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Drawing ability in typical and atypical development; colour cues and the oblique effect

Emily K. Farran[1]

Georgina F. Dodd[2]

[1]Department of Psychology and Human Development, Institute of Education, University of London

[2]School of Psychology and Clinical Language Science, University of Reading

Address correspondence to:

Dr Emily K. Farran

Department of Psychology and Human Development

Institute of Education

25 Woburn Square

London WC1H 0AA

Tel: +44(0)207 6126272

E-mail: E.Farran@ioe.ac.uk

Abstract

Background. Individuals with Williams syndrome (WS) have poor drawing ability. Here, we investigated whether colour could be used as a facilitation cue during a drawing task.

Method. Participants with Williams syndrome (WS) and non-verbal ability matched Typically Developing (TD) children were shown line-figures presented on a 3 by 3 dot matrix, and asked to replicate the figures by drawing on an empty dot matrix. The dots of the matrix were either all black (control condition), or nine different coloured dots (colour condition). In a third condition, which also used coloured dots, participants were additionally asked to verbalise the colours of the dots prior to replicating the line drawings (colour-verbal condition).

Results. Performance was stronger in both WS and TD groups on the two coloured conditions, compared to the control condition. However, the facilitation effect of colour was significantly weaker in the WS group than in the TD group. Replication of oblique line segments was less successful than replication of non-oblique line segments for both groups; this effect was reduced by colour facilitation in the TD group only. Verbalising the colours had no additional impact on performance in either group.

Conclusion. We suggest that colour acted as a cue to individuate the dots, thus enabling participants to better ascertain the spatial relationships between the parts of each figure, to determine the start and end points of component lines, and to determine the correspondence between the model and their replication. The reduced facilitation in the WS group is discussed in relation to the effect of oblique vs. non-oblique lines, the use of atypical drawing strategies, and reduced attention to the model when drawing the replication.

Keywords

Williams syndrome, drawing, colour, visuo-spatial cognition, oblique lines

Drawing ability in typical and atypical development; colour cues and the effect of oblique lines

Introduction

Williams syndrome (WS) is a rare genetic disorder with a prevalence of 1 in 20, 000 live births (Morris & Mervis, 1999). One of the hallmark cognitive characteristics of WS is poor visuo-spatial cognition, relative to verbal cognition (Bellugi, Wang & Jernigan, 1994). In particular, individuals with WS are often reported to show poor drawing abilities (e.g. Bellugi, Sabo & Vaid, 1988). Many studies have used drawing as evidence to support the hypothesis that individuals with WS show a local processing bias within the visuo-spatial domain (e.g. Bellugi et al., 1988). This hypothesis states that individuals with WS attend to the details or parts of an image at the expense of the global or whole image. However, further evidence has shown that individuals with WS do not show a local bias at the level of perception (Farran, Jarrold & Gathercole, 2003), and it has been proposed that drawing ability is limited due to a difficulty replicating the spatial relations between elements of a drawing (e.g. Farran & Jarrold, 2005). More recent evidence against a local processing bias in WS has shown that when copying a line-picture of a house, individuals with WS replicate similar proportions of global elements as TD participants of the same level of non-verbal ability (Hudson & Farran, 2013a).

Recent in-depth analysis of how drawings are created in WS has demonstrated that the ability to use typical drawing strategies in WS interacts with the complexity of the to-be-drawn image. Individuals with WS use typical strategies when drawing simple figures, but then fail to use typical strategies for complex figures such as those with many spatial relations between the parts or with numerous intersecting parts (Hudson & Farran, 2011). Intriguingly, when asked to copy a model of a house (a complex figure), individuals with WS make far fewer looks to the model image than TD children matched for non-verbal ability (Hudson &

Farran, 2013a). It is likely that this inattention to the model has knock on effects on the ability to reproduce the model in a number of related ways. Infrequent attention to the model places additional demands on the visuo-spatial working memory system, an area of weakness in WS (e.g. Jarrold, Baddeley & Hughes, 1998). In turn, poor memory of the model impacts the ability to plan ahead and to organise the parts of an image. Finally, limited planning could lead to difficulty in replicating the spatial relations between parts.

