Removal of negative feedback enhances WCST performance for individuals with ASD

Jaclyn Broadbent *, Mark A. Stokes

School of Psychology, Deakin University, Australia

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ABSTRACT

Negative feedback was explored as a potential mechanism that may exacerbate perseverative behaviours in individuals with Asperger's syndrome (AS). The current study compared 50 individuals with AS and 50 typically developing (TD) individuals for their abilities to successfully complete the Wisconsin Card Sorting Task (WCST) in the presence or absence of negative feedback. The results revealed that negative feedback led to perseveration in individuals with AS. When negative feedback was removed from the WCST, performance by individuals with AS was enhanced, and was no different to that of the TD individuals under the same conditions. These results suggest negative feedback may impair learning in persons with AS, and prevent the development of more effective strategies in many life domains.

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Perseveration was first considered a key feature of autism by Kanner (1943), who observed that individuals with autism displayed behaviours that indicated a need for sameness, resistance to change, and stereotyped and ritualistic behaviours. These traits confer strengths to some degree on individuals with autism spectrum disorders (ASD); the ability to focus intently on aspects of their environment, to take in voluminous information, and to display great attention to detail (Happé & Frith, 2006). However, such perseverative traits may also explain why individuals with ASD have difficulty in regulatory functions; shifting focus of attention, modifying behaviour appropriately, or inhibiting familiar, over-learnt responses, once engaged in an activity (Ozonoff, 1995). This pervasive cognitive and behavioural rigidity across functional domains has become a diagnostic feature of autism (Geurts, Corbett, & Solomon, 2009).

One task used to assess perseveration is the Wisconsin Card Sorting Task (WCST; Grant & Berg, 1948; Heaton, Chelune, Talley, Kay, & Curtiss, 1993; Hill, 2004; Liss et al., 2001; Ozonoff, 1995, 1997). The task represents a test of concept formation in which the participant must identify the clandestine rule determining the correct response. This is achieved over successive trials with verbal feedback from the experimenter, where the rule is subject to arbitrary modification without warning. These sudden and unprepared changes of clandestine rule challenge the participant's executive function, as they require the participant to change their response strategy (Anonkhin, Golosheykin, Grant, & Heath, 2010; Hendry, 2006; Ozonoff, 1997; Pennington & Ozonoff, 1996; Poljac et al., 2010). This tests the ability to develop and maintain appropriate problem-solving strategies and attention across changing stimulus conditions, while inhibiting inappropriate responses (Poljac et al., 2010).

Cognitive inflexibility on the WCST is commonly measured through two key perseveration scores; perseverative responses (PR) and perseverative errors (PE; Grattan & Eslinger, 1989). Perseverative errors measure the number of times a

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* Corresponding author at: School of Psychology, Faculty of Health, Deakin University, 221 Burwood Hwy, Burwood 3125, Australia. Tel.: +61 3 9244 3043; fax: +61 3 9244 6858.

E-mail addresses: jaclyn.broadbent@deakin.edu.au, jaqi@deakin.edu.au (J. Broadbent).

participant persists in responding to a stimulus characteristic that is incorrect. Perseverative response is measured when a participant persists in responding to a stimulus characteristic and may include incorrect and correct responses (Heaton et al., 1993).

Performance on the WCST by individuals with ASD highlights their perseveration particularly when their performance on the WCST is compared to that of other groups. For example, individuals with ASD have been shown to persevere longer in their sorting strategy than typically developing (TD) individuals (Minshew, Myer, & Goldstein, 2002; Pascualvaca, Fantie, Papegeorgiou, & Mirsky, 1998; Prior & Hoffman, 1990; Ozonoff & Jensen, 1999; Rumsey, 1985; Shu, Lung, Tien, & Chen, 2001). Individuals with ASD were also been found to persevere longer than other groups, such as those with learning disabilities (Bennetto, Pennington, & Rogers, 1996; Hughes, Russel, & Robbins, 1994; Liss et al., 2001; Ozonoff, Pennington, & Rogers, 1991; Rumsey & Hamburger, 1990), individuals with ADHD (Geurts, Verté, Oosterlaan, Roeyers, & Sergeant, 2004; Ozonoff & Jensen, 1999; Tsuchiya, Oki, Yahara, & Fujieda, 2005; Yang, Zhou, Yao, Su, & McWhinnie, 2009), and Tourette's syndrome (Ozonoff & Jensen, 1999). Even when control participants and persons with ASD are matched on full scale intelligence quotient (IQ), nonverbal age, and socio-economic status (Liss et al., 2001), age, IQ, socio-economic status and gender (Minshew et al., 2002), and verbal or performance mental age (Pascualvaca et al., 1998), individuals with ASD have been shown to persevere for significantly longer times. These results suggest perseveration is a direct consequence of autistic symptomology rather than a consequence of co-morbid deficits in other areas.

