



## Research report

# Covert face recognition in congenital prosopagnosia: A group study

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## ARTICLE INFO

## Article history:

Received 4 August 2010

Revised 20 October 2010

Accepted 13 January 2011

Action editor Stefan Schweinberger

Published online 22 January 2011

## Keywords:

Covert recognition

Face recognition

Forced choice task

Priming task

Prosopagnosia

## ABSTRACT

**Introduction:** Even though people with congenital prosopagnosia (CP) never develop a normal ability to “overtly” recognize faces, some individuals show indices of “covert” (or implicit) face recognition. The aim of this study was to demonstrate covert face recognition in CP when participants could not overtly recognize the faces.

**Methods:** Eleven people with CP completed three tasks assessing their overt face recognition ability, and three tasks assessing their “covert” face recognition: a Forced choice familiarity task, a Forced choice cued task, and a Priming task.

**Results:** Evidence of covert recognition was observed with the Forced choice familiarity task, but not the Priming task. In addition, we propose that the Forced choice cued task does not measure covert processing as such, but instead “provoked-overt” recognition.

**Conclusions:** Our study clearly shows that people with CP demonstrate covert recognition for faces that they cannot overtly recognize, and that behavioural tasks vary in their sensitivity to detect covert recognition in CP.

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## 1. Introduction

Individuals who do not report a history of brain injury yet have severe difficulties recognising faces are known as developmental (DP) or congenital prosopagnosics (CP) (Behrmann and Avidan, 2005; McConachie, 1976; Duchaine, 2000). As many as 2–3% of the general population may find it very difficult to recognize faces (Bowles et al., 2009; Kennerknecht et al., 2006) and these difficulties can run in families (Schmalzl et al., 2008; Lee et al., 2010; Grueter et al., 2007). The impairment can be restricted to the recognition of facial identity, with no impairment recognising other facial cues such as expression

and eye gaze (Duchaine et al., 2003a, 2003b; Duchaine et al., 2009; Humphreys et al., 2007; Lee et al., 2010) or discriminating between other similar objects (Duchaine and Nakayama, 2005). However, in some cases face recognition impairments co-exist with more general difficulties in non-face (i.e., object) recognition (Duchaine et al., 2007; Lobmaier et al., 2010; Wilson et al., in press) or with difficulties perceiving biological motion (Dobel et al., 2007; Lange et al., 2009).

Whereas individuals with CP have failed to develop an adequate face recognition system, those with acquired prosopagnosia (AP) find themselves unable to recognize faces

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doi:10.1016/j.cortex.2011.01.005

after brain damage resulting from incidents such as stroke or anoxia (Barton, 2008). Individuals with AP have severe deficits of overt (explicit) face recognition, in that previously familiar faces no longer give rise to feelings of familiarity and patients are unable to provide names or other identifying autobiographical information. However, some APs demonstrate covert (or implicit) recognition (see Schweinberger and Burton, 2003 for review). Covert recognition in AP has been demonstrated with physiological measures, as well as with different behavioural techniques. The most commonly used physiological technique to assess covert face recognition is the measurement of autonomic activity through Skin Conductance Responses (SCRs). Some people with AP display larger SCRs for familiar than unfamiliar faces (Tranel and Damasio, 1995; Bauer, 1984), and this presence of differential autonomic arousal in the absence of overt face recognition to familiar faces has been interpreted as an index of covert recognition.

Behavioural tasks are also frequently used to assess covert face recognition. Behavioural techniques include forced choice tasks, like the *Forced choice familiarity task*, where participants indicate which of two simultaneously presented faces is familiar, and the *Forced choice cued task*, where a printed name (cue) must be matched to the correct face (see Barton, 2008 for review). Despite their complete inability to recognize familiar faces, some APs choose the familiar face (in forced choice familiarity tasks) and/or match the name to the correct face (in forced choice cued tasks) significantly more often than chance (Young and Hellawell, 1988; Sergent and Signoret, 1992; Diamond et al., 1994; De Haan et al., 1991). Another behavioural task commonly used to assess covert recognition in AP is a *Priming task*, in which categorizing a printed name (e.g., Tony Blair) as either an actor or a politician is facilitated after viewing the same face, rather than a face from the opposite category (e.g., actor George Clooney) (Barton et al., 2004; Young and De Haan, 1988).

