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Do left and right asymmetries of hemispheric preference interact with attention to predict local and global performance in applied tasks?

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Many cognitive neuroscience studies show that the ability to attend to and identify global or local information is lateralised between the two hemispheres in the human brain; the left hemisphere is biased towards the local level, whereas the right hemisphere is biased towards the global level. Results of two studies show attention-focused people with a right ear preference (biased towards the left hemisphere) are better at local tasks, whereas people with a left ear preference (biased towards the right hemisphere) are better at more global tasks. In a third study we determined if right hemisphere-biased followers who attend to global stimuli are likely to have a stronger relationship between attention and globally based supervisor ratings of performance. Results provide evidence in support of this hypothesis. Our research supports our model and suggests that the interaction between attention and lateral preference is an important and novel predictor of work-related outcomes.

Keywords: Attention; Hemispheric asymmetries; Lateral preference; Ear preference; Global attentiveness; Local attentiveness.

The central focus of this research is to propose a mechanism by which attentional control (Derryberry & Reed, 2002) and Attention and Direction

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in Accomplishment Striving (ADIAS; Barrick, Stewart, & Piotrowski, 2002) can be expected to lead to better work-related outcomes. Attention to detail can be expected to lead to higher performance on local tasks (such as work involving just an individual), whereas attention to global concerns can be expected to lead to higher performance on broader and more strategic tasks (such as involving others and seeing the bigger picture). Based on relatively well-established neuropsychological evidence that the left hemisphere has an attentional bias towards local information and the right hemisphere has an attentional bias towards global information (MacNeilage, Rogers, & Vallortigara, 2009), the aim of this research is to determine the effect of hemispheric asymmetries on attention and how they relate to specific and global work outcomes. This is important within the applied domain, as attention has not previously been considered to be an important variable.

Attention refers to the selectivity of processing and was initially defined by James (1890) as the ability to focus on one out of several possible objects. Posner and colleagues (Posner & Petersen, 1990; Posner & Raichle, 1994; Posner & Rothbart, 1998) distinguish between several systems related to voluntary and involuntary processes. Several researchers have proposed that the anterior brain system (located within frontal regions including the anterior cingulate cortex and connected with limbic and frontal motivational systems) constitutes an important executive system associated with monitoring or resolving conflicts (Fan, Flombaum, McCandliss, Thomas, & Posner, 2003; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Derryberry and Reed (2002) argue that this executive system can be generally understood as providing attentional control in relation to positive and negative reactions. Good attentional control, for example, is associated with coping with threat and negative stimuli. This means that effective task performance is maintained through high attentional control even in the presence of distractors.

In the organisational literature there has been limited interest in the role of attention on task and job performance, which is surprising given the evidence of its centrality to psychological science (Posner & Rothbart, 2007). One notable exception is Barrick et al. (2002) who developed a scale of attention as a sub-scale of Accomplishment Striving. ADIAS reflects attention to task completion and is thought to lead to high task orientation. The authors focused their research mainly on the higher order scale of Accomplishment Striving such that little is known about the attention facet of the scale. It is of interest as, to the best of the authors' knowledge, it is one of the very few measures of attention published in the organisational literature. No biological basis for this scale is suggested by the authors Derryberry and Reed (2002) argue that attentional processes should be understood as being different from effort. This is important because effort is known to be an important predictor of performance outcomes within the organisational literature (Brockner, Grover, Reed, & DeWitt, 1992). Simply

defined, work effort refers to the readily operationalised behaviours of employees that refer to the amount of resources that are expended on the job (Behling & Starke, 1973). In layman's terms high levels of effort should be related to simply working hard (Porter & Lawler, 1968) and research supports this perspective (Blau, 1993; Byrne, Stoner, Thompson, & Hochwarter, 2005; Gardner, Dunham, Cummings, & Pierce, 1989; Katerberg & Blau, 1983). Effort is therefore different from attention, as effort refers to the individual's amount of resource expenditure, whereas attention refers to the individual's ability to focus on an object (James, 1890). Barrick et al. (2002) also recognise that attention is different from effort in accomplishment striving by defining attention as an intention to succeed, and they use a separate construct referred to as intensity and persistence, which seems very similar to effort.