One way in which drawing ability could be facilitated in WS is to use colour to individuate spatial locations within the to-be-drawn image. Nakumara et al. (2001) administered a drawing task to three individuals with WS, which was adapted from the Frostig Developmental Test of Visual Perception (Iibachi et al. 1979; Japanese version). Participants were shown a matrix of nine dots, in which some of the dots were joined by black lines to form an abstract figure comprised of 4 or 5 line segments. The participants were asked to replicate the figure on an empty dot-matrix. In one condition the nine dots in the model and response matrix were all black, and in a coloured condition the nine dots were all different colours. Results showed stronger performance in the coloured compared to the black condition. This facilitation effect is likely because the nine dots in the coloured condition were easier to identify individually than in the black condition. This helped to determine the correspondence in spatial locations between the model image and the response matrix, thus facilitating the poor spatial relational understanding in WS. It is also possible that participants were able to use a verbalisation strategy, by verbalising the colours of each of the dots, again helping to determine correspondence across the model and response matrices, and potentially reducing the requirement to attend to the model and putting less of a burden on visuo-spatial working memory (and more emphasis on their stronger verbal working memory).

However, Nakumara et al. (2001) only used a small number of trials, three participants with WS and did not include a control group. In support of Nakumara et al. (2001), Hudson and

Farran (2013b) provided a group of 17 individuals with WS with guide dots (a bit like a dot-to-dot template) as a facilitation aid to copy three overlapping figures; performance was stronger when the guide dots for each overlapping figure were a different colour (i.e. yellow guide dots for the circle, red for the square and blue for the diamond), than when they were all black. The effect of facilitation was comparable to that of TD participants of the same level of non-verbal ability. Thus, similar to Nakamura et al. (2001), this suggests that colour serves to facilitate replication of the model.

The current study is adapted from the task used by Nakumara et al. (2001). We investigated whether the benefit of using a coloured matrix as a cue for drawing observed in WS can be replicated, and how the benefit compares to any facilitation affects observed in the typical population. We also wanted to compare performance between oblique (diagonal) and non-oblique (horizontal and vertical lines), and how this might be impacted by the use of a coloured dot matrix. In the typical population, oblique lines are harder to discriminate among than non-oblique lines (Cecala & Garner, 1986), and the ability to draw oblique lines develops later than non-oblique lines (Beery, 1997). This 'oblique effect' (Appelle, 1972) is evident across perceptual, haptic and somato-vestibular systems (Gentaz et al., 2001). It has been suggested that orientation detectors are stronger for vertical and horizontal meridians (Dick & Hochstein, 1989). Relatedly, the oblique effect is considered a perceptuo-motor effect in which vertical (and horizontal) orientations are used as a reference norm thus biasing one's ability to reproduce oblique orientations towards the vertical norm (Gentaz et al., 2001). Evidence of a relative difficulty with oblique lines, i.e. an oblique effect, has been demonstrated in WS in discrimination and construction tasks (Farran, Jarrold & Gathercole, 2001; Farran & Jarrold, 2004; Palomares, Landau & Egeth, 2009), as well as in drawing, within the context of drawing diamonds and squares (Hudson & Farran, 2013b). In the current study, this predicts a relative difficulty in replicating oblique line segments versus non-oblique (horizontal and vertical) line segments.

Despite the perceptuo-motor origin of the oblique effect (Gentaz et al., 2001), a possible contributor to the effect of obliqueness relates to verbalisation strategies: it is more difficult to verbalise oblique lines than non-oblique lines. In English, words such as ‘diagonal’ do not differentiate positive and negative oblique angles, whilst non-oblique lines are readily distinguished verbally (horizontal, vertical, up, across, etc.). We were also interested in the potential impact of verbal labelling as a general strategy, but also with reference to oblique vs. non-oblique line segments. This is particularly relevant to WS, where there is a contrast between stronger verbal abilities relative to non-verbal abilities, and verbal labelling has been shown to bolster performance on non-verbal tasks (e.g. Farran, Blades, Boucher & Tranter, 2010). To this end a third condition was included in which participants were asked to name each of the coloured dots before commencing drawing.

