the “sign up” group completed both parts of the experiment whether their data was used for analysis later or not. Three participants were excluded from the data analyses because of high error rates (exceeding 10%). Participants were identified by their student ID numbers in order to match responses on the two tasks to the same individual.

Apparatus

Navon letters
The Navon letter task was presented using a PC with a 14-in monitor. The letters ‘H’ and ‘S’ served as the response device. Stimulus presentation and response registration were controlled by the same personal computer. The stimuli were black hierarchical letters (i.e., small letters suitably arranged to form a big letter; Navon, 1977) that appeared on a white background. Each of the small letters were approximately 8 mm wide (visual angle of 0.48) and 8.5 mm high (0.49), and the big letters were approximately 40 mm wide (2.3) and 80 mm high (4.58). As mentioned, in the literature review, certain visual angles can bias processing to one level over the other. To avoid such a bias, angles were kept smaller than 6˚. To avoid advantages to either side of the visual field and to prevent participants from fixating on one point, the Navon letters were presented at various points on a vertical axis. A fixation cross in the middle of the screen was presented before each trial.

Four different Navon letters were used in experiment one and are illustrated in Fig. 1. There were two types of congruent letters 1) a large H made up of small Hs and 2) a large S made up of small Ss. In addition, there were two types of incongruent letters 3) a large S made of small Hs, 4) a large H made of small Ss. Each letter was presented 12 times during experimental trials and 2 times during practice trials, thus, there were 48 recorded trials and 8 non recorded practice trials.

**OCD Measure**

The Kaplan (1994) Self-Rated Scale (SRS) for Obsessive Compulsive Disorder was used to measure the severity of OCD (Appendix A). Even though the aforementioned studies did not use this measure, the SRS was considered appropriate for this study as, it can be used as quick way to distinguish a high OCD group from a low OCD group. The SRS for OCD was designed to be an objective, comprehensive, and easy-to-administer instrument. Kaplan reported a strong correlation ($r=.62$) between the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) and the SRS. The reported internal consistency reliability was also quite high: Coefficient alpha was .95 ($n = 40$). The Kaplan scale is a
sound scale measuring the same constructs as the Y-BOCS and can serve as a self-administrative substitute.

Participants are asked to circle one response for each of the 35-item according to his or her experiences during the previous week. Response alternatives for the first 16 items were presented on a 6 point likert scale and were as follows: (0) almost never; (1) a few times per week; (2) almost every day; (3) usually 1 to 5 times per day; (4) usually 5 to 20 times per day; (5) usually more than 20 times per day. Some examples from the first 16 items include the following, “I am plagued by thoughts or images that I cannot get out of my mind”, “I repeat simple actions that, realistically don’t need to be repeated”, and “I have an urge to put things in order”. For the following 19 items a 5-point liked scale was used and was as follows: (0) never; (1) rarely; (2) occasionally; (3) frequently; (4) always. Example items for the last 19 scale items included, “I am greatly concerned for symmetry or order” “I have the urge to wash myself after touching things that other people don’t worry about”, “my rituals interfere with my daily functioning”. Scale scores were achieved by adding 35 item-scores into a total score, which could range from 0 to 156 (i.e. the corresponding numbers to each choice on the likert scale represents the score for that item). No subscales of the SRS have been developed as yet, so effects of different types of OCD (i.e. checkers, obsessionals or orderers and so on) can not be explored using this scale.

Procedure

Three hundred introductory psychology students were given the Kaplan (1994) anxiety OCD scale measure. Only those scoring high or low (determined by the top and bottom 25% of data) were eligible for the second part of the experiment. All participants were asked to complete a consent form, which explained the basic outline of the experiment. After the form was signed and any questions answered, the participants began the first phase. All participants were asked to complete the Kaplan questionnaire as accurately as possible. This scale took approximately 5 to 10 minutes to complete. Upon completion, participants were asked whether they had any questions or needed anything clarified. Next, participants completed the second phase, the
Navon letter global/local computer task. Participants were asked to sit in front of the computer at a distance of approximately one meter for the task.

The main body of the Navon letter experiment consisted of two phases, namely, the practice and the experimental monitored trials, the results of the latter being used in the statistical analyses. A two-choice response task was used. Participants were asked to focus their attention on one of the two possible levels of the hierarchical stimuli (i.e., the global or the local) while ignoring the other level. Each trial began with the words 'global' or 'local' on the screen. This served as the instructions for the required response on the following trial. When participants were ready to proceed to the next trial they pressed the space bar. A visual fixation cross in the centre of the screen was then presented for 500ms. Following this, one of the 4 Navon letters was presented on the screen until a response was made. Participants were told to press the letter shown in the instructed level. Given that the correct response for any trial could only be “S” or “H”, participants were asked to keep one finger ready on the “S” key and the other on the “H” key. This meant that responses were not interfered with by participant’s searching for the correct key. The interval between the response and the next display was 1.5 seconds. Letter conditions were randomly varied. Feedback was given for both correct and incorrect trials during the practice trials only. After the practice trials were completed, participants were instructed, on screen, to enter their student ID numbers (for comparison to their OCD score) and to continue on to the experimental trials.
Figure 1. The four stimuli used in experiment 1. Congruent letters are shown in 1 and 2, 3 and 4 are examples of incongruent Navon letters. Illustrations are not the actual size used in the experiments.

