Author(s): Moore, Derek G.
Article title: Reassessing emotion recognition performance in people with mental retardation: a review
Year of publication: 2001
Citation: Moore, D.G. (2001) 'Reassessing emotion recognition performance in people with mental retardation: a review.' American Journal on Mental Retardation. 106 (6) 481–502.
Link to published version:
http://dx.doi.org/10.1352/0895-8017(2001)106<0481:RERPIP>2.0.CO;2
DOI: 10.1352/0895-8017(2001)106<0481:RERPIP>2.0.CO;2

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REASSESSING EMOTION RECOGNITION PERFORMANCE IN PEOPLE WITH MENTAL RETARDATION: A REVIEW.

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Keywords: mental retardation; emotion recognition; information-processing; task demands; review.

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Acknowledgements: This paper was written with the help of a sabbatical from the Psychology Department, University of East London.

Published in American Journal on Mental Retardation. 2001

Abstract

A number of studies have reported that adults and children with mental retardation have problems on emotion recognition tasks. Rojahn, Rabold & Schneider (1995) have proposed that people with mental retardation have a specific deficit in emotion recognition and this may be a cause of their other social adaptive problems. This paper reviews evidence from a wide range of studies exploring the emotion recognition capacities of people with mental retardation, and considers the evidence for the specificity hypothesis. A new typology of emotion recognition tasks is presented and the review highlights the importance of using MA-matching, control tasks and considering stimulus complexity, abstraction and ecological validity. The paper concludes that evidence from studies employing identification tasks suggests that underlying emotion perception capacities may be intact in people with MR. It is proposed that evidence of specific performance deficits on cross-modal matching and rating tasks do not as yet support an emotion specificity hypotheses as they can be accounted for with reference to capacities for imagination, memory and attention and in dealing with static and/or ambiguous stimuli. Such capacities are likely to be IQ-related and not controlled for by MA-matching. Control tasks employed to date have not always made equivalent demands in all these areas. Recommendations are made for future research and an alternative account is proposed of the reported relationship between emotion perception performance and socio-emotional problems in adults with mental retardation.

Introduction

Individuals with cultural familial mental retardation often have impairments in social skills, have difficulties in adjusting socially and vocationally, and sometimes develop additional psychopathology. What are the root causes of these social adaptive problems?

Rojahn, Rabold and Schneider (1995) have suggested that there is a direct causal link between emotion perception 'deficits' and the social adaptive problems of people with mental retardation (MR). Rojahn et al's emotion specificity hypothesis suggests that, in addition to general intellectual impairments, people with mental retardation have specific emotion perception deficits, and that these may be a cause of their social adaptive problems. This proposed causal link rests firstly on associations found between emotion perception performance and the presentation of challenging behaviors (see, for example, Moffatt, Hanley-Maxwell and Donnellan, 1995). Secondly, and more central to the hypothesis, are reports that individuals with mental retardation perform poorly on emotion perception tasks when compared to groups of typically developing (TD) children of the same Chronological Age (CA) and, in some cases, when compared to children of the same Mental Age (MA).

In contrast, rather than hypothesizing that emotion perception is impaired, one could propose that basic emotion perception capacities are intact in individuals with mental retardation (Moore, 1994; Moore, Hobson & Lee, 1997). Ecological psychologists (e.g. Baron, 1980) have suggested that humans may not employ the same processes in perceiving people as they do in perceiving objects and suggest that social perception should not be assumed to be an inferential, cognitively-based process. Similarly, cognitive psychologists have proposed that humans may possess a number of independent cognitive mechanisms which deliver basic meanings necessary for social understanding (see Fodor, 1983). Each of these mechanisms may operate in single domains and have their own dedicated neurological architecture (i.e. for face-perception and the identification of goals). They may also be modular. That is, their operation is automatic and they act independently of each other and of the sort of higher-level symbolic processes typically associated with general intelligence (Anderson 1992). Work with infants has provided some support for the existence of these domain-specific and/or modular social-perceptual capacities[1]. (Carey & Spelke, 1994; Gergely, Knadasny, Csibra & Biro, 1995; Leslie & Keeble, 1987; Morton & Johnson, 1991;

Premack, 1990).

Although this does not preclude individuals with mental retardation from having deficits in these areas of social functioning[2], the suggestion that some social-perceptual capacities in individuals with mental retardation are unaffected by impairments in general cognitive functioning fits well with this approach (see Moore, Hobson & Anderson, 1995). Indeed, there is some evidence for unimpaired social-perceptual capacities in individuals with mental retardation in domains other than emotion perception. For example, Dobson & Rust (1994) showed that children with mental retardation were impaired in remembering objects compared to MA-matched TD controls, but performed equivalently when remembering faces (see also Anderson & Miller, 1998). Similarly, Moore et al (1995) have demonstrated that individuals with mental retardation have intact abilities for perceiving human bodily movements in contrast with specific impairments in other information processing capacities.

Is it possible that people with mental retardation also have intact domain-specific capacities for perceiving emotions? If so, how do we explain their deficits on emotion perception tasks in relation to MA-equivalent TD controls? One possibility is that emotion recognition tasks make additional task demands that disadvantage participants with MR and performance on these tasks may be determined not only by emotion perception competence, but also by information-processing capacities that relate to IQ rather than MA. (Simon, Rosen & Ponpipom, 1996). IQ-related differences have been found between MA-comparable TD children and children with MR in their speed of information processing (see Anderson, 1992), perception of global motion (Fox and Oross, 1990), and in memory and discrimination capacities (see Weiss, Weisz & Bromfield, 1986 for a review and see Cole, 1998 for a recent theoretical overview).

The purpose of this paper is to reexamine reports of the emotion perception performance of people with MR in light of these alternative explanations. The central issue is whether it is possible to account for performance deficits with reference to information processing, or whether such performance deficits are a consequence of underlying impairments in emotion perception competence.

In sum, the two proposals are: 1) that impaired performance on emotion-

perception tasks is a reflection of impaired emotion perception competence (as Rojahn et al propose); or 2) that basic emotion perception is intact, and that poor performance is a consequence of poor IQ-related information processing abilities.

Review of studies

This review includes studies of emotion recognition in voices and bodies as well as giving an update on studies exploring emotion recognition in faces and extends the arguments by focusing in more detail on the information-processing demands made by different types of task. This allows an assessment of the relationship between task performance, emotion recognition capacities, and IQ. Similar analyses have proven useful when considering the nature of emotion perception in individuals with autism (Hobson, 1991) and in children with specific learning disabilities (Maheady, Harper & Sainto, 1987).

The studies included in the review were selected by performing an extensive literature search using the databases Psychlit (Silverplatter) and BIDS. Studies were included if they were published in a peer-reviewed journal and if sufficient details of sample characteristics and methodology were given to be able to evaluate the findings. The intention was to be as inclusive as possible.