Based on Nakumara et al. (2001) we predicted that individuals with WS would show stronger performance in the colour condition than the control (black dot) condition. We predicted that this would not be unique to the WS group, but would also be observed in typically developing controls of the same level non-verbal ability. If facilitation related to the use of a verbal strategy, this might predict a greater facilitation in the WS than the TD group, given the relative strength in verbal cognition in WS. If performance was stronger in the colour-verbal condition than the colour condition, this would suggest that participants were not spontaneously using a verbal strategy in the colour condition and that explicit naming of the colours introduced a verbal strategy. We also hypothesised that both groups would demonstrate a relative difficulty in replicating oblique versus non-oblique line segments; if verbal coding is used in the coloured dot conditions, this effect would be most apparent in the control condition. The rationale for this prediction is because the dots provide distinct start and end markers for each component line (perceptual facilitation) and, in verbalising the colours, participants might be able to overcome the inherent difficulty in verbalising oblique lines (verbal facilitation).

Method

Participants

Twenty-one participants with Williams syndrome (WS) were recruited from the records of the Williams Syndrome Foundation, UK. All participants had received a positive diagnosis of WS based on phenotypic and genetic information. Genetic diagnosis was based on a Fluorescent insitu Hybridisation (FISH) test (see Lenhoff, Wang, Greenberg & Bellugi, 1997). Participants with WS were individually matched to Typically Developing (TD) children by level of non-verbal ability, measured using the Raven’s Coloured Progressive Matrices (RCPM; Raven, 1993). This is an appropriate matching measure because individuals with WS show typical patterns of errors and developmental progression on this task (Van Herwegen, Farran & Annaz, 2011). Participants also completed the British Picture Vocabulary Scale II (BPVS; Dunn, Dunn, Whetton & Burley, 1997), as a measure of verbal ability. Participant details are shown in Table 1

Table 1 about here

Design and Procedure

For each trial, participants were presented with a line-figure depicted on a 3 by 3 matrix of dots (see Figure 1). The dots in the matrix were 5 mm in diameter and spaced 30mm apart, and the matrix was presented centrally on an A4 page of the test booklet. Participants were given a corresponding empty matrix on an A4 sheet of paper, on which to copy the line-figure. In the control condition, all dots in the matrix were black. For the colour and colour-verbal conditions, the same nine different colours were used. These were primary and secondary colours (red, blue, green, yellow, orange, purple, pink, white, brown), which are known to TD children by the age of 4 years (Pitchford & Mullen, 2002).

For all three conditions there were 4 difficulty levels, determined by the number of lines that each figure was comprised of, ranging from three lines (level 1) to 6 lines (level 4). There were four trials at each difficulty level. Oblique versus horizontal/ vertical lines featured at equal frequencies within line figures that had an even number of lines, and in line figures with an odd number of lines, one line type featured once more than the other line type, such that across each set of four trials oblique and horizontal/vertical lines featured at equal frequencies. In the colour and colour-verbal conditions, four different arrangements of dot colours were used and each featured once at each difficulty level. To equate difficulty level across conditions, but to also prevent practice effects, the line-figures used in the control condition were rotated 90 degrees to the left to create the line-figures used in the colour condition and 90 degrees to the right to create the line-figures used in the colour verbal condition.

In both the control and colour conditions, participants were simply asked to copy the line-figure onto their empty matrix. In the colour-verbal condition, prior to copying the first stimulus, participants were asked to name each of the colours of the dots on the matrix. If participants were unable to name all of the colours they would have been excluded, but in practise this was not necessary. Conditions were presented in a fixed order (control, colour, colour verbal) to prevent carryover effects from the colour verbal condition. A threshold procedure was used; in each condition participants proceeded to the next level if they completed three or four line-drawings out of four correctly (i.e. all lines of a line-drawing were present). As there were 4 levels, a maximum score of 16 could be achieved. To maintain attention, the task was made shorter by starting at level 2 (4 line-figures). For participants that passed level two they were credited with a score of four for level 1, and for participants that failed level 2, level 1 (3 line-figures) was administered and scored.