Results

Mean reaction times and errors were calculated separately on each trial for every participant. A total average score was calculated for each condition, level (local, global) and type (congruent, incongruent,) and was used to compare reaction time between groups. The mean error rate was 5.4%. Three individuals were removed from analysis due to high error rates (exceeding 10%). In order to minimize the influence of outliers on the analyses, individual trial scores that were more than 2 standard deviations from the mean were excluded.

Local interference

To determine whether the local level was distracting when it was not the attended level, (i.e. if RTs differed between the congruent and incongruent global letters) and to assess whether such differences distinguished each group a two-way ANOVA with a between subjects factor of Group (high versus low OCD) and within-subjects factor of Congruency (global congruent, global incongruent) was conducted. A main effect of Congruency was found ($F(1,40) = 6.94, p = .01$) but no main effect of Group ($F(1,40)=.50 \ p=.48$), indicating faster overall RTs in congruent trials for both groups. No interaction of Congruency and Group was found ($F(1,40) = 2.20, p = .15$). The findings indicated that both groups were faster at congruent letter types
indicating that, both the high and the low group showed a similar amount of local interference. See Figure 1 for graph and Table 1 for means and standard deviations.

Global interference

A two-way ANOVA was conducted with between subjects factor of Group (high versus low) and within-subjects factor of Congruency (local congruent, local incongruent) to determine whether there was any global letter interference for either group (when the global non-attended level slows down processing of the local attended letters). A main effect of Congruency was found ($F(1,40) = 8.95, p = .005$) but no main effect of Group ($F(1,40) = 2.3, p = .14$). Again no interaction between group and type was found ($F(1,40) = 1.21, p = .28$). Both groups showed equal amounts of interference by the non-attended (global) level. See Table 1 for means and standard deviations and Figure 1 for graph.

Table 1.

Means and standard deviations for letter type for the low OCD and high OCD group.

<table>
<thead>
<tr>
<th>Type</th>
<th>Low OCD group</th>
<th>High OCD group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Global Incongruent</td>
<td>1156.56</td>
<td>357.67</td>
</tr>
<tr>
<td>Global Congruent</td>
<td>1051.08</td>
<td>264.45</td>
</tr>
<tr>
<td>Local Incongruent</td>
<td>1181.18</td>
<td>274.88</td>
</tr>
<tr>
<td>Local Congruent</td>
<td>1116.91</td>
<td>386.20</td>
</tr>
</tbody>
</table>
Figure 2. Reaction times to congruent and incongruent global and local instructed letters for high and low OCD groups.

Global/Local advantage in congruent letters

To determine whether or not RT differed between the local and the global tasks and to assess whether such differences distinguished each group, RT data were submitted to a mixed ANOVA with factors of Group (high vs. Low OCD) and level (local congruent, global congruent). No main effect of Level (F(1,40) = .07, p = .79), or Group (F(1,40) = 1.32, p = .26) was found however, a significant interaction of Level and Group was found (F(1,40) = 4.61, p = .04), indicating that the high OCD group was quicker at the local congruent compared to the low OCD group. There was no difference at the global level for both groups. This does not specifically support the hypothesis, but does support a local advantage in higher OCD scores for congruent Navon letters.

Global/Local advantage in incongruent letters

To determine whether there were any differences in reaction times between the two groups for global and local level with incongruent letters a mixed ANOVA was conducted. No main effect of Level F(1,40) = .41, p = .53) or Group (F(1,40) = 1.36, p = .26) or interaction
between Level and Group ($F(1,40) = .00, p = .99$) was found. See Table 1 for means and standard deviations and Figure 2 for graph.

![Graph](image)

**Figure 3.** Reaction times to congruent and incongruent global and local instructed letters for high and low OCD groups.

**Error data**

Errors were relatively rare for both groups across conditions (High OCD $M = 5.13\%$, $SD = 3.5$; Low OCD: $M = 3.2\%$, $SD = 2.98$). A main effect of error in Level was found ($F(1,40) = 25.73$, $p < .001$), showing that more errors were made in incongruent compared to congruent trials. No main effect of Group ($F(1,40) = 2.23$, $p = .14$) or interaction between Level and Group ($F(1,40) = 1.7$, $p = .22$) was found.

**Discussion**

Experiment 1 was interested in examining whether high scorers on the Kaplan (1994) SRS would show a local visual processing bias. It was predicted that the high OCD group would 1) respond quicker to global congruent trials compared to global incongruent trials (the local interference effect) and 2) that both groups would respond quicker to global congruent than local congruent letters (global advantage). Results confirmed a local interference effect in the high
OCD group, however, the low OCD group also showed a local interference effect. In addition, both groups showed global interference where local congruent letters were processed faster than local incongruent letters. Therefore, the hypothesis that only the low OCD group would show local interference was not supported by these results. Rather, these findings showed that the non-attended level is harder to ignore for both groups regardless of whether it is the global or local level.