Assessing individual experimental studies according to design characteristics

The first part of the review groups studies according to their design. Studies sharing particular design characteristics are presented together in the accompanying tables. These tables describe the participant characteristics, type of stimuli, the range of emotions examined, the type of response employed, the type of control tasks employed and summarize the results.

Classifying tasks and outlining their information processing demands

A central element of this review is the examination of the demands emotion perception tasks make on participants over and above the capacity to perceive the emotional content of stimuli. Even some seemingly simple tasks require participants not only to perceive

a stimulus, but also to encode it, discriminate it from others, and verbally respond to it. To this end, McAlpine, Kendall & Singh (1991), Adams and Markham (1991), and Rojahn, Lederer & Tasse (1995) classified tasks into those involving identification, labeling, or rating (in increasing difficulty). However, these classifications are incomplete in describing the full range of tasks employed. An attempt at a more fine-grained classification system is presented in Table 1. Tasks are classified into seven different types and given more distinguishing labels. This system of classification is used throughout the review and in the accompanying tables.

[Table 1 about here]

Table 1 also gives an indication of the unique profile of information processing demands each type of task makes. The impact of these information processing demands on performance will be considered in more detail in the final part of the review.

Participant selection, control groups and matching

One step towards determining whether groups of people with mental retardation and TD individuals are equally capable of coping with task-related demands is to match for Mental Age. However, matching for MA does not mean that people with MR and TD individuals have exactly the same cognitive structures and there may still be differences in the quality of cognitive processes between MA-matched groups (Weiss et al, 1986). This aside, matching does mean that differences in performance can not be attributed to differences in the level of knowledge acquisition indicated by the test on which they are matched. Importantly, one also has to consider whether matching is on a measure that tests verbal or non-verbal cognitive abilities. If two groups are matched for non-verbal MA, but the target task relies on verbal responding, one can not necessarily assume that differences in performance between groups are unrelated to MA.

[Table 2 about here]

None of the eight studies listed in Table 2 used verifiable MA-comparable control groups. One study used a comparison group similar in MA but did not provide sufficient

details to establish exact comparability (McAlpine et al 1991) and four studies looked at performance in comparison to CA-equivalent TD individuals (Gumpel & Wilson, 1996 and Harwood, Hall & Shinkfield, 1999; Levy, Orr & Rosenweig, 1960; Maurer & Newbrough, 1987). Of these five studies, four reported that participants with mental retardation performed poorly in relation to TD participants overall and one reported no difference. Three of the studies had no comparison groups of any kind (Gray, Fraser & Leudar, 1983; Simon, Rosen, Grossman & Pratowski, 1995; Simon, Rosen & Ponpipom, 1996). Two of these were specifically concerned with how within-group differences in IQ influences performance. Simon, Rosen, Grossman & Pratowski (1995) found a significant relationship between emotion recognition performance and IQ suggesting that information processing capacity impacts on performance. Simon, Rosen & Ponpipom (1996) also found a similar association. However, none of these studies allow one to determine the cause of performance deficits because they did not include MA-comparable control groups nor control tasks.

[Table 3 here]

The six studies detailed in Table 3 included MA-comparable groups in their design but did not include control tasks. Three of the studies in Table 3 used faces as stimuli. One of these studies reported differences in performance between MA-comparable groups of TD individuals and people with MR (McAlpine, Singh, Kendall & Ellis, 1992). In contrast, another study reported that the performance of groups of people with MR and TD individuals were comparable[3] (Xeromeritou,1992) and the other (Adams & Markham, 1991) found that MA-comparable, younger people with MR and TD individuals performed similarly, whilst older MA-comparable people with MR and TD individuals differed in their performance. These contradictory findings highlight the need to consider in detail the nature of the tasks employed and determine the precise source of performance deficits. The use of control tasks would have helped in this regard.

The other three studies included in Table 3, used schematic stimuli representing bodily forms rather than human faces (Brosgole, Gioia and Zingmond,1986; Marcell & Jett, 1985; Weisman & Brosgole,1994). All studies showed performance <u>similarities</u> between MA-comparable people with MR and TD individuals but also demonstrated the effects of IQ on performance. Marcell and Jett (1985) found that their ‘trainable’ participants with MR of

lower IQ was less accurate than 'educable' participants with MR, even though both groups were similar in MA. Similarly, Brosgole, Gioia and Zingmond (1986) found that their participants with severe MR did significantly worse than their other two groups of people with mild and moderate MR. Weisman & Brosgole (1994) used the same stimuli as Brosgole, Gioia and Zingmond (1986). They revealed how the nature of the task differentially affects performance. On an identification task the groups of adults with mild and moderate retardation were equivalent to MA-matched TD children, but when picture-story tasks were given the performance of the groups of people with MR deteriorated more rapidly than that of the TD control group.

On the basis of the six studies outlined above one can see that on some basic emotion perception tasks people with MR and TD individuals of comparable MA may perform similarly. In other studies where group differences were found it is unclear what the source of these differences are. A control task would have allowed an examination of the influence of IQ on those aspects of performance not related to emotion perception capacities and enabled an examination of the specificity of performance deficits.

Control tasks, specificity and ecological validity

If one wishes to demonstrate a specific impairment one needs to demonstrate, firstly, that participants are impaired in processing information in the specific domain in relation to MA-matched control participants. Secondly, one needs to show that when people with mental retardation are presented with a control task involving the processing of information not specific to the domain in question, they are not impaired in relation to the matched controls. Together this would demonstrate that performance on the domain-specific task is not simply determined by general MA- or IQ-related capacities but is specific to the domain in question. Note that where no differences are found between MA-comparable groups, the administration of a control task is not required to demonstrate that competence is equivalent to MA-matched TD individuals. However a control task might still be useful to demonstrate that performance is superior relative to another domain (see for example, Anderson & Miller, 1998; Moore et al, 1995).

When control tasks are employed it is also critical that the index and control tasks

are of equal levels of difficulty and make the same response demands on each group. The aim is to set up experimental conditions so that participants' performance on the index task is determined primarily by capacities specific to the domain in question and that the control task is equivalent in terms of extraneous demands. This may not be a straightforward undertaking, particularly as one also has to make sure that in the process of designing comparable index and control tasks the ecological validity of the stimuli is not compromised. If the stimuli are not natural representations of emotions, it can not be assumed that deficits in performance are representative of emotion perception as a whole. Processes involved in 'perceiving' and understanding specific aspects of the particular stimuli employed may determine performance and these capacities may have more to do with aspects of intelligence than emotion recognition capacities. As Hobson (1991) has put it "...there is a danger of creating a setting in which one participant's intuitive emotional sensitivity might confer little advantage over another participant's [...] cognitively effective classification abilities" (p1139).

