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Interference with facial emotion recognition by verbal but not visual loads

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ABSTRACT

The ability to recognize emotions through facial characteristics is critical for social functioning, but is often impaired in those with a developmental or intellectual disability. The current experiments explored the degree to which interfering with the processing capacities of typically-developing individuals would produce a similar inability to recognize emotions through the facial elements of faces displaying particular emotions. It was found that increasing the cognitive load (in an attempt to model learning impairments in a typically developing population) produced deficits in correctly identifying emotions from facial elements. However, this effect was much more pronounced when using a concurrent verbal task than when employing a concurrent visual task, suggesting that there is a substantial verbal element to the labeling and subsequent recognition of emotions. This concurs with previous work conducted with those with developmental disabilities that suggests emotion recognition deficits are connected with language deficits.

Emotional recognition has been suggested to be impaired across a wide range of developmental and intellectual disabilities (see Gross, 2004; Collin, Bindra, Raju, Gillberg, & Minnis, 2013). For example, deficits in recognizing emotions from the faces of others have been found in individuals with Autism Spectrum Disorders (Bal et al., 2010; Harms, Martin, & Wallace, 2010; Hobson, Ouston, & Lee, 1989), Down syndrome (Dimitriou, Leonard, Karmiloff-Smith, Johnson, & Thomas, 2014; Kasari, Freeman, & Hughes, 2001), intellectual disabilities and impairments (Gross, 2004; Loveland et al., 1997; Moore, 2001), and Williams syndrome (Dimitriou et al., 2014; Williams, Wishart, Pitcairn, & Willis, 2005). Problems with emotional recognition are associated with a range of further difficulties for these individuals, including social functioning (e.g., Jawaid et al., 2012), social isolation (Bauminger, 2003; Howlin, Mawhood, & Rutter, 2000), mental health and well-being (Baker, Montgomery, & Abramson, 2010; Denham & Holt, 1993), and they also provide an indicator of academic success (Raver & Knitzer, 2002; Reed & Osborne, 2014). Thus, understanding the factors that contribute to facial emotional recognition deficits is of some theoretical and practical importance.

There are many individual differences in the pathways that allow or hinder facial emotional recognition, including cognitive processing, motivation, and emotional state (see Adolphs, 2001). In terms of developmental disabilities, deficits in intellectual (Harms et al., 2010; Moore, 2001) and language (Loveland et al., 1997; Nelson, Welsh, Trup, & Greenberg, 2011) ability have been implicated in causing emotional recognition deficits. For example, Moore (2001) suggested that

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emotional-recognition deficits may be primarily due to associated intellectual problems involving memory and attention in individuals with developmental disorders. In support of this suggestion, it has been found that differences in facial emotional recognition between those with Autism Spectrum Disorders (ASD) and comparison groups are less pronounced when intellectual functioning across the groups is matched (see Loveland et al., 1997; Harms et al., 2010). Alternatively, differences in facial emotion recognition have been found to depend upon the level of verbal ability of the individual in question (Harms et al., 2010). Braverman, Fein, Lucci, and Waterhouse (1989), and by Ozonoff, Pennington, and Rogers (1990) observed no differences in recognizing facial emotions by children with ASD and controls when each group was matched for verbal ability. Moreover, strong reliance on verbal information in recognizing facial emotions has also been noted in low-functioning individuals with ASD by Loveland et al. (1997), and impairments in the ability to label emotions have been thought to be a driver of emotional recognition deficits in individuals with ASD (Hale & Tager-Flusberg, 2003; Sigman, Kasari, Kwon, & Yirmiya, 1992). However, as these two abilities are often strongly associated with one another, it is difficult to tease them apart in terms of their impact on facial emotion recognition.