Results

Overall accuracy

Participants were awarded a score out of 16 (one point for each correctly replicated line figure) (see Table 2 for descriptive statistics). Examples of participant's drawings are shown in Figure 1.The data was bimodal (Kolmogorov-Smirnoff: $p<.05$ for all conditions for both groups) and so performance was compared across conditions and between groups using non-parametric analysis of ranked data. Friedman's ANOVA was carried out with condition (control, colour, colour-verbal) as a within-participant factor. This demonstrated a main effect of condition in both groups (TD: χ^2 (2)=22.12, $p<.001$; WS: χ^2 (2)=14.25, $p=.001$). For both groups, Wilcoxon paired comparisons demonstrated that this was due to higher scores in the colour and colour-verbal conditions than the control condition (WS, colour vs. control: $p=.002$, colour-verbal vs control: $p=.001$; TD colour vs. control: $p=.001$, colour-verbal vs control: $p=.001$), but no difference between the colour and colour-verbal conditions (WS: $p=.67$; TD: $p=.40$). However, independent samples comparisons between the two groups for each condition showed that the effect was more pronounced for the TD group. That is, for the control condition, Mann-Whitney showed no group difference, $N_A=21$, $N_B=21$, $U=175.50$, $p=.25$, but for the colour and colour-verbal condition the TD group outperformed the WS group (colour: $N_A=21$, $N_B=21$, $U=129.00$, $p=.012$; colour-verbal: $N_A=21$, $N_B=21$, $U=143.00$, $p=.03$).

Further analysis of the association between group and condition was carried out by categorising participants into those who scored above or below the median score of the TD group in the control condition, as shown in Figure 2. Chi-squared was carried out to determine whether there was an association between group (WS, TD) and low versus high scoring performance. This showed no association for the control condition, χ^2 (1) =0.87, p=.35, and a significant association in both the colour and colour-verbal conditions due to higher scores being associated with the TD group (colour: χ^2 (1)=5.46, p=.043; colour-verbal: χ^2 (1)=4.20, p=.04).

Figures 1 and 2 about here

Line type accuracy: oblique versus non-oblique line segments

All responses, correct and incorrect, were coded at a more detailed level by recording whether each oblique and non-oblique (horizontal and vertical) line segment was correct or incorrect/absent in participants' drawings, recorded as mean proportion correct across the line drawings attempted by each participant. The data was negatively skewed (Kolmogorov-Smirnoff: p<.05 for all conditions for both groups), thus nonparametric analysis follows.
As with analysis of overall accuracy above, Friedman's ANOVAs for each group demonstrated improvement across conditions (control, colour, colour-verbal) for both oblique and non-oblique line segments (WS oblique: χ^2 (2)=13.94, p=.001; WS non-oblique: χ^2 (2)=10.21, p=.01: TD oblique χ^2 (2)=9.39, p=.01; TD non-oblique: χ^2 (2)=8.20, p=.02). Overall, for both groups a higher proportion of non-oblique line segments were replicated than oblique line segments (Wilcoxon signed ranks test, WS: Z=-3.21, p=.001; TD: Z=-2.61, p=.01). To explore any changes in this effect across conditions, difference scores were created by subtracting the proportion correct non-oblique line segments from proportion correct oblique line segments. As difference scores were derived from proportion correct rather than angular deviation, signed difference scores were deemed most appropriate. A difference score of zero, therefore, represents no effect of obliqueness and the higher the difference score, the more non-oblique line segments over oblique line segments were

reproduced (negative difference scores were rare) (see Table 2 for descriptive statistics). Friedman's ANOVA with condition (control, colour, colour-verbal) as a within-participant factor demonstrated a main effect of condition in the TD group only (TD: χ^2 (2)=8.84, p=.01; WS: χ^2 (2)=1.61, p=.45) due to lower difference scores in the colour and colour-verbal conditions than the control condition (i.e. a reduced effect of obliqueness) (Wilcoxon, colour vs. control: p=.03, colour-verbal vs. control: p=.047), but no difference between the colour and colour-verbal conditions (p=.88).