These criticisms can be applied to a number of studies undertaken in this area, in particular those using schematic drawings or cartoons that may represent some type of learned 'emotional shorthand'. Even the use of stimuli of apparently high ecological validity such as photographs of faces may lead to ungeneralizable findings because of the lack of dynamic movement (Moore et al, 1997).

Table 4 presents studies that tested MA-comparable people with MR and TD individuals and included control tasks that allow for the assessment of IQ-related factors and allow an examination of the specificity of relatively impaired or spared performance. Of the four studies included, one looked at emotion understanding solely in faces, two were concerned with emotion understanding in verbal and facial expressions, and one was concerned with understanding emotion expressed in dynamic bodily movements.

[Table 4 here]

The first study to consider is that of Rojahn, Rabold & Schneider (1995). This study had appropriately matched groups, used validated black and white photographs of faces and included a control task to examine the specificity of any deficits. They required adults with mental retardation and two control groups of CA- and MA- matched typically

developing participants to rate faces in terms of the intensity of emotion or the extent of their age (the control condition). For the emotion task participants had to show an experimenter on a five-point scale, how happy or sad the person in the depicted photograph was. On the control task the participants had to indicate on a scale ranging from young to old the age of the person depicted in the photograph. In terms of overall number of correct responses, the MA-equivalent control groups performed better than people with MR on the emotion task. In contrast when rating age the MA-matched people with MR and TD individuals performed equivalently. Importantly in terms of levels of difficulty, the participants with MR performed at the same level of accuracy on both tasks. Given that this study admirably included many of the methodological features recommended earlier, it would appear that this provides some evidence for a specific deficit in emotion recognition.

However, further exploration of their data reveals other possible interpretations. Rojahn et al also reported that MA-matched people with MR and TD individuals did not differ in the proportion of correct ratings of happy faces. Also the data presented in figure 2 of their paper suggests that the participants with mental retardation did better than the MA-matched TD children in rating sad faces. Thus, when rating faces expressing happiness and sadness both groups appear equally able to rate them correctly. What then is the source of the overall difference between the groups? It appears that the proportion of neutral faces rated correctly by the group of people with MR was significantly lower than for the MA-equivalent TD control group. The same pattern applied when rating photographs by age, with the group of people with MR performing poorly when it came to rating faces that were neither young nor old. The adults with mental retardation were more likely to rate a neutral face incorrectly as happy or sad than the control groups who were more likely to use the middle of the scale. Importantly the participants with mental retardation were not poorer at classifying faces that were definitely happy or sad. Thus, the reported specific emotion recognition deficit rests on the rating of faces with no emotional content.

This of course leads one to ask why rating a neutral item is a problem for people with MR? It may be that adults with MR believe that their primary task is to determine whether faces are happy or sad, old or young and may not be confident enough in their own abilities to rate an ambiguous stimulus such as a neutral face as neutral. Findings from other studies (i.e. Brosgole et al 1986, tasks 2 & 4) suggest that adults and children with MR may

have particular problems with classifying ambiguous emotional stimuli and may lack confidence in making such decisions.

Hobson, Ouston and Lee (1989a & b) used different techniques to explore this issue. These studies were also well designed and included many of the features missing in other explorations. Their tasks involved the labeling and cross-modal matching of vocally expressive voices to corresponding photographs of emotionally expressive Ekman[4] faces. In the first study (Hobson, Ouston and Lee, 1989a) adolescents with MR and MA-comparable TD control groups were required to point to a picture to go with a sound. In the emotion-matching task, participants were played audiotapes of a person either reading prose expressively or making vocal expressions and had to select the appropriate face to go with the voice. In the control tasks, participants had to point to one of six pictures of a familiar object, to 'go with' a corresponding sound, i.e. pictures and sounds of vehicles, types of bird, electrical appliances.

The results were that the two groups of individually matched participants did not differ in their abilities to match objects to their sounds, but did differ significantly in their abilities to match emotional faces with voices. Even when the levels of difficulty of the control tasks were controlled for by the exclusion of those control tasks that were relatively easy, this interaction effect remained, suggesting that it was not the difficulty of the matching that created the group difference. The results of this task suggest that individuals with mental retardation may have a specific difficulty in emotion perception that cannot be explained purely in terms of task-specific or MA-related factors.

However, in a second study (Hobson Ouston and Lee, 1989b) the same non-retarded and retarded participants who participated in the first study, were asked to verbally label, rather than match, a sub-set of the materials employed in Hobson et al (1989a). Although the individuals with mental retardation showed slightly worse performance overall when labeling both emotions and objects, there was no evidence that individuals with mental retardation had a specific deficit in labeling emotions compared to objects. Hobson et al proposed that "...the present results indicate the need to reappraise previous uncontrolled studies purporting to demonstrate emotion recognition deficits in […] retarded participants, in the light of increased evidence for potentially confounding task-related variables."(Hobson,

Ouston & Lee, 1989a; p248). They suggest that a possible reason for the differential findings across tasks is that cross-modal matching tasks may require more imaginative processes than labeling tasks. The emotion stimuli might be 'abstractions' from emotionally expressive people in a different sense than the non-emotion task materials. A photograph of an emotionally expressive face freezes one instant of a complex moving configuration of facial features. Facial figures are in constant dynamic change and relations among bodily features over time may contribute much to the communication of emotion. A photograph of an inanimate object may not, therefore, be equivalent. They propose that differences in the matching study may arise not because of any lack of sensitivity to real life emotional expressions, but because of a lack of imaginative activity to bring the faces 'alive' in order to map them onto the dynamic sounds.

These studies show how the type of response mode and type of stimuli affect performance in these populations. Using the same participants one can demonstrate apparent emotion-specific problems when using cross-modal matching which are not apparent when labeling the same stimuli. This also demonstrates how the use of static stimuli may underestimate the emotion perception capacities of children and adults with mental retardation.

Moore, Hobson, & Lee (1997) attempted to explore these issues by employing dynamic stimuli. Instead of examining the emotional capacities of individuals by using static faces or static drawings of facial expressions, a different approach was employed to access the more dynamic elements of emotional meanings. MA-matched groups of TD children and adolescents, children with autism and children with mental retardation were tested for the ability to spontaneously comment on and label videotaped representations of people's actions and emotion-related attitudes presented as moving point-light displays of their whole bodies (Maas, Johansson, & Jansson, 1970).

Using this technique Moore et al demonstrated that people with MR and TD participants were equally likely to spontaneously comment on the emotional expressions of these dynamic stimuli when simply asked to describe what was happening. Also, when specifically asked to label different clips showing actions and emotional expressions, their performance was equivalent to MA comparable TD children. In comparison, autistic

participants were specifically impaired in attending to and discriminating people's emotions and attitudinal states.