These results can be compared to previous research on perceptual versus attentional mechanisms in global precedence. Following Navon (Navon, 1977, 1981; Navon & Norman 1983), global precedence occurs because the global level is perceived before the local level. He argued that, although both levels are available at the same time, perceptual mechanisms allow the global level to be responded to more quickly. The data from the present study does not support this. If perceptual mechanisms allowed only the global level to be processed first then asymmetrical interference (i.e. local congruent faster than local incongruent, but no difference between global congruent and incongruent) would have been found. The finding that both levels produced interference effects, suggests that both global and local aspects are perceived at the same time. Therefore, these results are more fitting with Kahneman and Henik (1981) Paquet and Merikle (1988) and Miller (1981a,b). For instance, Kahneman and Henik found that the global and local levels are perceived prior to responding. Paquet and Merikle showed that both levels of the non-attended letter have an influence on responding to attended letters. Finally, Miller argued that both global and local levels are available at the same time, and the reason for global precedence is because the global level is more salient. Results for the global and local advantage were not consistent with predictions, but did offer support for a local processing bias in the high OCD group. For instance, responses to the local congruent letters were quicker for the high OCD group compared to responses to the local letter for the low OCD group. Following Miller’s (1981a,b) attentional argument, the finding of a local level advantage for the high OCD group
reflects the properties of the local level being more salient. For the low OCD group, typical
global advantage was found suggesting that the global level was more salient for this group.

The local and global advantage for high and low OCD scorers respectively did not extend
to incongruent letters. Instead the present study found no difference between groups for
responses to either the global or local incongruent letter trials. This lack of difference between
the levels in incongruent letters could more appropriately be interpreted as showing the effects
that the non-attended level has on global and local processing. That is, responses on incongruent
letters for both groups were equally affected at both the global and local levels by the non-
attended letter. As there is no interference from either non-attended level in congruent letters,
they are perhaps more appropriate for looking at advantages in global and local processing. Since
a local processing advantage was found for the high OCD group in congruent Navon letters, this
can be taken as some evidence for a local processing bias in this group.

However, it is still unclear whether the local advantage effect for the high OCD group
and the global advantage effect for the low OCD group were due to attentional or perceptual
mechanisms. Although the interference effects seem unlikely to be because of perceptual
mechanism, as both global and local properties were available at the same time and influenced
responses, Robertson and Lamb (1991) argued that interference and advantage are operated on
different mechanisms. Therefore, it may be possible that the local advantage was due to the high
OCD group responding faster to a particular perceptual mechanism in local letters. The aim of
experiment 2 was to explore some perceptual differences by manipulating various spatial
frequencies.
Experiment 2: Divided attention task with Spatial Frequency Manipulations

In experiment 1 some support was found for a local bias in high OCD scorers. For instance, the finding of both global and local interference supported the idea that both levels were perceived at the same time. Further, the high OCD group responded quicker to local congruent letters compared to the global congruent letters and the low OCD group responded quicker to the global congruent letters compared to the local congruent letters. However, the reason behind this difference between the two groups is unclear. Experiment 2 aimed to investigate the group differences using a divided attention task and manipulating spatial frequency (SF). For instance, rather than finding a particular level easier to process, group differences could emerge because one type of frequency is easier for them to process than the other.

The first aim of Experiment 2 was to evaluate whether the high OCD scorers would show a local bias in a divided attention task. Previous studies have found that for autistic participants a local advantage is not found in selective attention conditions but is found in the divided attention task (Plaised et al 1999; Bellgrove et al 2003). Ferman, Primeau, Delis & Jampala, (1999) also found a local processing bias in the divided attention Navon letter task for schizophrenic participants. However, Moritz and Wendt (2006) and Moritz et al (2008) found no local advantage for a high OCD group using the divided attention condition, although their method was slightly more complex as they used two target letters instead of just one. Therefore by using a simple divided attention procedure with only one target letter, the present study may result in a local processing advantage for the high OCD group and a global processing advantage for the low OCD group.

The second aim of Experiment 2 was to assess the influence of different spatial frequencies (SF) on global and local processing. As mentioned, global or local advantage can occur without global or local interference (Robertson and Lamb 1991; Mottron, & Belleville, 1993) therefore; manipulating available spatial frequencies may reduce interference from either
hierarchical level (depending on the respective manipulation) or reduce the respective global or local advantage. Previous research has shown that low SF letters result in faster global letter responding than high SF letters. Conversely, high SF letters result in slower global letter responding.

The predictions for Experiment 2 are outlined below. The first predictions were based on global/local advantage. As a local advantage was found for the high OCD group and a global advantage was found for the low OCD group in Experiment 1, Experiment 2 was expected to have similar results for original frequency trials (non-manipulated stimuli containing high and low frequencies). In original frequency trials, it was expected that the high OCD group would show faster reaction times when the target letter was at the local rather than global level. In contrast, it was expected that the low OCD group would show faster reaction times to target present trials at the global rather than the local level. However, both groups were expected to respond more quickly on congruent trials.

Concerning spatial frequency manipulations, it was expected that if the high OCD group show a bias towards HSF when visually processing, and since HSF is related to local processing then removing this frequency should reduce the local advantage and decrease global letter RT. Conversely, if the low OCD group shows a bias towards LSF when visually processing, then removing this frequency should reduce the global advantage and decrease local letter RTs (Badcock et al. 1990; LaGasse 1993; Lamb and Yund 1993, 1996; Boeschoten et al. 2005). No differences were expected for the high OCD group RTs to local high SF and local original SF. Similarly, no differences were expected for the low OCD group RTs to global low SF and global original SF.