The association between group and condition was assessed by categorising participants into those who scored above or below the median difference score of the TD group on the control condition, as shown in Figure 3. Chi-squared analyses of group (WS, TD) by low versus high difference scores were carried out for each condition. This showed no association for the control or the colour condition (control: χ^2 (1) =0.01, p=.76; colour: χ^2 (1)=1.62, p=.20), but a significant association in the colour-verbal condition due to lower difference scores being associated with the TD group (colour-verbal: χ^2 (1)=5.08, p=.02).

Discussion

Individuals with WS are able to use colour as a tool to facilitate their performance on a drawing task. That is, when presented with a line figure on a dot matrix, and asked to replicate the figure onto an empty dot matrix, performance was stronger when the dots were different colours than when they were all black. Comparison to the performance of TD children of the same non-verbal level of ability as the WS group showed that facilitation was observed in both groups, but that facilitation in the WS group was attenuated relative to the TD control group. That is, colour acted to perceptually organise the stimuli in a beneficial manner for both groups, with a stronger impact on TD, than WS performance. An effect of oblique lines was observed in both groups (i.e. oblique lines were correctly replicated less frequently than non-oblique lines), and the addition of colour reduced this effect in the TD group only. Comparison across the colour and colour-verbal conditions showed no overall additional facilitation of explicitly asking participants to verbalise the colours. This could suggest that the participants spontaneously adopted a verbalisation strategy once colour was introduced, but we cannot rule out that the introduction of colour simply enabled better perceptual organisation, and that verbalising the colours in the verbal colour condition was not sufficient to encourage verbal labelling. We return to this in our discussion of the advantage in replicating non-oblique over oblique line segments.

Performance on the control condition was comparable across the two groups in terms of overall accuracy and the presence of an effect of oblique lines. The TD group were matched to the WS group based on level of non-verbal ability, and so were much younger than the WS group. Thus, in line with previous studies, this demonstrates that drawing ability is not at an age-appropriate level and represents a relative weakness within the WS cognitive profile. Comparison across the two groups on the coloured conditions further extends our understanding of the drawing process itself in WS. On these conditions, the WS group performed at a lower level than the TD controls, i.e. performance was lower than predicted from their overall level of non-verbal ability. This is at odds with our prediction that the introduction of colour would encourage verbal strategy use, and thus would play to the verbal strengths of the WS group. This suggests that even when verbal facilitation could be employed, the weighting of the visuo-spatial perceptuo-motor demands remained relatively strong.

Our results extend the findings of Nakumara et al. (2001). We suggest that the use of colour made the dots easier to individuate than when the dots were all black. For both WS and control groups this improved their ability to determine the spatial relationships between the component lines in the line figures, as well as the start and end point of each component line, and aided participants' ability to determine the correspondence in spatial locations between the model image and the response matrix, i.e. it enhanced their perceptual organisation of the stimuli. However, the WS group did not benefit as much from colour cues as the TD group. We present three possible explanations for this, none of which are mutually exclusive. One explanation is that the WS group attended to the model less than the TD group, which limited the extent to which colour was able to facilitate performance, relative to the facilitation observed in the TD group. That is, although using colour reduced the requirement to attend to the model, this was not sufficient to overcome the reduced attention to the model observed in WS on drawing tasks (see Hudson & Farran, 2013a), with knock-on effects on working memory and planning demands.

A second possible explanation for the reduced effect of colour in the WS group could relate to the complexity of the figures. Research has shown that the ability to use a typical drawing strategy is dependent on the complexity of the to-be-copied figure, with complex figures inducing atypical strategies in WS (Hudson & Farran, 2011). We did not record participant's completion strategies at a line-by-line level (e.g. starting point, pen lifts, etc). However, if the WS group were not using a typical completion strategy on the current task (perhaps due to the demands on their visuo-spatial working memory and planning abilities) this also might have confounded any potential improvement brought about by the use of colour cues.

A third possible explanation for the reduced effect of colour in the WS group is that the TD group were additionally employing a verbalisation strategy, but the WS groups were not. This is discussed below in relation to the oblique effect.