Assessing evidence from each type of task

From the evidence presented above it is apparent that IQ-related task-specific factors influence the level of performance achieved by participants with MR. To aid the examination of how information-processing demands may influence performance Table 5 presents findings of studies grouped by type of task (as classified in Table 1). For those studies where more than one task was administered each task appears separately in the relevant sections of the table. Of particular interest, is the relative performance of individuals with MR in comparison to MA-comparable TD control groups and this is shown in the table. Although few studies included MA-comparable control groups and control tasks to assess task-specific demands, within group IQ- related effects have been reported in some studies and these are also commented on in the table.

[Table 5 about here]

Evidence from identification studies

Identification tasks require participants to indicate which of a number of distracters is the picture that corresponds to a target emotion word. As indicated in Table 1, to succeed on these tasks participants must hold in mind verbal information (the target label), access emotional meaning across modalities (match a picture to the target word), and then select the response from amongst a number of distracters (these vary between three and six across studies). Looking at Table 5 one can see that there are some inconsistencies in findings across studies. Of the nine identification tasks administered to groups of people with MR and TD individuals comparable in MA, there was no difference between the groups on six of them. Differences were found on three studies: Two of these used stimuli that were ambiguous, depicting conflicting bodily and facial expressions. On the remaining study by McAlpine et al (1992) a difference was found when identifying one from six target Ekman displays. However, using the same method but only three target photographs, Adams and Markham (1991) found no group differences. It is possible that the nature of the MA-matching accounts for the differential effects (McAlpine et al do not report details of their

control groups), but it is also likely that using six targets increases memory load and distracters and contributes to poorer performance.

Taken together these findings suggest that when using non-ambiguous pictures and three or less targets identification tasks produce little evidence for a specific emotion-perception problem for individuals with MR. IQ-related capacities do, however, impact on performance on these tasks. Simon et al (1995) and Simon et al (1996) reported that identification performance within groups was related to IQ and both Brosgole et al (1986) and Weisman & Brosgole (1994) reported that groups of people with MR of low IQ performed poorly compared with other groups of people with MR.

Evidence from picture and video labeling studies

Picture labeling tasks require the participant to hold in mind the target picture, access emotional meaning across modalities, and give a verbal response. Five studies used labeling as a response mode. Of these, only two compared MA-equivalent groups of people with MR and TD individuals. Hobson, Ouston & Lee (1989b) found their group of people with MR to be poorer than their control group in labeling Ekman faces and emotional voices. However, this deficit was not specific to emotions as they had similar relative difficulties in labeling non-emotional control stimuli. This suggests a global IQ-related performance effect. Moore, Hobson & Lee (1997) with participants with MR similar in MAs to Hobson et al (1989a&b), found their group of people with MR to be equivalent to MA-matched TD controls when labeling point-light displays depicting bodily expressions of emotions. Thus the evidence from these tasks is contrary to the emotion-specificity hypothesis and findings suggests that using static displays may specifically impair performance in individuals with MR.

Evidence from matching studies

Simple picture/video matching requires participants to hold in mind the visual information for both a target stimulus and the stimuli making up the response set, make a direct correspondence between these stimuli, and select a response from among distracters. Picture-sound matching studies on the other hand require participants to hold in mind phonological and visual information, accessing meaning across modalities, and select their

response from among a number of distracters. These tasks provide evidence both for and against specific emotion-perception deficits. Of the four matching tasks listed in Table 5 it can be seen that three used MA-comparable control groups. One of these provided evidence for a specific emotion performance deficit studies (Hobson et al,1989a) and two other studies (Adams & Markham,1991; Marcell & Jett, 1995) also reported performance differences between people with MR and MA-comparable TD individuals (although only for adolescents with MR). However, these two studies did not establish the specificity of these performance deficits, as there was no control task.

Matching tasks appear overall to be more difficult than identification and labeling tasks for participants with MR and this pattern has also been reported in TD children (Wiggers and Van Leishout, 1985). However, the demands these type of tasks make seem to differentially affect participants with MR compared to MA-equivalent TD children. It is not clear yet whether this reflects an emotion specific deficit, or is due to information processing demands. As outlined earlier, appropriate control tasks are difficult to devise for this type of task given issues of complexity and level of abstraction.

Evidence from rating studies

Rating tasks require participants to hold in mind visual information, make a non-categorical judgement, and select their response on a scale that may include distracters. Two rating studies were reported in this review but only one of these employed a MA-comparable control group (Rojahn et al; 1995). This study also admirably included a control task and reported specific emotion-perception performance deficits. However, as the reported finding of an emotion specific deficit in comparison to the control tasks appears to rest primarily on the rating of emotionally neutral faces (see earlier) it is unclear whether this finding is generalizable.

Evidence from story labeling and picture-story matching studies

Story labeling tasks and picture-story matching tasks require participants to hold in mind significant amounts of verbal emotional information. Of the six tasks listed in table 5 Two demonstrated no differences from MA-comparable TD children but one (Weisman & Brosgole, 1994 Task 2) showed a significant difference. Gumpel & Wilson (1996) showed

that with increase in length and complexity of stories and with increase in the number of pictures to select from, picture-story performance deteriorates in people with mental retardation individuals. This suggests that both verbal- and visual-memory are central in determining overall performance and performance may relate to IQ.

In summary, from looking down Table 5, one can see the effect that different task demands have on the performance of people with MR in relation to MA-equivalent TD control groups. Whereas identification studies that used few distracters and static but ecologically valid stimuli, produced no performance differences between participants with MR and TD children of equivalent MAs, identification tasks employing more distracters or ambiguous stimuli produced relative performance deficits. Similarly, labeling tasks using static stimuli produced performance deficits but those with dynamic displays did not. Matching tasks using static stimuli and requiring abstraction across two modalities, and rating tasks using neutral (ambiguous) stimuli, also produced relative performance deficits but only in older participants with MR. Performance on story labeling and picture story matching relates strongly to IQ and again appears to be more impaired in older participants.

It appears that the proposal of Simon et al (1996) that IQ-related factors are instrumental in determining performance on emotion recognition tasks may be supported by the findings and it appears that identification seems to be the easiest response mode. Once memory, attentional and abstraction demands are increased in visual-matching, picture-sound matching, rating, story labeling and picture-story matching tasks, performance deteriorates in individuals with MR relative to MA-equivalent control children. For example, Adams and Markham (1991) showed that while their participants with MR had problems on a picture matching task, they did not show the same deficits when required to identify pictures.