Further, it was expected that in original frequency, both groups should show global and local interference effects (Miller, 1981). However, for both groups it was expected that under LSF conditions local interference would decrease but local interference was expected to increase in HSF trials (Badcock et al. 1990; Lamb and Yund, 1996; Boeschoten et al. 2005).
Method

Design

A two-level mixed-subjects design using both within and between measures was also used for experiment 2. All participants received the Navon letter task, in which they were required to respond to the Navon letter. A divided attention procedure was used, whereby the target letter could be at either the local or the global level. The between group variables was the global and local conditions as well as the three types of spatial frequency (original, high and low). Participants were divided into two groups according to their scores on the Kaplan OCD scale; high OCD scores and low OCD scores respectively (between participants factor). The dependent measures were the reaction times in recognising the Navon letters as well as response accuracy.

Participants

Participants for Experiment 2 were invited through an email invitation which explained the nature of the study. Participation was voluntary and participants gave no personal details except for gender. Ethical approval was granted by the Victoria University research ethics committee. Participants were asked to give their initials and date of birth in both the OCD scale and the Navon letter task so that their individual scores could be compared to each other. Sixty nine participants completed both parts of the experiment. The two groups (low and high OCD) were created from the top and bottom 25%, this resulted in 24 low scorers and 24 high scorers. For the top group scorers were above 40 and for the bottom group scorers were below 14

Stimuli

Navon letters

Stimuli appeared in three versions: original (with both high and low spatial frequencies intact) low spatial frequency, and high spatial frequency. Low and high spatial frequency letters were achieved using high-pass filter and low-pass filter respectively. The low and high-pass cut-offs corresponded to SF below and above 8 and 24 cycles/image, respectively (recommended in
Schyns and Olivia, 1999). The Graphic Image Manipulation Program (GIMP) version 2.4.5 was used to manipulate the image frequencies.

Six different stimuli were used for each frequency condition (original, high and low). Thus, a total of 18 different letters were used. See figure 4 for an illustration. Stimulus 4, 10 and 16 were large As made up of small As. Stimulus 1, 7 and 13 were large Xs made up of small Xs. Stimulus 5, 11 and 17 were large As made up of small Hs. Stimulus 2, 8 and 14 were large Xs made up of small Ks. Stimulus 6, 12 and 18 were large Hs made up of small As and Stimulus 3, 9 and 15 were large Ks made up of small Xs.

The experiment was presented through a website designed purely for this task. All response times and accuracy measures were available through a separate secured password protected site. The letters ‘v’ and ‘n’ on the participant’s keyboard served as the response device. All stimuli were presented 12 times during the experimental (recorded trials) and twice for the practice trials (not recorded trials). Hence, there was a total of 216 recorded trials and 36 practice trials. Half of all the trials contained the letter A and stimuli were presented in random order. For the practice trials, each of the 18 stimuli appeared twice. Correct and incorrect feedback was given for each response during the practice trials. Response times and accuracy was not recorded during practice trials.

The stimuli were white hierarchical letters (i.e., small letters suitably arranged to form a big letter; Navon, 1977) that appeared on a white background. Each of the small letters were approximately 8 mm wide (visual angle of 0.48) and 8.5 mm high (0.49), and the big letters were approximately 40 mm wide (2.3) and 80 mm high (4.58). Again, to avoid advantages to either side of the visual field and to prevent participants from fixating on one point, the Navon letters were presented at various points on a vertical axis. A fixation cross in the middle of the screen was presented before each trial. Although there was no control over the size of the participants screen, instructions were given to the participant to try and sit approximately one meter away from the screen. This made each Navon letter roughly the same size.
The Kaplan (1994) scale was used again for Experiment 2. Items were exactly the same as in experiment 1, except participants responded.

**Procedure**

Experiment 2 was conducted as an online study. The OCD scale was presented through the SurveyMonkey.com website (Finley, 2009) and the Navon letter task was presented using a private webpage. A snowball strategy was used to recruit participants, whereby the first email invitations were sent to participants from the author’s personal and professional email network. Participants were encouraged to forward the email on to people in their respective email networks.

Participants who agreed to take part were instructed to click on the link in the email, which started the Kaplan scale in the surveymonkey.com website. At the beginning of the survey, participants were required to fill out their initials and date of birth so that their scores on the scale could be compared to their scores on the Navon letter task. After the survey was completed, participants were instructed to click on the box saying ‘done’ which then loaded the webpage for the Navon letter experiment.

Throughout the experiment, the participant’s task was to press one button if the stimulus contained the letter A and the other button if the letter A was not present. On any given trial, the target letter A could be at the global level, the local level or no levels. Participants were told to press the letter “v” when the letter “a” was present and the letter “n” when the letter “a” was not present. These letters were chosen as they are located in the centre of the bottom row of letters on the keyboard, and therefore it was considered that they provided a fair and equal way of responding to present or not present trials. The interval between the response and the next display was 1.5 seconds. Letter conditions were randomly varied. Participants were informed at the start of the practice session and reminded at the beginning of the experimental trials on which button to press for present and which to press for not present trials. After the practice
trials were completed, participants were instructed, on screen, to enter their initials and date of birth (for comparison to their OCD score) and to continue on to the experimental trials.
Figure 4. The eighteen stimuli used in the divided attention procedure. Letters 1-3, 7-9 and 13-15 are high, low, and original frequency images respectively, that appeared on target absent trials. Letters 4-6, 10-12 and 16-18 are high, low, and original frequency images respectively, that appeared on target present trials.
Results

Reaction times for the target present Navon letters (Letters 4-6, 10-12 and 16-18 in figure 4) were analysed by a mixed between-within subjects analysis of variance. The between subjects factor was OCD Group (High or low OCD) and the within-subjects factors were hierarchical Level (congruent, global, local) and Frequency (original, high and low). The mean error rate was 1.69%. No participants were removed from analysis due to high error rates. In order to minimize the influence of outliers on the analyses, individual trial scores that were more than 3 standard deviations from the mean were excluded. It was decided that removing 2 standard deviations from the mean (as in experiment 1) might have been too strict and perhaps could act to wipe out any effect that might be operating.