In contrast to the role of effort, attention has been generally neglected in the organisational psychology literature and the current research serves an important role in partially filling this gap. However, this is not true for the cognitive neuroscience literature, which has long had an interest in the role of attention and the possible role of hemispheric asymmetries associated with attention. In particular, visual recognition tasks in the laboratory provide evidence that the relationship between attention and work outcomes may be more complex than a simple direct relationship. Research shows that object recognition (e.g., of faces, words, and animals) depends on the identification of both local and global stimulus features (see Kimchi, 1992), which has led to the idea that models of attention need to understood in terms of being local or global (Navon, 1977).

Data from behavioural, patient, and functional neuroimaging studies also indicate distinct brain mechanisms, lateralised to different cerebral hemispheres of the brain, play asymmetric roles in attending to global versus local aspects of an object's shape (Robertson, Lamb, & Knight, 1988; Weissman & Banich, 1999; Yamaguchi, Yamagata, & Kobayashi., 2000). Mevorach, Humphreys, and Shalev (2005) used low-frequency transcranial magnetic stimulation (TMS) to show that brain regions that focus on the "trees" while ignoring the "forest" are related to handedness. Posner et al. (1988) use positron emission tomography (PET) to show that hemispheric differences are important in attention. In general these views are also supported in studies of brain-damaged individuals. Robertson et al. (1988) for example report that damage to right temporo-parietal regions of the brain impairs the identification of an object's global overall form (e.g., an aeroplane's overall shape) while damage to left temporo-parietal regions adversely affects the identification of an object's local parts (e.g., an aeroplane's propeller). The idea that there are underlying differences in attention between the hemispheres is widely regarded as compelling (e.g., Geschwind & Levitsky, 1968; Kinsbourne, 1970, 1974; MacNeilage et al., 2009).

While most of this work has focused on visual attention, some researchers argue that hemispheric asymmetry is just as important to conceptual attention as spatial attention (Derryberry & Reed, 1998; Friedman & Forster, 2005). For the purpose of this research this is a key finding, as conceptual attention is likely to be a more pertinent variable to the prediction of performance and other workplace outcomes. Results using conceptual attention are similar to those of visual attention such that the left hemisphere shows an advantage for processing high-frequency or local information, while the right hemisphere shows an advantage for low-frequency or global information (Ivry & Robertson, 1998; Robertson & Ivry, 2000). The scope of perceptual attention has been shown to influence the scope of internal attention to cognitive representations, or conceptual attention (Friedman, Fishbach, Forster, & Werth, 2003; Friedman & Forster, 2005). If the left hemisphere is more active then conceptual attention may be quite focused, so that only those representations specifically relevant to the immediate decision are activated. If the right hemisphere is more active then conceptual attention may be broader, so that weakly connected representations are more likely to be activated.

There are many ways of measuring asymmetries of hemispheric activity. These methods are distinctly different, and none is considered to be most appropriate for any particular task. Papousek and Schulter (2006) provide a review of different measures of lateral preference and find fault with all measures, but dwell especially on the situational problems associated with psychophysiological measures such as EEG and related techniques. Even in the laboratory there is no clear rule of thumb as to which measure of laterality is most preferred since studies employ a variety of measures including line bisection, chimeric faces, lateral preferences, dichotic listening, and yet others use EEG and related techniques.

The use of self-report measures of lateral preference (handedness, footedness, and the like) is a widely studied and yet controversial area of neuropsychology. The implicit assumption is that patterns of preference reflect the lateralisation of other function in the cortical hemispheres (Zangwill, 1960). Behavioural self-report measures of lateral preference can be useful because they provide measures of habitual hemispheric preference that are less likely to be confounded by situational problems inherent in psychophysiological measures. However, they are also more indirect than physiological measures. Reviews by Dean and Reynolds (1997) and Kinsbourne (1970, 1974) review the controversies surrounding self-report measures and generally support the idea that differences in lateral preference reflect hemispheric preferences.