At first blush, the attenuated facilitation in the WS group in the current study appears to contrast to Hudson and Farran (2013b), in which WS and non-verbal matched TD controls showed similar facilitation by colour. Hudson and Farran (2013b) used colour to perceptually group guide-dots of each of the three to-be-drawn shapes together. Perceptual grouping is a pre-attentive process which enables individuals to attend to relevant information (in this context, the guide-dots relevant to each overlapping object), and to recognise objects. In contrast, colour was used in the current study to individuate the dots in the matrix, to facilitate participants when matching the model to their drawing and when replicating spatial relations. Thus, although both methods acted to reduce memory and attentional demands, it appears that when colour is used to group elements together it has a more typical beneficial effect in WS than when colour is used to individuate items.

Interestingly, the TD group showed an interaction between the effect of oblique lines and facilitation by the coloured dot matrix. That is, on the introduction of the coloured dot matrix the advantage in replicating non-oblique lines over oblique lines reduced in the TD group. We suggest that the coloured dots served to indicate the start and end points of each line, as well as providing verbal cues and that this was particularly beneficial to oblique lines on account of children's difficulty discriminating the direction of oblique lines (Cecala & Garner, 1986). Thus, despite the perceptuo-motor origin of the oblique effect this suggests that a degree of compensation is possible via verbal facilitation, although replication is required in order to fully support this claim. For the WS group, the effect of oblique lines was consistent across conditions. Thus, accuracy improved for both oblique and non-oblique line replication across conditions, but oblique lines remained harder to replicate than non-oblique lines. This suggests, in contrast to the TD group, that the difficulties inherent in encoding oblique lines could not be overcome by individuation of start and end points.

The difference in the pattern of results between the WS and TD group also speaks to whether the overall effect of facilitation by colour reflected verbal strategy use. If the introduction of colour encouraged spontaneous verbal coding, this could predict a reduced oblique effect for colour compared to control conditions. This is because difficulty in verbalising positive vs. negative diagonal directions might be ameliorated by the opportunity to verbalise the colour of the start and end points instead. We could tentatively suggest, therefore, that the TD group were using a verbal strategy. Statistically, the effect of obliqueness differed between groups for the colour-verbal condition only. This could also suggest that there were some additional benefits of explicit verbalisation in the TD group. However, since there was no statistical change in the effect of oblique lines between the colour and colour-verbal conditions for the TD group (or the WS group), this effect is considered with caution.

In contrast to the TD group, the lack of interaction between colour and the effect of oblique lines in the WS group could indicate that the WS group were facilitated by colour due to enhanced perceptual organisation only, and did not employ verbal coding, and that this facilitation was not sufficient to impact the perceptual difficulties related to oblique lines. This contrast between the WS and TD group aligns with Farran and Jarrold (2004) in which individuals with WS presented an atypical effect of obliqueness, relative to TD children. With reference for the three possible explanations for the reduced effect of colour in WS presented earlier, the group differences in the effect of oblique lines support a verbal coding hypothesis. However, this does not rule out that reduced attention to the model and / or stimulus complexity also impacted the effect of colour in WS. Clearly, further studies are required to fully explore the impact of increased perceptual organisation vs. verbal coding on the oblique effect. This could be accomplished by including articulatory suppression during the colour condition.

Considered as a whole, we have provided evidence of qualitative differences in the benefits of facilitation in the TD and WS groups. For the TD group the coloured dot matrix improved overall accuracy, and reduced the effect of obliqueness. For the WS group the coloured dot matrix improved overall accuracy, albeit in an attenuated manner relative to the TD group, but did not impact the effect of obliqueness.

In summary, despite limitations, drawing performance can be improved in WS by using colour as a cue. Colour has also recently been shown to be a useful cue for individuals with WS in a spatial navigation task (Farran, Courbois, Van Herwegen, Cruickshank & Blades, 2012). In both the current task and the navigation task, colour enabled participants to organise the visual scene, enabling them to improve their ability to complete the task. Because the names of focal (primary and secondary) colours are learnt relatively early (Pitchford & Mullen, 2002), and colours can be easily applied to any visual stimuli, we suggest that applying colour cues to visuo-spatial tasks has the potential to provide a useful facilitation device within the poor visuo-spatial domain in WS, as well as in other neurodevelopmental disorders.