Discussion

Comparing theoretical positions

The concern of this paper was to consider whether there is sufficient evidence to enable one to assess the merits of the two theoretical positions outlined in the introduction. Only the studies of Hobson, Ouston & Lee (1989a&b), Moore Hobson & Lee (1997) and

Rojahn, Rabold & Schneider (1995), were equipped to test the specificity of an emotion perception deficit. Only one of these (Hobson, Ouston and Lee, 1989a) found an emotion specific, performance deficit and this was on a task involving matching static faces to emotional voices -a task proposed to require considerable 'imaginative' abilities (Hobson, Ouston and Lee, 1989a). When the same participants were asked to label these stimuli separately (Hobson, Ouston & Lee, 1989b), no emotion-specific impairment was found. In contrast there were a number of studies in which no differences in performance were found between MA-matched children and adults (Adams & Markham, 1991, task 1; Brosgole et al 1986, tasks 1,3 & 5; Moore et al 1997; Weisman & Brosgole, 1994, Task 1; Xerometeriou, 1992). These findings tended to be on tasks where information-processing demands were fewer. Taken together these findings suggest that emotion perception capacities may be intact in people with MR. However, even if neurological mechanisms required for basic emotion perception, located perhaps in the amygdala (see Streit, Ioannides, Liu, et al, 1999), are intact in people with mental retardation, it may be difficult to demonstrate their emotion perception competence unless we account for IQ-related information processing deficits.

As pointed out by Cole (1998) and Weiss et al (1986), it appears that matching on mental age does not control for all cognitive differences between people with MR and TD individuals. Even when simple identification tasks are given, and certainly when more complex matching tasks are administered, simply matching for MA may not be sufficient to control for all information processing demands that may serve to disadvantage individuals with MR.

Recommendations for future research

Delays and differences have been reported in the encoding and retrieval of short-term verbal and visual memories by individuals with familial retardation in relation to CA and MA-comparable TD controls (Burack & Zigler, 1990; Ellis, Deacon, & Wooldridge, 1985; Ellis & Wooldridge, 1983; Gutowski & Chechile, 1987; Hornstein & Mosely, 1987; Mosely, 1981). Additionally Philips & Nettelbeck (1984), have shown that on item-recognition tasks individuals with mental retardation take longer to respond but will show greater improvement with practice than their MA-comparable controls. They suggest that poorer performance in item recognition tasks may be partially down to a tendency for

individuals with mental retardation, initially, to use inefficient encoding and response strategies. All or some of these differences in information-processing capacities between MA-matched groups may be responsible for group differences on the more demanding emotion perception tasks. Using a control task is one way to partial out some of these effects.

Control tasks and covariates

However, selecting a single control task to control for all IQ-related information processing factors may not be possible. The problem is that although a control task may control for some general information processing demands it may not control for the information- processing demands specific to the stimuli used. The critical question is whether the control and emotion stimuli are of comparable complexity and abstraction. Some studies have used faces that differ in age or identity as control stimuli. These appear to be appropriate control stimuli because they are also faces and are therefore equally complex as patterns. However, it is not clear that a person's identity or age is comparable in level of abstraction to their emotional state (Hobson et al 1989b, Hobson, 1991).

It seems that studies may need to administer a number of control tasks, using stimuli of varying complexity and abstraction to assess their relative impact on performance if it is impaired. Additionally it would seem appropriate to include tasks designed specifically to test participants' short-term memory and attentional capacities. See, for example, McDaniel, Foster, Compton & Courtney (1998) for a strategy for achieving this. These measures can then be included as covariates in analyses to partial out the role that these factors play in determining emotion perception performance.

Choice of stimuli

Some studies reported in this review have demonstrated how the use of ambiguous or neutral stimuli appears differentially to affect the performance of individuals with MR. It is essential to ensure that only ecologically valid stimuli are used to assess emotion perception capacities. The use of schematic drawings of faces and cartoon pictures of animals may be inappropriate. Even using ecologically valid pictures of faces may lead to an underestimation of emotion perception capacities in people with MR, particularly for matching tasks (Hobson et al, 1989a). Harwood et al (1999) have reported that individuals

with MR find emotions easier to match when the stimuli are moving rather than static. While it has yet to be shown how much the use of moving emotional stimuli improves the performance of people with mental retardation relative to MA-matched controls, the studies of Harwood et al (1999) and Moore et al (1997) may give some direction when considering the sort of stimuli to use.

Ages of participants: Stigma, self esteem, and depression.

The majority of the studies reported in this review have involved adolescents and adults with mental retardation rather than children with MR. It is important to recognize that studies of adults with MR may not provide the best account of the underlying capacities of people with MR. A number of studies that have included both children and adults have reported that adults and adolescents with MR actually perform poorly compared to children with MR (Brosgole & Gioia, 1986, task 2; Marcell & Jett, 1985; McAlpine et al 1991). How might we explain this finding?

It may be that relatively intact emotion perception capacities leave children with MR socially vulnerable because they are perfectly able to perceive other people's negative emotional responses towards them. Responses that in many cases are a product of the social stigma associated with being handicapped. This could lead, over time, to defensive reactions and low self esteem which then contribute to the later development of psychopathologies such as depression. These factors would all inhibit the emotion perception performance of adults with MR. An example, perhaps, of what Sinason (1992) called secondary handicapping. There are, in fact, high incidences of depressive symptomology in adolescents with mild mental retardation (Masi, Mucci & Favilla, 1999) and self-esteem and depression are associated in people with mental retardation in much the same way as in people without intellectual disabilities (Dagnan & Sandhu, 1999).

Conclusion

A more systematic approach is required to assess emotion perception in children and adults with mental retardation. Each type of task identified in Table 1 has a unique profile of information processing demands and these may not be fully controlled for by MA-

matching or by using a control task. What is required are a series of studies, preferably using repeated-measures designs, examining the relationship between IQ-related information-processing demands and emotion perception performance across different types of task. To enable exact comparisons across tasks, studies should employ the same type of non-ambiguous, ecologically valid, dynamic stimuli. A thorough assessment of how information processing demands act to constrain emotion perception performance would help predict how individuals with particular profiles of cognitive impairments will respond in different real-life situations. This would then allow the development of more targeted, effective and generalizable interventions. Of course, even if people with mental retardation are able to determine the emotions and social intentions of others, it does not necessarily mean they are capable of initiating appropriate social interactions in response to them. Additionally, a more thorough consideration of age-related socio-emotional factors is required. In particular, where adult participants with mental retardation are involved, it seems clear that more thorough assessments of their self-esteem and depression are required and consideration must be given to these as causes rather than consequences of reduced emotion recognition performance in adults with MR.

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Footnotes

[1] Note the distinction between modules and domain-specificity. All modules are domain specific, but domain-specific capacities need not be modular. See Karmiloff-Smith (1992) and Carey and Spelke (1994) for fuller explanations of these issues.

[2] Modularity in cognitive function may not necessarily be represented in localized neurological structures. Neural pathways involved in the implementation of these processes may be distributed throughout the brain and consequently may be affected by general synaptic or neuronal impairments.

[3] Note that in their review, Rojahn, Lederer & Tasse (1995) stated that Xeremeritou (1992) found a significant difference between groups. Xeromeritou reported no such difference.

[4] This term refers to the widely used standard set of emotional photographs collected by Paul Ekman and collated in his book ‘Unmasking the Face’ (Ekman & Friesen, 1975).