The current research focuses on ear preference as a differential indicator of hemispheric activity. Use of ear preference for this purpose is a straightforward and indirect way of measuring hemispheric asymmetry (Gullo, Jackson,

& Dawe, 2010; Jackson, 2005, 2008, Jackson, 2010; Jackson, Furnham, & Miller, 2001). Jackson (2008) demonstrates that ear preference is highly related to headset preference in telesales people, and provides evidence that ear preference is an index of action goal formation tendencies in specific support of Davidson's well-known model of laterality (e.g., Davidson & Sutton, 1995). Gullo et al. (2010) provide supplementary evidence in favour of the role of ear preference.

Right ear preference is indicative of left hemisphere activity based on the well-accepted superior contralateral connections between ear and brain compared to ipsilateral connections (e.g., Springer & Deutsch, 1993). Ear preference may therefore provide a biological marker of asymmetric hemispheric activity such that right ear preference is associated with left hemispheric activity and left ear preference is associated with right hemispheric activity. Jackson (2010) shows that ear preference is positively related to contralateral ear temperature and interprets this observation as being supportive of a model in which ear preference provides an index of contralateral hemispheric activity. Jackson (2008) shows that ear preference has a relatively small correlation of about $r = 0.4$ with hand preference which indicates that it is a different marker of asymmetries of hemispheric activity to hand preference.

THE CURRENT RESEARCH

The current research spans three studies and is designed to take advantage of existing measures of attention; namely attentional control (Derryberry & Reed, 2002) and ADIAS (Barrick et al., 2002). Also, it builds on Jackson's research on ear preference as a marker of biases in hemispheric activity (Gullo et al., 2010; Jackson, 2005, 2008, Jackson, 2010; Jackson et al., 2001).

The three studies are designed to test the proposed model in increasingly applied settings. Study 1 provides a laboratory test of the proposed model in which both scales of attention are used. This study determines if attentional control and ADIAS interact with ear preference in the prediction of the number of times a person stops progressing forward in a maze completion task (an objective perceptual measure likely associated with attentive people overly focusing on local stimuli). Study 2 builds on Study 1 by using the attention control × ear preference interaction to predict conceptual knowledge as measured objectively by local and global tests of knowledge. Study 3 builds on Study 1 by using the ADIAS × ear preference interaction to predict supervisor ratings of work performance that are known to be global as they are affected by the halo rating error (a tendency to rate people according to a global impression; Heneman, 1980; Holzbach, 1978; Sulsky & Balzer, 1988).

Hypotheses to be tested are:

- H1: The association between attention and outcomes related to local criteria will be stronger for left-hemispheric biased (i.e., right ear preferenced) workers.
- H2: The association between attention and outcomes related to global criteria will be stronger for right-hemispheric biased (i.e., left ear preferenced) workers.

STUDY 1: INTERACTION BETWEEN ATTENTION AND EAR PREFERENCE IN THE PREDICTION OF STOPPING IN A MAZE PERFORMANCE TASK

The aim of this study is to examine the proposed interaction between attention (measured as attentional control and ADIAS) and ear preference in the prediction of perceptual attention while performing a maze task. In this study the performance criterion was the total number of times fixated while progressing forward as a participant completed a series of mazes. We used this criterion as a marker of the number of times a participant is focusing attention on the next stage of the maze because it is likely to be pertinent to both attentional control and ADIAS.

Crowe, Averbeck, Chafee, Anderson, and Georgopoulos (2000) report that number of fixations of eye movements is a strong predictor of maze success and indicates that the person is focusing their mental resources on planning the next stage of progressing through the maze. This is a highly local and highly focused activity. We expected that people with high local attentional control would stop more to focus their attention on the next stage of the maze, and people with high attention related to achievement striving would also want to focus on the next step of achieving success.

Consistent with the hypotheses, it is argued that both attentional control and ADIAS in interaction with right ear preference would predict total number of times fixated.

Participants

Participants were 90 first-year students studying at The University of Queensland, Australia. Most participants were aged less than 20 years (78%), some were aged between 20 and 30 years (19%), and a few were above 30 (3%). The majority of participants were female (69%).

Procedure

Upon entering the experimental room participants were seated behind a desk and provided with a booklet of 10 identical mazes. Participants were instructed to focus on completion only, begin a fresh maze whenever they made a mistake, and were stopped after 5 minutes. Following the maze task participants completed electronically administered questionnaires in the same room. At all times they were under the supervision of a research assistant.