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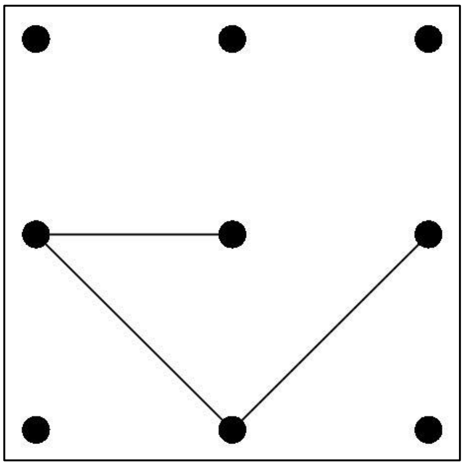
Table 1:
Participant details for Williams syndrome (WS) and typically developing (TD) groups: Chronological age (CA), British Picture Vocabulary Scale (BPVS) raw scores and Raven's Colored Progressive Matrices (RCPM) raw scores.

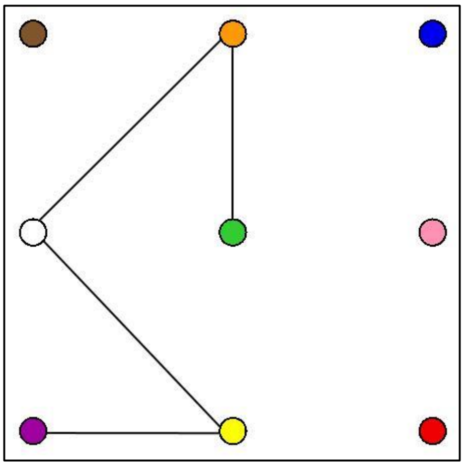
	CA in years; months	BPVS raw score	RCPM raw score
	Mean (standard deviation)		
WS (N=21)	24;11 (10;03)	101.62 (22.19)	17.71 (6.02)
TD (N=21)	5;07 (0;07)	64.90 (13.07)	17.23 (5.22)

Table 2:
Descriptive statistics for overall accuracy and line type accuracy

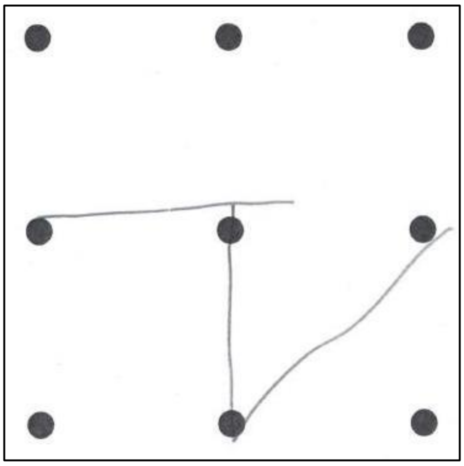
	Overall accuracy (number correct out of 16)					
	Mean (S.D.)			Median (range)		
	control	colour	colour verbal	control	colour	colour verbal
WS	8.33(6.96)	10.81(5.89)	10.62(6.52)	11(0-16)	14(0-16)	15(0-16)
TD	9.52 (6.62)	14.67(3.15)	14.24(4.05)	14(0-16)	16(5-16)	16(3-16)
	Line type accuracy (difference scores: proportion correct non-oblique minus proportion correct oblique)					
	Mean (S.D.)			Median (range)		
	control	colour	colour verbal	control	colour	colour verbal
WS	0.12(0.17)	0.07(0.16)	0.03(0.11)	0.22(-0.03-0.5)	0.00(-0.13-0.67)	0.00(-0.33-0.28)
TD	0.09(0.13)	0.02(0.06)	0.04(0.13)	0.03(-.08-0.41)	0.00(-0.08-0.20)	0.00(-0.08-0.58)



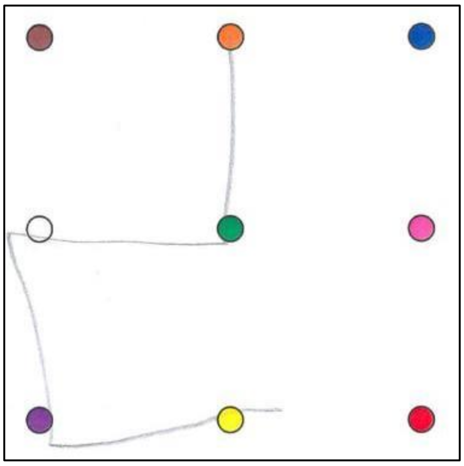
a) 3-line figure, control condition



b) 4-line figure, colour condition



c) Drawing: TD (6;02 years;months



d) Drawing:WS (14;02 years;months)