Individuals with developmental disorders often have deficits in multiple domains, and it could be that it is the summed impact of these deficits, or interactions between them, that produces attenuation of facial emotional recognition. Consideration of such potential confounds can make using such a sample problematic for the investigation of which aspects of cognitive processing are implicated in these deficits. The importance of both intellectual and verbal ability to the recognition of facial emotions has also been noted for individuals who do not have a developmental or intellectual disability (see Edmonds, Glisky, Bartlett, & Rapcsak, 2012; Nelson et al., 2011). It may be that manipulating the degree to which individuals are able to engage in particular cognitive processing activities by imposing different types of cognitive loads, could facilitate understanding about the processing requirements for facial emotion recognition. For example, if a load that impacts verbal functioning has an impact on facial emotion recognition, but another type of load that requires processing capacity but which does not impact verbal processing does not, then this might suggest that verbal processing skills are more important than general cognitive resources. In turn, this may help to highlight the problems that might be experienced by individuals with complex developmental delays (see Broomfield, McHugh, & Reed, 2008; Reed & Gibson, 2005, for discussions of this potential approach).

There are some experimental investigations of facial emotion recognition that have employed typically-developing individuals, and have manipulated their cognitive capacity by the application of a concurrent task (e.g., Doherty-Sneddon, Bonner, & Bruce, 2001; May, Kennedy, Williams, Dunlap, & Brannan, 1990). These studies have noted that while a concurrent task does not reduce the ability to identify emotions from whole faces (e.g., Doherty-Sneddon et al., 2001), it does result in the reduced ability to recognize emotions from facial elements (May et al., 1990). In particular, May et al. (1990) noted that increased additional cognitive load reduced the number of eye movements across a face resulting in reduced sampling of elements. This latter phenomenon is highly similar to that observed in the sampling of any complex stimulus under conditions of reduced cognitive capacity (see Reed & Gibson, 2005), and is referred to as over-selectivity (e.g., Broomfield et al., 2008; Cumming & Berryman, 1965; Reed, Broomfield, McHugh, McCausland, & Leader, 2009; Thomas & Jordan, 2004). Cumming and Berryman (1965) and Cumming and Berryman (1965; see also Thomas & Jordan, 2004) suggested that the capacity to attend to the multiple stimuli present in facial emotions is essential for understanding social concepts, but that over-selective responding may impede this ability.

The over-selectivity literature allows a suggestion to be made regarding the discrepancies in the impact of cognitive loads on facial emotion recognition. When the emotional recognition process is well-learned, sampling one facial feature may be enough to correctly recognize an emotion. However, when this ability is less developed, as in developmental disorders and intellectual disabilities (e.g., Gross, 2004; Collin et al., 2013; Harms et al., 2010), or when cognitive resources are taken up by a concurrent load and an unhelpful facial element is selected by which to recognize the emotion, then facial emotional recognition may be impaired. This might explain why some reports suggest unimpaired whole face recognition with concurrent load (Doherty-Sneddon et al., 2001), but others report impaired elemental recognition (May et al., 1990). This literature also points to the role of language difficulties rather than intellectual impairment as a key factor in producing over-selective responding (see Kelly, Leader, & Reed, 2015), but it is not known if this would also apply to recognition of facial emotions.

In terms of the elements of the face that may or may not be helpful in recognizing emotion, emotional recognition deficits in typically developing individuals are greatest when individuals are asked to recognize the emotions from the upper portion of faces, and that this holds for most types of emotion (Bassili, 1979; Dunlap, 1927). This effect is also noted for individuals with developmental delays and ASD, particularly when asked to recognize emotions from the eyes (Gross, 2004), which they have been noted to avoid (Graham & LaBar, 2012). A similar effect has been noted with individuals with other forms of developmental disability such as Down and Williams syndromes (see Annaz, Karmiloff-Smith, Johnson, & Thomas, 2009). Thus, it may be that particular areas of the face are differentially selected by those with reduced cognitive processing capacities.

Given all of the above considerations, the current study had two main aims. The first aim was to examine the effects of different types of cognitive load on facial emotional recognition in order to examine the different cognitive systems that may be implicated in this process. Whereas it is known that the presence of a cognitive load sometimes impacts ability to recognize facial elements (May et al., 1990), it is not known which types of cognitive load will have this impact, and which potential systems are responsible for such an impact. Therefore, the impacts of two different cognitive loads were compared – a verbal load and a concurrent visual load – in order to assess which would impact facial emotion recognition to a greater