However, there is a possible limitation regarding the learning style needed, which is inherent to the test itself that has not been previously considered, and that may be exacerbating this poor performance. The WCST relies upon trial and error learning, which is believed to be based upon operant conditioning. Operant conditioning works on the premise that behaviour 'operates' in its environment and is maintained by its consequences (Keller & Schoenfeld, 1950). Among the elucidated principles of operant conditioning is the principle that behaviours associated with positive reinforcement, or the removal of negative reinforcement, are more likely to be repeated. Conversely, it is argued that when behaviour is punished, the likelihood of the behaviour reoccurring decreases (Candland & Campbell, 1961; Kelleher & Gollub, 1962). Importantly, however, what serves as a punishment or reinforcement is determined as a result of the actions of the individual (Candland & Campbell, 1961). For example, a child may have a tantrum to get his/her parent's attention. If the parent gives the child lots of attention (by reprimanding the child), then the child is likely to engage in the same behaviour in the future in order to gain the parent's attention. Thus, in this instance, the target action would increase, indicating that the behaviour was reinforced rather than punished (as the parents may have hoped). In the case of the WCST, the theoretical underpinnings assume participants will be reinforced by the word "correct" (which will increase or strengthen the desired response) and undesirable responses (such as incorrect sorting strategies) will be weakened by hearing "incorrect", which serves as a punishment. It further assumes that participants will use this information to identify a new rule and change sorting strategies accordingly.

For TD individuals, there is a long history of research that has investigated the relative efficacy of positive and negative feedback (cf. Ashby & O'Brien, 2007) in tasks similar to the WCST. In studies that examine learning acquisition under reinforcement combinations (correct-incorrect vs. correct-blank; where blank represents no feedback in the place of incorrect) it was found that TD individuals learn more slowly under correct-blank conditions than correct-incorrect conditions (Buchwald, 1959; Buss & Buss, 1956; Curry, 1960; Spence, 1964, 1966; Spence & Dunton, 1967; Spence, Lair, & Goodstein, 1963; Spence & Segner, 1967). This still holds even when verbal rewards are substituted for candy and punishments are substituted with a loud noise (Spence & Dunton, 1967; Spence & Segner, 1967). Further, Buss and Buss (1956) and Curry (1960) found that positive and negative feedback in combination was more effective for learning than positive feedback alone, when using a modified version of the WCST for TD individuals. These studies, and the current study, give support to the view that receiving both positive and negative feedback is a better learning aid than receiving positive feedback alone for TD individuals.

Individuals with ASD have also shown enhanced performance in the presence of positive feedback (Baltruschat et al., 2011a, 2011b; Demurie, Roeyers, Baeyens, & Sonuga-Barke, 2011; Freitag, 1970; Garretson, Fein, & Waterhouse, 1990). Baltruschat and colleagues (2011a, 2011b) examined the use of positive reinforcement for improving performance on working memory tasks – a common executive functioning deficit seen in individuals with ASD. The authors found considerable improvements in performance were obtained when the child received positive feedback (in the shape of an identified highly preferred toy or food item) for every correct response given. Furthermore, studies have shown that performance by autistic individuals on tasks can be improved with the introduction of social, and more so, tangible rewards during the task (Demurie et al., 2011; Garretson et al., 1990).

Despite the research on positive feedback, to date, there has been little consideration given to the possibility that the reinforcement and motivational factors associated with negative feedback may not be as relevant or may be interpreted differently by individuals with ASD. There is a small, but growing body of evidence in the romantic attachment literature that suggests that perseverative behaviours in individuals with ASD may actually be reinforced by negative feedback they receive (Church, Alisanki, & Amanullah, 2000; Green, Gilchrist, Burton, & Cox, 2000; Stokes, Newton, & Kaur, 2007); namely, that persistent behaviour is not discouraged in the presence of negative feedback. For example, Church et al. (2000) and Green et al. (2000), reported that ASD individuals are overly persistent in their pursuit of a romantic target (e.g. intrusive following and stalking like behaviour), in spite of negative feedback (complaints) expressed by the targets. Moreover, Stokes et al. (2007) found that compared to TD individuals, individuals with high-functioning Autism reported they would persist longer in their pursuit of a romantic target of interest as the degree of resistance and negative feedback from the target increased. Further many researchers acknowledge the harassing and stalking behaviour displayed by individuals with an ASD despite