Independent variables

Attentional Control. Derryberry and Reed's (2002) scale consists of the following items: It's very hard for me to concentrate on a difficult task when there are noises around (R); When I need to concentrate and solve a problem, I have trouble focusing my attention (R); When I am working hard on something, I still get distracted by events around me. (R); My concentration is good even if there is music in the room around me; When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me. Each items is scored 1 = strongly disagree to 5 = strongly agree.

Derryberry and Reed (2002) argue that attentional control is different from effort (which has been measured in the applied literature) in that it includes only attention items, apart from more behavioural forms of inhibition. Derryberry and Reed note that the term attentional control is sometimes used to refer to a coping strategy that allows individuals to avoid depressogenic thought and reaction patterns (Teasdale, Segal, & Williams, 1995), but argue that their definition refers to a general capacity to control attention in relation to positive and negative reactions. Derryberry and Reed (2002) report that attentional control is internally consistent (alpha = .88), positively related to indices of positive emotionality such as extraversion ($r = .40$) and inversely related to negative emotionality such as anxiety ($r = -.55$).

ADIAS. This scale (Barrick et al., 2002) consists of the following items: I frequently think about getting my work done; I focus my attention on completing work assignments; I set personal goals to get a lot of work accomplished; I spend a lot of time thinking about finishing my work tasks; I often consider how I can get more work done. Barrick et al. (2002) do not utilise this scale but aggregate it with other measures to provide a more general measure of Accomplishment Striving. Each item is scored 1 = strongly disagree to 5 = strongly agree.

Moderator variable

Hand, Eye and Ear Preference Questionnaire (HEEP). The HEEP (Jackson, 2005, 2008, Jackson, 2010) consists of a 7-item ear preference scale, a 5-item eye preference scale, and a 10-item hand preference scale, and is an adaptation of the Lateral Preference Inventory (Coren, Porac, & Duncan, 1979). Coren et al.'s (1979) measure of lateral preferences has a demonstrated concordance of 92% between self-reports and direct behavioural observation. Example ear preference items used in the current questionnaire are: In which ear would you place the earphone of a transistor radio? If you wanted to listen to a conversation going on behind a closed door, which ear would you place against the door? What ear would you place against someone's wrist to listen to a ticking watch? A high score on the ear preference scale reflects a tendency to habitually prefer the right ear across multiple situations and a low score reflects a tendency to habitually prefer the left ear. In the current research, only the ear preference data were analysed. Each item is scored 1 = always left and 5 = always right with 3 = either left or right.

Dependent measure

Total Number of Times Fixated was measured within a modified version of the Porteus Maze Test (Porteus, 1965). Participants were given up to 10 attempts at completing the same, difficult maze, and the number of times fixated across all 10 mazes was computed. The Total Number of Times Fixated was defined as the number of times there was a gap in the continuous line drawn by the participant or where there was no forward movement on the line. Both are objective indications that the person focused their attention on the next part of the maze. The Total Number of Times Fixated was computed by a research assistant independent of the author team.

Procedure

Participants were instructed to complete a complex maze by drawing a continuous line though the maze towards the finish point. When participants made a mistake in completing a maze (i.e., where a dead end was met and the person was forced to double-back), they were instructed to begin a fresh maze from the start. The laboratory task was therefore ostensibly a learning exercise, such that a participant aimed to learn the correct route through the maze. Using different participants and for different purposes, O'Connor and Jackson (2008) used this task to measure learning which was defined as the total progress through the maze.

Statistical analyses

First, alpha reliabilities are assessed to show that the internal consistencies of the scales employed in the studies are at least adequate (defined as above 0.70). Second, the correlations between the scales are examined to show the inter-relationships between them. Third, hierarchical moderated multiple regression is used to identify significant main effects and interaction terms. All independent variables are mean-centred prior to the multiple regression procedure. At Step 1, Ear Preference and relevant scale of attention are entered. At Step 2, interaction terms between Ear Preference and scale of attention are entered. Significant interactions are then plotted (Jaccard, Turrisi, & Wan, 1990) to illustrate the relationship between the independent variable (such as Neuroticism) and its moderator (such as Ear Preference – 1 *SD* above and 1 *SD* below the mean) in the prediction of the relevant dependent variable. Simple slopes analysis of the interaction is reported to determine which slopes are significantly different from zero. Conservative two-tailed significance tests are used. Study 3 utilises hierarchical moderated regression due to the multilevel nature of the data.