Table 1: Classification of emotion recognition tasks and catalogue of information processing demands

		Information processing required for successful completion							
Task	**Description**	Need to hold in mind visual information	Need to hold in mind verbal information	Need to hold in mind phonological information	Need to access meaning across modalities	Need to determine equivalence of multiple visual stimuli	Need to select response from among distracters	Need to access and give a verbal response	Need to make non-categorical judgements
Picture Identification	Participants point to an emotion picture when given an emotion word		*		*		*		
Picture/video Labeling	Participants say a word corresponding to an emotion picture or video clip	*			*			*	
Picture/video visual matching	Participants point to an emotion picture corresponding to another picture or video clip	*				*	*		
Picture-sound matching	Participants point to an emotion picture that corresponds to an emotional sound			*	*		*		
Rating	Participants indicate emotional intensity on a scale	*					*		*
Story labeling	Participants say a word describing the emotion of a protagonist in a story		*					*	
Picture-story matching	Participants point to an emotion picture corresponding to the emotion of a protagonist in a story	*	*		*		*		

Table 2: Studies without MA-equivalent control groups or control tasks

Authors	Participant details	Control group(s) details	Type of Stimuli	Emotions	Tasks	Results
Gray, Fraser & Leuder (1983)	Young Adults N=26 Age not given 13 'mild' MR Mean IQ: 68.7 13 'severe' MR Mean IQ: 47.5	None	Ekman Photos	Happy Sad Angry Fearful Surprised Disgusted	Picture-story matching Had to pick face to go with a story	• MR adults showed impaired performance compared to TD adults tested by Tomkins and McCarter (1964) .
Gumpel & Wilson (1996)	Adults N=29 Mean Age = 22.21 No details of IQs and MAs provided	Adults N=101 Mean Age = 30.05	Ekman photos	Happy Sad Angry Fearful Surprised Disgusted	Picture-story matching Difficulty was increased across vignettes. Vignettes 1-6: Participants chose one from 2 photos: 6 different emotions, same identity. Vignettes 7-12 Participants chose one from 6 photos: 6 different emotions, same identity. Vignettes 13-18: Participants chose one from 6 photos: different emotions, different identity.	• MR adults showed impaired performance compared to older TD adults • MR performance deteriorated with increase in task demands
Harwood, Hall & Shinkfield (1999)	Adults N=12 CA range: 19-54 Mean IQ= 62 IQ range 56 to 73	Adults N=12 CA range 19-54	Video and photos of posed emotions	Happy Sad Angry Fearful Surprised Disgusted	Picture labeling, picture-matching and Picture-video visual matching Moving and static videotaped and photographic displays of posed expressions were presented. Participants chose the corresponding emotion portrayed by the displays from among six written and pictorial labels of the emotions.	• MR adults showed impaired performance compared to CA equivalent TD adults • Both MR and TD adults performed better with moving displays.
Levy, Orr & Rosenzweig (1960)	Adults N= 66 Gender: All male CA range: 15-21 Mean IQ: 62 IQ range: 50-79	Adults 96 College students 50 male psychiatric in-patients CA range: 17-35 years old	Photos	Happy Unhappy	Rating Participants rated each expressive face on a nine-point scale	• MR adults were similar in their performance to TD adults.

Table 2 (cont): Studies without MA-equivalent control groups or control tasks

Authors	MR participant details	Control group(s)	Stimuli	Emotions	Tasks	Results
McAlpine, Kendal & Singh, (1991)	Children N= 179 children CA: mean =13; range 5-19 Adults N= 194 adults CA = 33 ; range 19-67 Bordeline: (IQ 70-84):19 children ; 6 adults Mild (IQ 55-69) 62 children; 35 adults Moderate (IQ 40-54) 78 children, 104 adults Servere (IQ: 25-39) 20 children 40 adults Profound (IQ:10-24) 9 adults	Children N= 128 Age range 5-6 & 8-13 Mean age 9.5 years No MAs given	Ekman Photos	Happy Sad Angry Fearful Surprised Disgusted	Picture labeling	• MR adults and children showed impaired performance compared to TD children
Maurer & Newbrough (1987)	Adults N=32 Gender: 18 male;14 female CA: mean = 31; range 24-62	Adults N=23 11 male; 12 female Mean age 34.3 years old (range 21-61)	Posed Photos	Happy Sad Mad 'just ok'	Picture labeling	• MR adults showed impaired performance compared to TD adults
Simon, Rosen, Grossman & Pratowski (1995)	Adults 24 men 22 women IQs: mean 50.2 (sd 9.53) Age : mean 42.85 (sd 10.28)	None	Ekman photos	Happy Sad Angry Fearful Surprised Disgusted	Picture identification	• Performance correlated with IQ (r = .4) • Performance did not relate to the Vineland adaptive behavior scales or quality of life measures.
Simon, Rosen & Ponpipom (1996)	Adults: 42 men 44 women 20 individuals aged 20-29 mean IQ: 55.5; sd = 9.16 23 individuals aged 30-39 mean IQ: 53.44; sd= 12.96 23 individuals aged 40-49 mean IQ: 52.00; sd= 11.63 20 individuals aged 50-59, mean IQ: 52.86; sd= 12.34	None	Line drawings of faces	Happy Sad Angry Fearful Surprised Disgusted	Task 1: Picture identification Participants were read a word and asked to select the face to go with it. Task 2: Story-labeling Participants were read small vignettes and asked to select the word to go with it i.e.: "you have just tasted something bad…" Task 3: Picture-story matching Read small vignettes and asked to select the face drawing to go with it.	• Performance on all tasks related to IQ • The younger groups did better than the older groups on story-picture matching and picture labeling.