In behavioural covert face recognition tasks, a distinction can be made between direct and indirect tasks (Barton et al., 2004). In direct tasks, participants are asked to make identity related decisions that directly involve the presented faces (e.g., Forced choice cued tasks and Forced choice familiarity tasks), whereas on indirect tasks, identity related decisions are measured by performance on another task, such as name classification (e.g., Priming task). Although some patients display covert recognition on both direct and indirect tasks, others only demonstrate covert recognition on one type (i.e., patient 008 displayed covert face recognition with a Forced choice cued task but not a Priming task) (Barton et al., 2004). Dissociations have also been reported between direct tasks; for example patient PH displayed covert recognition when assessed with a Forced choice cued task but not with a Forced choice familiarity task (Young and De Haan, 1988). The fact that performance on different behavioural covert recognition tasks can dissociate, both between and within participants, suggests that different behavioural tasks tap into different aspects of covert recognition (Barton et al., 2004; Barton, 2008).

Although some APs show covert recognition on a least a subset of behavioural tasks (Barton et al., 2001; Barton et al., 2004; Young and De Haan, 1988; Damian and Rahman, 2003), others fail to show any signs of behavioural covert face recognition (Sergent and Villemure, 1989; De Haan and

Campbell, 1991). It is not entirely clear why some patients show covert face recognition and others do not. However, there appears to be a link between overt processing and behavioural covert face recognition, with patients with more severe overt recognition deficits less likely to demonstrate behavioural covert recognition. This association has been used to argue that behavioural covert recognition relies on the same system that supports overt face recognition (Barton, 2008; Schweinberger and Burton, 2003).

Given that people with CP have never developed an adequate face recognition system, it is of considerable theoretical importance to determine whether covert recognition can be demonstrated in this population, and if so, the conditions under which it is present. Early case studies addressing this issue typically failed to demonstrate covert face recognition in CP. Case YT did not show covert recognition on an Interference task, which required categorizing a name superimposed on either related or unrelated faces (Bentin et al., 1999). Similarly, case AB did not display covert recognition when assessed with either a Matching task, a Priming task, or a Forced choice familiarity task (De Haan and Campbell, 1991). Results such as these support the proposal that covert face recognition is only apparent when previously intact face representations have been damaged (as in AP), but not when face representations have never been formed (as is presumably the case in CP) (Barton et al., 2004). More recent studies have, however, demonstrated behavioural covert face recognition in cases of CP. Case “C” demonstrated covert recognition when assessed with a Forced choice cued task (although not with a Forced choice familiarity task or a Priming Task) (Rivolta et al., 2010). The existence of covert recognition in CP has also been supported by the finding that visual scan paths to novel faces are also different to those made to famous (Case “AA”; Bate et al., 2008) or recently studied (Cases “MZ”, “RW” & “WS”; Bate et al., 2009) faces.

In the only group study published to date, six people with CP were quicker, and more accurate, at classifying whether two sequentially shown faces were the same or different when the faces were famous than when they were unknown, demonstrating covert recognition (Avidan and Behrmann, 2008). Avidan and Behrmann did attempt to control for the fact that CPs can overtly recognize some faces (on average, ~40%), by analysing only the faces of famous individuals which CPs could not overtly recognize a few weeks earlier. However, the overt recognition test only included one of the five images of each famous individual used in the matching task, leaving open the possibility that the participant might have been able to recognize some, or all, of the other images, particularly if they were more iconic images.

The aim of the current study was to determine whether behavioural covert recognition could be reliably observed in a group of CPs. Our study differs from the only previous group study (Avidan and Behrmann, 2008) in three ways. First, we tested a larger sample size ( $n=11$ ). Second, we used three covert face recognition tasks that have been shown to be sensitive to covert recognition in AP. The use of multiple measures will allow us to examine whether covert recognition occurs on all, none, or just some measures in CP. Third, we implemented two crucial features in our experimental design to ensure that we could be confident that covert recognition

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