Global / local advantage Original Frequency

To examine whether there was an advantage at the local level for high OCD scorers and a global level advantage for low OCD scorers in original frequency letters, a two way ANOVA was conducted, with Level (global original SF, local original SF) and Group (high versus low OCD). As shown in figure 5, results showed that there was no main effect of Level (F(1,47) = .41 p=.52) or Group (F(1,47) = 3.48, p = .07). There was also no interaction between Level and Group (F(1,47) = .24 p = .88). Therefore, in the original frequency trials for both groups, RT to the global and the local levels were not significantly different. In other words, a global (or local) processing advantage was not found for either group.

Effects of frequency on global/local advantage

A two-way mixed ANOVA was conducted with factors Level (global low SF, local low SF) and Group, (high and low OCD). Compared to the results for the original frequency conditions, the low frequency conditions made little difference to the RTs. There was no significant main effect of Level (F(1,47) = .04 p=.84). However, there was a main effect of group (F(1,47) = 7.48, p=.01) thus, showing faster overall RTs for the high OCD group. No interaction between Level and Group (F(1,47) 1.72 p=.20) was found. In the low frequency condition both
groups showed no difference in responding to the global or the local level, however the high OCD group was faster overall.

The same analysis was conducted with high SF letters. A main effect for Group (F(1,47) = 4.89, p=.03) was found but no main effect was found for Level (F(1,47) = 1.52 p = .22). However, an interaction between Level and Group (F(1,47) = 5.40 p = .03) was found. As shown in figure 5, the interaction showed that the low OCD group was slower at responding to global high frequency letters compared to the high OCD group’s RTS to the global high spatial frequency letter.

![Figure 5](image-url)

*Figure 5* Reaction times to global and local letter conditions under the original, high and low spatial frequency manipulations for high and low OCD Groups.

Global interference Original Frequency

A two-way ANOVA was conducted with factor of Group (high versus low) and within-subjects factor of congruency (congruent local A, incongruent local A) to determine whether there was any global letter interference for either group. A main effect of Congruency (F(1, 47) = 4.55, p=.04) and Group (F(1,47) = 4.4 p=.04) was found. No interaction between Group and Congruency was found (F(1,47)=.32 p = .58). Therefore, both groups showed equal amounts of interference by the non-attended (global) level. The high OCD group was faster at responding overall. See figure 6.
Effects of frequency on Global Interference

Similar results were found with high and low frequencies, see figure 6. In high frequency (congruent and local) letters, a main effect of Congruency was found ($F(1,47) = 9.65, p = .001$) but no main effect of Group ($F(1,47) = 3.61, p = .06$). No interaction was found between Congruency and Group ($F(1,47) = 3.84, p = .06$). Therefore both groups responded faster to the congruent level. The overall RTs did not differ between groups in HSF congruent and local letters.

With the low frequency letters, a main effect of Congruency ($F(1,47) = 17.57, p < .001$) and Group ($F(1,47) = 6.58, p = .01$) was found. No interaction was found between Congruency and Group ($F(1,47) = .00, p = .97$). For the LSF trials responses were faster for congruent letters for both the high and low OCD groups. The high OCD group responded faster overall. Across all frequencies (original, high, low) both groups showed global interference, where local letters were slower to produce a response to compared to congruent letters.

![Figure 6](image-url)

*Figure 6* Reaction times to local congruent and incongruent letter conditions under the various spatial frequency manipulations for high and low OCD Groups.

*Local interference original Frequency*
To determine whether or not RT differed between the congruent and global letters and to assess whether such differences distinguished each group a two-way ANOVA with a between subjects factor of Group (high versus low OCD) and within-subjects factor of Congruency (congruent global A, incongruent global A) was conducted. A main effect of Congruency ($F(1,47) = 8.01, p = .01$) and Group ($F(1,47) = 4.37, p = .04$) was found. No interaction between Congruency and Group was found ($F(1,47) = .55, p = .46$), indicating that both the high and the low group showed significant amounts of local interference in original frequency conditions, see figure 7. The high group produced faster response times overall.

**Effects of frequency on Local Interference**

The same analyses were conducted using high and low spatial frequencies. In high frequency congruent and local Navon letters, A main effect of Congruency ($F(1,47) = 17.08, p < .001$) and Group ($F(1,47) = 8.08, p = .01$) was found. No interaction was found between Congruency and Group ($F(1,47) = 2.81, p = .10$). Both groups responded faster to HSF congruent letters and the high OCD group were faster at responding overall.

With the low spatial frequency letters, no main effect of Congruency was found ($F(1,47) = 3.9, p = .06$), although a main effect of Group ($F(1,47) = 6.22, p = .02$) was found. No interaction was found between Congruency and Group ($F(1,47) = 1.64, p = .21$). Results showed that the low frequencies reduced local interference for both groups. The high OCD group responded faster overall.
Figure 7 Reaction times to local congruent and incongruent letter conditions under the various spatial frequency manipulations for high and low OCD Groups.