Table 3: Studies with MA-equivalent control groups but with no control tasks

Authors	MR participant details	Control group(s)	Stimuli	Emotions	Tasks	Results
Adams & Markham (1991)	Children Group (a): Primary school N=33 CA: 8 to 12.4 years-old MA: 4.3 to 9.3 years-old Group (b): High school N=16 CA: 15 to 17.5 years-old MA: 7.8-12.8 years-old	Group (c) 15 kintergarten children MA match for Group (a) MA/CAs 5.2-7.7 years-old Group (d) 30 primary school MA match for Group (b) CA match for Group (a) MA/CAs: 7-12.8 years-old Group (e) 16 High school CA match for Group (b) MA/Cas 15 to 17.9 years-old	Ekman Photos	Happy Sad Angry Fearful Surprised Disgusted	Task 1: Picture identification Each emotion presented with two foils. Participants had to 'show me the Happy person…' etc. Task 2: Picture-matching 'Point to the picture that goes with…' a target photo.	• There was no difference in performance between young MR participants (group a) and MA equivalent TD children (group c) • The older MR participants (group b) differed from MA comparable TD children (group e) • Identification performance was better overall than matching performance.
Brosgole Gioia & Zingmond (1986)	Children & Adolescents 23 males 7 females Group 1 10 mild/borderline retarded: A 8-12 years; Median CA: 10;06 IQ 50-79; Mean MA: 6;00 years Group 2 10 moderate retarded CA 9-18 years; Median CA: 14;06.IQ 36-46; Mean MA: 4;11 years Group 3 10 severe retarded CA 9-20 years; Median CA: 16;06.IQ 21-32; Mean MA: 3;10 years	Children Group 4 (Approx. MA match to Group 2) 10 TD children CA 4;11 to 5;06 yr Median CA: 5;02. Group 5 (Approx. MA match to Group 1) 10 TD children CA 5;07 to 5;11 yr Median CA: 5;08.	Cartoon drawings of animals' faces and postures.	Happy Sad Angry (Neutral for screening task)	Task 1 Picture identification Participants had to point to the animal face that went with the word. Task 2: Picture identification Bodies with blank faces. Task 3: Picture identification Concordant faces + bodies. Tasks 4 & 5: Picture identification Bodies with conflicting expressive faces.	• Task 1: mild and moderate MR groups performed similarly to MA- comparable TD groups • Task 2: moderate and severe MR groups showed impaired performance compared to the other three groups. • Task 3: mild and moderate MR groups performed similarly to MA- comparable TD groups. • Tasks 4 & 5: older TD children performed significantly better and severe MR did significantly worse than the other groups.
McAlpine, Kendall, Singh & Ellis (1992)	Children: 20 mild MR (mean IQ: 62) 20 moderate MR (mean IQ: 45) Adults: 20 mild MR (mean IQ: 60) 20 moderate MR (mean IQ: 47)	MA equivalent controls were used but no details of the matching procedures were given in paper No Mental-Age details provided for either group	Ekman photos	Happy Sad Angry Fearful Surprised Disgusted	Picture-identification	• Performance of all four groups of MR participants was significantly poorer than that of the TD control group.

Table 3 (cont): Studies with MA-equivalent control groups but with no control task

Authors	MR participant details	Control group(s)	Stimuli	Emotions	Tasks	Results
Marcell & Jett (1985)	Adolescents 36 Trainable mentally retarded adolescents Mean CA: 16.5 Mean MA: 5.7 Mean IQ: 43.9 Children 30 Educable mentally retarded children Mean CA: 12.5 Mean MA: 6.3 Mean IQ: 57.1	Children N=40 Mean CA: 5.8 Mean MA: 5.8 Mean IQ: 105	Stick figure drawings of people and voices speaking in a foreign language	Happy Sad Afraid Angry	Picture-sound matching Participants had to point to a stick figure drawing that 'went with' an emotionally expressive vocalization presented on audiotape.	• EMR children performed as well as TD controls. • TMR adolescents were less accurate than EMR children and the TD control group.
Weisman & Brosgole (1994)	Adults 15 Mildly retarded Age: range 28;02 to 44;02, mean 34;09. IQ: range 53 to 69, mean 62. MAs not given 15 Moderately retarded Age: range 21;11 to 37;11, mean 30;10. IQ: range 36 to 49, mean 42. MA: range 3;10 to 7;01, mean 5;09	15 TD children Approximately equivalent in CA to the MA of the moderately retarded adults Age range 4;0 to 6;09, Mean age 5;07	Same animal stimuli as Brosgole et al (1986)	Happy Sad Angry Neutral	Task 1: Picture identification Participants had to point to the picture that went with the word. Task 2: Story-picture matching Participants had to point to the picture that went with the story and word. The length of story was varied and also whether or not the emotion word was used.	• MR and TD groups performed equivalently on the identification task. • Accuracy of identification was directly related to IQ. • MR participants did significantly worse than TD group on story-picture matching.
Xeromeritou (1992)	Children Group 1(HEMR) N=10 MA: 6;03 - 9;08, mean 7;08; CA: 8;01 to 12;02 mean10;06 Group 2(LEMR) MA: 4;09 to 5;11, mean 5;01; CA 8;08 to 11;08 mean10;02	20 TD children. Matched using a none-standardized version of the PPVT translated into Greek Group 1(HNRC) MA: 6;03 to 9;10, mean 7;09 CA 5;03 to 5;09 mean5;05 Group 2 (LNRC) MA: 4;01 to 5;02, mean 4;08 CA 5;00 to 5;08 mean10;06	Line drawings of children's faces	Happy Sad Angry Scared Neutral	Task 1: Picture identification Participants had to point to an emotion (one of 8 pictures - 4 being neutral) after hearing a short vignette that explicitly mentioned the emotion. Task 2: (a) Story labeling & (b) Story-picture matching Participants were read a vignette that did not contain the emotion label. They were then asked to label the vignette and to select a picture to match.	• There was no difference in performance between MR and TD children on any of the three tasks.

Table 4: Studies with MA-equivalent control group and control tasks

Authors	Participant details	Control group details	Stimuli	Emotions portrayed	Response measure	Control tasks	Results
Hobson, Ousten & Lee (1989a)	Adolescents/Adults 21 adolescents/ and adults with mental retardation CA:12.5 to 25.83, mean:18.4; MA: 4;06 to 11;00, mean 7.;01	Children 21 non-retarded children CA:4.83-11.58, mean 7.2; MA: 4;08 to 10;10, mean 7;00 21 adults with Autism	Ekman faces, non-word emotional vocalizations and emotional readings of neutral prose.	Happy Sad Angry Fearful Surprised Disgusted	Picture-sound matching Participants were required to "chose the picture to go with each emotional sound" and had to point at a picture to indicate their preference.	Picture-sound matching Participants had to perform a similar matching task using pictures and sounds of vehicles, birds, household items, gardening tools, types of water, and types of walking.	• The MR and TD groups did not differ in their performance when matching objects. • MR participants were worse than TD participants in their abilities to match emotional faces with voices
Hobson, Ousten & Lee (1989b)	Same as above	Same as above	Same as above	Same as above	Picture Labeling Participants were asked to give the name of the emotional sound or picture presented.	Picture Labeling Participants had to label pictures and sounds of vehicles, birds, household items, gardening tools, types of water, and types of walking.	• Although MR participants were generally poorer at labeling across all tasks, there was no significant interaction to indicate an emotion specific deficit.
Moore, Hobson & Lee (1997)	Children/Adolescents 13 MR: CA 10;11 to 16;06 Verbal MA: mean =7;01	Children 13 TD children of average IQ individually matched for Verbal Mental age plus 13 children with autism matched for verbal mental age and CA with the MR group	Point-light displays of the human body	Happy Sad Angry Fearful Surprised	Video labeling Participants were asked to say 'what happened' and were asked how the actor felt (directed response).	Video labeling Participants were asked to label actions and non-emotional subjective states: itchy, tired etc.	• TD and MR groups were equivalent in spontaneous naming and labeling of emotional stimuli.
Rojahn, Rabold & Schneider (1995)	Adults: 7 men 9 women IQs: 40 - 70 (tested within previous 5 years) Ages 20-49 Mean age 29.93 From sheltered workshop	Adults Ages 20-35 Children 7 boys 9 girls Individually matched on PPVT CAs 6.5-12 years old	Black and white photos	Range from Happy to Sad	Rating Participants had to rate emotion photo on a 5-point rating scale from happy to sad.	Rating Participants were asked to rate a face on a 5-point rating scale from young to old.	• There was a significant task by group interaction suggesting a specific emotion deficit. • Groups performed similarly on age rating but MR participants performed poorer on overall emotion rating • 'Neutral' emotion photographs were particularly difficult for MR participants to classify.

