Children with autism show a reduced category contrast effect

Categorization abilities in autism

Autism spectrum disorders (ASDs) are relatively common neurodevelopmental conditions associated with atypical learning processes. The current study focuses on one aspect of these, the ability to categorize novel instances.

Individuals with ASD who are high functioning can categorize novel stimuli. Categorization performance has been reported variably as being entirely typical (Sociour et al., 2007), initially less accurate but eventually typical (Sociour et al., In Press; Vladusich et al., In Press) or even enhanced for certain stimuli (Bonnel et al., 2003). It is possible however, that impairment in applying context to these kinds of categorization tests will be observed. This prediction is derived from the weak central coherence account of autism (Happe, 1997; Happe & Frith, 2006); specifically the notion that individuals with ASD have trouble integrating information in context.

The Context in, the form of prior learning trials, influences categorization performance to produce sequence effects. We used a paradigm designed to induce a category contrast effect (Stewart et al., 2002) to detect sequence effects in a categorization task.

The Category Contrast Effect

This effect is a key prediction of the memory and contrast (MAC) model (Stewart et al.) that aimed to show how relative magnitude information may be used in uni-dimensional binary categorization tasks. The prediction concerns responses to borderline stimuli: Stimuli preceded by a distant member of the other category will be categorized more accurately than those preceded by a distant member of the same category.

Stewart et al demonstrated support for the prediction with a categorization task using 15 pure auditory tones with feedback provided after each tone. See Figure 1.

*The more recent “recalled stimulus MAC model” disregards magnitude information (Stewart & Brown, 2004). According to this model contrast effects arise following Trial n-1 stimuli that are “sign useless”. i.e. feedback on Trial n-1 cannot be used to predict the category of Trial n with certainty. The optimal strategy of switching category labels after a “sign useless” Trial n-1 with p > .5 produces a contrast effect.

We presented the category contrast effect paradigm to two participant groups: one ASD and one typically developing. If individuals with ASD show reduced sensitivity to context, as predicted by the weak central coherence account, they should show a reduced category contrast effect relative to the comparison group.

Method

Participants

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*Participants group differences were not significant (Min P = .5; Paired t-test). Participants were recruited from specialist and mainstream schools. Diagnoses for the ASD group were made by clinicians using DSM-IV or similar criteria. For all participants, the total score on the Autism Diagnostic Observation Schedule met or exceeded that for autism spectrum cut-off.*

Stimuli

Stimuli were ten 500 ms sine wave auditory tones. Frequency varied from Tone 1 = 550Hz to Tone 10 = 657.30 Hz. Each frequency represented an increase of 2% from the immediately lower tone. Tones were presented by laptop computer and played over Sennheiser PX250 headphones.

Design & Procedure

The tones were divided into two categories: the five lowest and five highest were assigned to LOW and HIGH categories respectively. Tones were presented in pseudo random sequences, each of 20 trials. SAME category pairs (Tones 1 & 5, and 6 & 10) and DIFFERENT category pairs (Tones 1 & 4 & 6 & 9) occurred once in each sequence.

Each sequence was selected at random from the set of 42 sequences used by Stewart et al. (2002). Participants completed 6 blocks of 20 trials with an optimal rest period every two blocks. Each trial began simultaneously with tone onset and the category labels “LOW” and “HIGH” on screen. Participants responded by pressing either the F or L key. See Figure 2 for an illustration of screen events for each trial.

Stimuli preceded by a distant member of the other category will be categorized more accurately than those preceded by a distant member of the same category. Moreover, a reduced category contrast effect was observed. See Figure 3 below.

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Results

The prediction that individuals with ASD would show a reduced category contrast effect was supported. See Figure 3 below.

- A mixed repeated measures ANOVA on Group (ASD, Comparison) and Category (Same, Different) revealed a significant Group by Category interaction: F(1,27) = 5.71, p = .024. The comparison group showed a contrast effect: t(13) = 7.44, p < .001, but the ASD group did not: t(14) = 1.59, p = .13. (Removal of 3 ASD children with CA > 12 years yielded same pattern of findings.)

- The ASD group showed slightly reduced categorization accuracy on filler items. Mean proportion of accurate items (SD) for ASD group = 78.6 (16); for comparison group = 83.45 (15). The difference in means was not significant:

- Figure 4 illustrates that both groups showed broadly similar classification curves. A mixed repeated measures ANOVA on Group (ASD, Comparison), Category (Low, High) and Filter Item (Tone Nos: 1, 2, 3, 4, 7, 8, 9, 10) revealed no significant group effects.

Discussion

The finding of a reduced category contrast effect in ASD supports the prediction derived from the weak central coherence account of autism: specifically that there will be a reduced influence of context.

Despite evidence of a weakened contrast effect, ASD categorization performance remained successful. This observation raises the question of what is driving ASD categorization performance.

The ASD group may rely more upon absolute magnitude information than the comparison group.

Alternatively, individuals with ASD may utilize sign-useful trials, but adopt a guessing strategy. Immediately following sign-useless trials: switching labels with p = .5, rather than the optimal probability of p = .5. This possibility would be consistent with the finding that ASD individuals favor guessing strategies in early trials (Sociour et al., In Press).

The reduced sequence effects described in the current study may account for the delays in achieving categorization accuracy described earlier (Sociour et al., In Press; Vladusich et al., In Press).

In addition, reduced sequence effects may contribute to impairments in ASD performance on tasks consisting exclusively of sign-useless trials, such as those presented for tone duration estimation (Martin et al., 2010).

References


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