Error data

Errors were relatively rare for both groups across conditions (High OCD $M = 1.74\%$, $SD = 1.8$; Low OCD: $M = 1.63\%$, $SD = 2.01$). A main effect in Congruency ($F(1,41) = 8.46$, $p = .00$) and Frequency was found ($F(1,41) = 5.72$, $p = .01$), whereby more errors were made in incongruent compared to congruent trials and more errors were made on high and low frequencies compared to original frequency. No main effect of group ($F(1,41) = .039$, $p = .85$) or interaction between Congruency and Group ($F(1,41) = .054$, $p = .95$) was found, showing no difference between the high and low group with the level where errors were made. An interaction of Congruency and Frequency was found ($F(1,41) = 4$, $p = .03$), indicating that the high OCD group made more errors on the high frequency trials compared to the low OCD group, and the low OCD group made more errors on the low frequency compared to the high OCD group.
Discussion

Experiment 2 was interested in examining whether participants in the high OCD group had a local visual processing bias and whether the participants in the low OCD group had a global visual processing bias. The first set of predictions was made in regards to the global or local advantage effect. Specifically, it was predicted that the high OCD group would respond quicker to the local target present letters and the low OCD group would respond quicker to the global target present letters (when presented in original frequency). Further, it was predicted that LSF trials would result in quicker RTs to global letters for the high OCD group. For the low OCD group in local trials, it was expected that responses would be quicker for local HSF presented letters. The second predictions were based on the interference effects of the non relevant level. It was expected that both the high and low OCD groups would show global and local interference. This would result in congruent letters having faster RTs than incongruent letters. In addition, low SF was expected to reduce local interference and high SF was expected to reduce global interference for both groups.

No support for a local advantage in the high OCD group and no support for a global advantage for the low OCD group were found. In fact, both groups showed no difference in RTs to global and local original frequency trials. Moreover, SF manipulations had no effect for the high OCD group. However, for some HSF trials a difference was found for the low OCD group. Specifically, local HSF letters produced quicker RTs compared to global HSF. This finding is consistent with some previous research in spatial frequency (Badcock et al. 1990; LaGasse 1993; Lamb and Yund 1993, 1996; Boeschoten et al. 2005) and supports the idea that HSF is related to local processing. Since a global advantage was not found in original frequency trials for the low OCD group, it cannot be concluded that the participants with low OCD traits show a preference for low frequency resulting in global dominance. However, when LSF was removed, the low OCD group were quicker at responding to the local level. The lack of difference between the global and local level for the high group and the finding that SF manipulations were not
facilitating or hindering in any way shows that both groups tend to perceive hierarchical levels in a similar fashion. If people with high OCD traits, or OCD patients have a local visual processing bias it may well occur in a later processing stages.

Some support was shown for the second group of predictions on global/local interference. For instance, both groups showed equal amounts of interference for both the global and local levels in original frequency. This replicates previous findings in the divided attention condition (Miller, 1981) and suggests that both the global and local levels are available and perceived at the same time. Again, spatial frequency manipulations appeared to make little difference to the RTs. For instance, global interference was still present for HSF and LSF conditions for both high and low OCD groups. However, for local interference SF appeared to have some effect on RTs. That is, the LSF trials reduced local interference for both groups. This finding is consistent with research claiming that LSF is related to global processing, as in these conditions the LSF made the global level more (or the local level less) salient.

Although, no support was found for a particular level advantage for either group, this finding could be a reflection of the limitations to this study. For instance, there were some disadvantages with the online recruitment method where certain task factors were not as easily controlled. For example, the results could have been affected by size difference in participants’ monitors affecting the stimulus size or by tone settings that potentially affected the SF. Another factor to consider is fatigue caused by the amount of time spent in front of the computer immediately prior to participating in the experiment. Research by van der Linden and Eling (2006) has shown that fatigued participants respond less well to local letters compared to global letters. Since experiment 2 was conducted online, it is possible that participants had been sitting at their computers for quite some time before they began the study. If they were already fatigued this could have influenced the responses to the Navon task and reduced their attention, particularly to the local level.
In addition to the above findings, results showed that the high OCD group responded faster overall to most letter conditions. While this finding was not expected, it is in accordance with previous research on anxiety. For example, Rosenbaum (1950) (as cited in Farber & Spence, 1956) found greater responsiveness to stimuli in an anxious compared to a non-anxious group. Wenar (1954) showed that an increase in anxiety level produced a significant increase in RTs to various stimuli. However, this finding is also in disagreement with other findings with OCD participants (Georgiou-Karistianis, Howells, & Bradshaw, 2003; Assaf, Reuven, Galit, Nachshon, 2008). This disagreement could reflect the differences in the type of OCD traits. Perhaps the high scorers', scored particularly high on certain questions and their scores may reflect a certain type of OCD that is more highly anxious. In addition, the high OCD group in the present study are not OCD patients, rather individuals who have higher than average scores on a scale measuring OCD. It may be that a local bias is only present in OCD patients.

Overall, results for Experiment 2 showed that in a Navon letter task where attention was not directed to one level over the other, no global or local advantage was present for either group. For the low OCD group, SF manipulations made little difference to patterns of responding. Low spatial frequencies appeared to reduce global interference for both groups. However, since both global and local interference was present, these effects are likely to be because participants directed their attention equally between levels and benefited from congruency between global and local levels. The finding of no local advantage suggests that if there is a local bias in OCD patients it may be confined to later processing stages such as memory retrieval (Moritz & Wendt, 2006; Mortiz et al 2008; Hermans et al 2008).