Table 5: Summary of studies grouped by task demands

Identification

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Adams & Markham (1991)	**Task 1:** Identify named emotion among 3 Ekman Faces	Children Adolescents	33 16	8-12 15-17	4.3-9.3 7.8-12.8	- -	MR = TD MR = TD	
Brosgole Gioia & Zingmond (1986)	**Task 1:** Find emotion among 3 animal faces	Children & Adolescents	10 10 10	8-12 9-18 9-20	6;00 4;11 3;10	50-79 36-46 21-32	MR = TD MR = TD -	Low IQ group were less accurate
Task 2:	Find emotion among 3 postures (faces blanked)	Children & Adolescents	10 10 10	8-12 9-18 9-20	6;00 4;11 3;10	50-79 36-46 21-32	MR = TD MR < TD -	Low IQ group were less accurate
Task 3:	Find emotion among 3 entire animal drawings	Children & Adolescents	10 10 10	8-12 9-18 9-20	6;00 4;11 3;10	50-79 36-46 21-32	MR = TD MR = TD -	Low IQ group were less accurate
Task 4:	Find emotion among 3 postures (with faces identical)	Children & Adolescents	10 10 10	8-12 9-18 9-20	6;00 4;11 3;10	50-79 36-46 21-32	MR < TD MR = TD -	Low IQ group were less accurate
Task 5:	Find emotion among 3 faces (with postures identical)	Children & Adolescents	10 10 10	8-12 9-18 9-20	6;00 4;11 3;10	50-79 36-46 21-32	MR = TD MR = TD -	Low IQ group were less accurate
McAlpine, Singh, Kendal & Ellis (1992)	Identify emotion among 6 Ekman Faces	Children Adults	20 20 20 20	-	-	62 45 60 47	MR < TD MR < TD MR < TD MR < TD	
Simon, Rosen, Grossman & Pratowski (1995)	Identify emotion among 6 Ekman Faces	Adults	46	42	-	50	-	Performance was related to IQ
Simon, Rosen & Ponpipom (1996)	**Task 1:** Identify emotion among 6 drawings of faces	Adults	20 23 23 20	20-29 30-39 40-49 50-59	-	55 53 52 52	-	Performance was related to IQ
Weisman & Brosgole (1994)	**Task 1:** Identify emotion among 3 faces of animals	Adults	15 15	28-44 21-37	na 5;09	62 42	MR = TD MR = TD	Performance was related to IQ
Xerometeriou (1992)	**Task 1:** Identify among 4 drawings of faces	Children	10 10	8-12 8-11	7;08 5;01	- -	MR = TD MR = TD	

Picture/video labeling

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Gray, Fraser & Leuder (1983)	Label Ekman photos	Young adults	13 13	Not given	- -	68 47.5	- -	Low IQ group were worse than high IQ group
Hobson, Ousten & Lee (1989b)	Label Ekman photos and emotional voices	Adolescents & Adults	21	12-25	7;01		MR < TD	Deficit was not specific to emotions
McAlpine, Kendal & Singh, (1991)	Label Ekman photos	Children & adults	25 97 182 60 9	5-19 19-67	-	70-84 55-69 40-54 25-39 10-24	-	Children performed better than adults
Maurer & Newbrough (1987)	Label posed photos of faces	Adults	32	24-62	-	-	-	
Moore, Hobson & Lee (1997)	Label point-light displays of bodily movements	Adolescents	13	10-16	7;01	-	MR = TD	

Picture/video visual matching

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Adams & Markham (1991)	**Task 2:** Match an Ekman face to 1 of 3 other Ekman faces	Children Adolescents	33 16	8-12 15-17	4.3-9.3 7.8-12.8	- -	MR = TD MR < TD	
Harwood, Hall & Shinkfield (1999)	Match a still or moving video clip to 1 of 6 still photographs	Adults	12	19-54	-	62	-	The moving stimuli were easier to match

Table 5 (cont): Summary of studies by task demands

Picture-sound matching

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Hobson, Ousten & Lee (1989a)	Match 1 of 6 Ekman photos to emotional voices	Adolescents Adults	21	12-25	7;01		MR <TD	Evidence of specificity
Marcell & Jett (1985)	Match 1 of 3 stick figures to emotional voices	Children Adolescents	30 36	12 16	6.3 5.7	57 44	MR = TD MR < TD	

Rating

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Levy, Orr & Rosenzweig (1960)	Rate photos of faces on happy to sad scale	Adults	66	15-21	-	50-79	-	
Rojahn, Rabold & Schneider (1995)	Rate photos of faces on happy to sad scale	Adults	16	20-49	-	-	MR < TD	Deficit in rating neutral faces

Story labeling

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Simon, Rosen & Ponpipom (1996)	**Task 2:** Give label for the emotion of a protagonist in story	Adults	20 23 23 20	20-29 30-39 40-49 50-59	-	55 53 52 52	-	Performance related to IQ
Xerometeriou (1992)	**Task 2 (a):** Give label for the emotion of a protagonist in story	Children	10 10	8-12 8-11	7;08 5;01	- -	MR = TD MR = TD	

Picture-story matching

Study	Task	Participants	N	Age	MA	IQ	v MA controls	Comments
Gumpel & Wilson (1996)	Match 1 of 2 or 6 Ekman photos to the protagonist in a story of increasing length	Adults	29	22	-	-	-	Performance deteriorated with length & number of foils
Simon, Rosen & Ponpipom (1996)	**Task 3:** Match 1 of 6 line drawings of a face to a protagonist in story.	Adults	20 23 23 20	20-29 30-39 40-49 50-59	-	55 53 52 52	-	Younger adults did better
Weisman & Brosgole (1994)	**Task 2:** Match 1 of 3 animal drawings to a story	Adults	15 15	28-44 21-37	5;09	62 42	MR < TD MR < TD	Accuracy related to IQ
Xerometeriou (1992)	**Task 2 (b):** Match 1 of 4 drawings of faces to story	Children	10 10	8-12 8-11	7;08 5;01	- -	MR = TD MR = TD	