Figure 1: Example model figures with corresponding participant responses

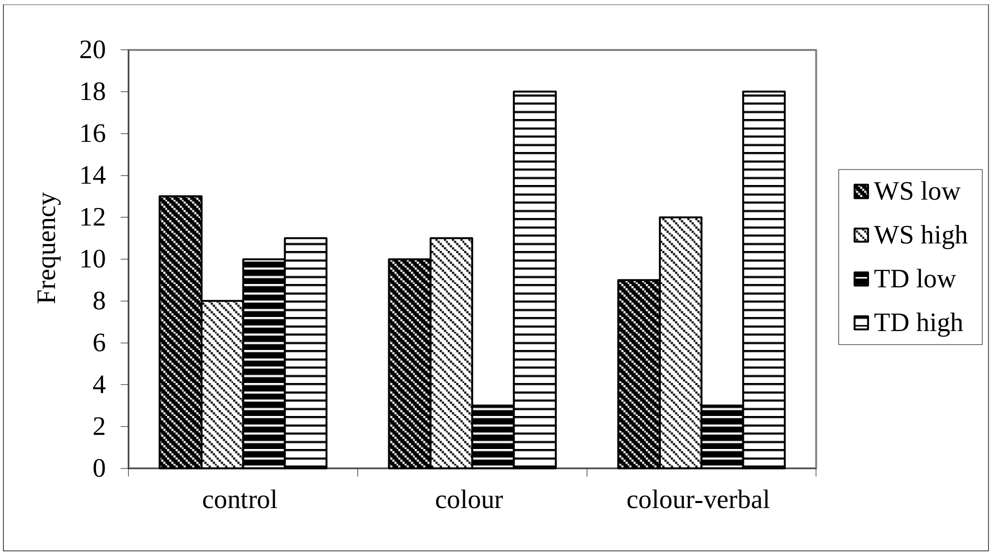


Figure 2: Overall accuracy: Frequency of participants achieving a low score and a high score in each condition.

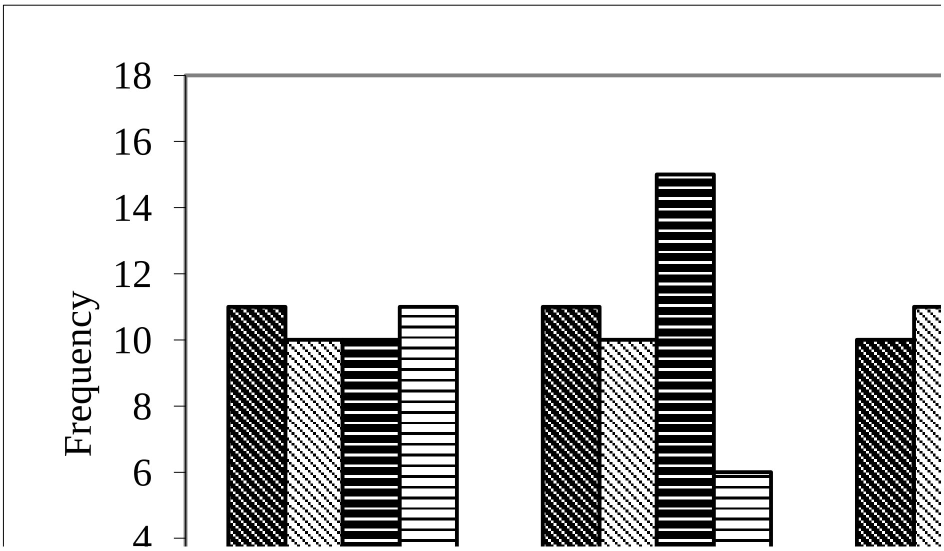


Figure 3: Line type accuracy difference scores: Frequency of participants achieving a low difference score and a high difference score in each condition.