**General Discussion**

Currently, there is a small body of research which suggests that OCD participants have a local bias where they tend to process small details first often at the expense of the global whole (Savage, et al, 1999; Savage, et al, 2000; Deckersbach et al, 2000; Mataix-Cols et al 2003; Penades et al, 2005). However, results from the current study suggest that there is little difference between
high and low scorers of OCD. The results suggest that both global and local information is available and processed at the same time. Although, in Experiment 1 when attention was specifically directed to one level (global or local), high OCD participants showed a local bias and low OCD participants showed a global bias. This result suggests that only when attention is directed will a bias emerge. Therefore, these results show that visual processing for global and local levels is the same for both high and low scorers. The finding that the global level is more salient for high scorers and the local is more salient for high OCD scorers when attention is directed to it suggests that there is a slight difference in processing for both groups. The difference appears to be due to the saliency of the objects that have been directed to. When there are no specific directions given with how to process an object then both the global and the local level is processed in parallel.

This study set out to investigate whether a local bias exists for high OCD scorers by examining group differences in RTs to global and local levels. Navon letter tasks (Navon, 1977) were manipulated to vary both attentional and perceptual demands and available frequencies were manipulated to examine differences between global or local advantage and global and local interference between the two groups.

In Experiment 1, the selective attention task, high OCD scorers showed a local processing advantage, showing that when attention is specifically directed to a hierarchical level, participants with high OCD responded faster to the congruent local level. Conversely, the low OCD group responded quicker to the congruent global level. Both the selective and divided attention conditions produced global and local interference effects showing that the global and local non attended levels for both groups were equally distracting. In Experiment 2, global and local advantages were not replicated. In fact, typical global precedence findings were not found at all in Experiment 2. Both the high and low OCD groups showed no preference to either hierarchical level. Interference from the irrelevant level was found in experiment 2. Therefore showing that both global and local levels are available and processed at the same time.
As mentioned, the finding of no local advantage suggests that a local bias in high OCD populations may be confined to later processing stages (e.g. memory retrieval). In fact, research has shown that OCD participants have memory distrust, in other words, OCD patients often find it difficult to tell whether they have preformed an action or just imagined it. Hermans et al (2008) found that OCD patients do not distrust their memory per se; rather they distrust their attention to a given situation. Often this distrust manifests in thoughts that they may have missed a potentially important detail in a past event. This lack of attentional confidence may bias OCD participants to look more intensely for details than most other populations (Hermans et al 2008). Intense focus towards small or irrelevant details due to attentional distrust may explain why a local advantage for the high OCD scorers was found in Experiment 1. For instance, high OCD individuals may from habit automatically check details first.

A further explanation for the lack of difference between global and local levels was that participants in both groups were able to equally divide their attention between the two hierarchical levels. For the purpose of finding the letter ‘A’, equally dividing attention was probably the most functional way to see whether A was present or not. That being said, it was still expected based on previous findings (Miller 1981a; Plaised et al 1999) that a bias for one level would occur over the other.

One possible reason for the finding of no difference is that stimulus duration was not limited; this could have allowed enough time to process both levels before producing a response. In other words, the global level may have been processed first but because the Navon letter remained on screen until a response was made, extra time may have been available to process the local level as well. Moreover, the mean RTs and standard deviations (SDs) for the current task appear to be higher than other studies. For instance, in Navon’s (1977) Experiment 3 the mean RTs in the, local instructed congruent, and incongruent conditions were 581, and 664 msec, respectively, and 471, and 477 msec, respectively, for the global instructed condition (standard deviations were not reported). Badcock, et al (1990) found a mean RT for congruent global
letters 369.45 (28.55), and incongruent 366.50(26.48) for local letters 423.00(39.11) and incongruent 477.55(53.87). Therefore, it is possible that the slower RTs for the present study were to do with the Navon letter exposure duration, which could have given extra time for the global (or local if the case may be) to be processed.

In the current study the letter remained on screen until participants made a response. However, in other studies where the Navon letter was presented for a limited time, exposure duration affected the pattern of global and local processing. For instance, Paquet and Merikle (1984) found that the interference effect was affected by exposure duration. In their experiment Navon letters were presented for 10, 40, or 100 ms. Interference was only found for the shortest exposure duration. When presented for 100ms both global and local interference was found, even though a global advantage was found in these trials. However, some other studies have shown no effect for longer exposure durations (e.g., Hughes, Layton, Baird, & Lester, 1984; Kimchi, 1988; Paquet & Merikle, 1988; Pomerantz, 1983). The Navon letter remaining on the screen until a response was made does not necessarily explain why the present study found longer response times. For instance, in Duchaine, Yovel, and Nakayama (2007) the Navon letter remained on screen until a response was made and average RTs in their study were also faster with lower SDs (514 (89) global congruent, 584 (124) for global incongruent, 554 (90) for local congruent and 627 (107) for local incongruent.

Given the limitations to the study, future research should further examine the potential bias in OCD patients. Specifically, future research should compare RTs for OCD patients with healthy controls on both a selective and divided attention Navon letter task (with limited exposure duration) and also with scores on the Rey-Complex figures task (Osterrieth, 1944). This comparison of the tasks would show more clearly if and where a local bias occurs. Further, the OCD group should be differentiated into types (checkers, obsessors and so fourth). As previous research has found attention distrust, the local bias might be more pronounced in OCD patients who have a compulsive behaviour of checking.
In summary, Experiment 1 provided some evidence for local processing in early perceptual stages for the high OCD group. A typical global advantage was found for the low OCD group in Experiment 1. The study also reported global and local interference effects for both high and low OCD groups, indicating that the irrelevant level is distracting for both groups. The finding of a local advantage in Experiment 1 when attention was directed suggests that the local advantage may be due to perceptual mechanisms. However, local and global advantage effects were not replicated for the high and low OCD groups respectively in Experiment 2 even with various SF manipulations. This showed that attentional and perceptual mechanisms did not make one level easier to process over the other. Therefore, it is quite possible that any local bias for OCD patients or higher than normal OCD scorers occurs in a later processing stage. It would now be pertinent to investigate whether individuals scoring high or low on OCD would show similar findings on the divided and selective Navon letter tasks and on a Rey-Complex figures task. Additionally, it would be useful to explore whether types of OCD showed differences in hierarchical letter processing.
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Appendix A: Kaplan (1994) SRS scale

VICTORIA UNIVERSITY OF WELLINGTON
Te Whare Wananga o te Upoko o te Ika a Maui

Information Sheet

Lisa McLean           John McDowall
Masters Student       Senior Lecturer
Email: lisa.mclean@vuw.ac.nz          john.mcdowall@vuw.ac.nz

What is the purpose of this research?
• This research will allow us to examine how people process visual information.

What is involved if you agree to participate?
• If you agree to participate in this study you will be shown images of Navon letters (a large letter made up of smaller letters) and you will be asked to name either the large or small letter.
• We anticipate that your total involvement will take no more than 30 minutes.
• During the research you are free to withdraw, without any penalty, at any point before your data has been collected.

Privacy and Confidentiality
• We will keep your consent forms and data for at least five years after completion of the Masters thesis
• You will never be identified in my research project or any in any other presentation or publication. The information you provide will be coded by number only.
• In accordance with the requirements of some scientific journals and organisations, your coded data may be shared with other competent researchers.
• Your coded data may be used in other, related studies. A copy of the coded data will remain in the custody of Dr. John McDowall

What happens to the information that you provide?
• The overall findings may form part of a Masters thesis that will be submitted for assessment.
If you have any further questions about this study please contact Lisa McLean or Dr. John McDowall using the contact details above.

Thank you for your time.

I have read the information sheet and I give consent to my data being used in this study.
Signature ___________________
Date_____________
Student ID __ __ __ __ __ __ __ __ __

This questionnaire asks about people’s thoughts, rituals, and fears. Please be sure to read each question carefully and respond honestly.
Please circle one response alternative for each question.

<table>
<thead>
<tr>
<th></th>
<th>Almost never</th>
<th>A few times per week</th>
<th>Almost every day</th>
<th>Usually 1 to 5 times per day</th>
<th>Usually 5 to 20 times a day</th>
<th>Usually more than 20 times a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am plagued by thoughts or images that I cannot get out of my mind.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I believe something terrible may happen if I don’t double check.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sometimes I have a feeling that I may have done something terrible.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>There are times when I know something is true and yet I doubt it anyway.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>In order to feel right about it, I touch things a certain way or a certain number of times.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have obsessions that cause me great distress.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I feel compelled to perform certain actions, for no justifiable reason.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I check to see if I have made a mistake or done something terrible.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I go back to check lights, doors, gas jets or electrical appliances.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I repeat simple actions that, realistically, don’t need to be repeated.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I worry too much about things that would not bother most other people.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>If I do not do something correctly, I start over.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have an urge to touch.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have an urge to put things in order.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have an unreasonable compulsion to correct things or set things right.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have phobias that cause great trouble to me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please read each statement carefully and use the scale to indicate how often you experience the following.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each day I think too much about everyday information (such as timetables, names, dates, how things work, etc.).</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Everyday I wonder whether something</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Everyday I fret over pointless matters. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
My obsessions interfere with my daily functioning. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I feel overwhelmed by a need for precision or perfection. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I am greatly concerned for symmetry or order. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I have difficulty making decisions. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
My indecision and hesitation are disturbing and/or interfere with my daily life. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I am bothered by uncertainty. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
My mind is unsettled and full of doubt. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I feel very disturbed if I get some contaminated substance on me. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I am afraid that something terrible will happen if I don’t perform certain rituals. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
My rituals interfere with my daily functioning. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I do certain things thoroughly in order to get it just right. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I have the urge to wash myself after touching things that other people don’t worry about. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
Please read each statement carefully and use the scale to indicate how often you experience the following.  
Never | Rarely | Occasionally | Frequently | Always
---|---|---|---|---
I am greatly concerned with unseen dirt, germs, poisons or toxins. | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
I get very anxious about certain things, even though I know that realistically, | 0 | 1 | 2 | 3 | 4
---|---|---|---|---|---
nothing bad is going to happen.  

<table>
<thead>
<tr>
<th>I avoid certain situations because of my symptoms.</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>

| I am afraid of certain people, objects, or situations that other people normally do not consider dangerous. | 0 | 1 | 2 | 3 | 4 |