RESULTS

Means, standard deviations, and correlations between focal variables in this study are summarised in Table 1. From Table 1 there is no direct relationship between the two measures of Attention and Total Number of Times Fixated in the maze. Also, Ear Preference has no direct relationship with any of the variables.

Next hierarchical moderated regression was used to predict Total Number of Times Fixated from the measures of Attention, Ear preference and their interaction. In the prediction of Total Number of Times Fixated using Attentional Control, there were no significant main effects but, after removal of one multivariate outlier, there was a significant Attentional Control × Ear Preference interaction ($\beta = .211$, $t = 1.976$, $p = .05$; $R^2 = .065$). Similarly in the prediction of Total Number of Times Fixated using Barrick et al.'s measure of ADIAS there were no main effects but there was a significant

TABLE 1
Means, *SD*, alphas and correlations of focal variables in Study 1 ($n = 90$)

	Mean	*SD*	*Alpha*	*Fixated*	*ADIAS*	*AC*
Total No. of Times Fixated (Fixated)	18.58	11.32				
ADIAS	18.47	3.89	.80	.19		
Attentional Control (AC)	37.42	8.77	.85	.04	.18	
Ear Preference	17.11	5.81	.82	−.12	.04	−.05

interaction after the removal of the multivariate outlier ($\beta = .268$, $t = 3.485$, $p = .001$; $R^2 = .113$). For both, note that the interaction terms were also significant without removal of the outlier.

The simple slopes of the interactions were plotted according to standard methodology (Jaccard et al., 1990). Attentional Control and ADIAS were positively related to the Number of Times Stopped for people with a right Ear Preference, $B = .254$, $t(85) = 2.83$, $p = .005$; $B = 1.119$, $t(85) = 2.594$, $p = .011$ respectively, but were not significant for people with a left Ear Preference, $B = -.236$, $t(85) = -1.32$, $p = .191$; $B = -.699$, $t(85) = -1.620$, $p = .109$ respectively.

Results of Study 1 suggest that the two measures of attention both positively predict Total Number of Times Fixated in a maze for people with a right ear preference but not for people with a left ear preference. As argued previously, contralateral connections between ear and brain suggest that right ear preference is an indicator of a bias towards left hemispheric activity, which is widely understood to be the centre of local as opposed to global attention strategies (e.g., MacNeilage et al., 2009). From this perspective, high attention leads to a greater number of stops in a maze for people who are locally attentive but not for people who are globally attentive. Such results are predicted from Crowe et al. (2000) who found the same pattern in terms of eye fixation.

Study 1 therefore presents initial evidence that attention both in terms of attentional control and ADIAS in interaction with right ear preference predicts local successful attention strategies. The strength of the current study is that total number of times fixated is a criterion that is common to both attentional control in terms of focused attention and avoiding distraction and ADIAS in terms of focused attention with a view to succeeding at the task. At the same time, a potential limitation of the study is that total number of times fixated in a maze is a relatively abstract measure. We argue it is a reasonable objective measure of focused attention on the next part of the maze given previous research on eye fixation being used in this respect (Crowe et al., 2000) but also acknowledge that this study on its own is not sufficient given the danger of misinterpreting an objective measure.

Study 2 and Study 3 are designed to progress the evidence in favour of an interaction between Attention and Ear Preference in the prediction of performance outcomes by determining how well Attention predicts criteria specifically chosen as being of local versus global performance for individuals with a right or left ear preference. Study 2 reports how Derryberry and Reed's (2002) Attentional Control predicts local and global knowledge over the short term, and Study 3 reports how Barrick et al.'s (2002) ADIAS predicts supervisor ratings of performance that are known to be global and more long term.

STUDY 2: INTERACTION BETWEEN ATTENTIONAL CONTROL AND EAR PREFERENCE IN THE PREDICTION OF GLOBAL AND LOCAL CONCEPTUAL KNOWLEDGE

This study uses two specific knowledge tests designed for this study, which differ in terms of being local and global perspective. We think that Attentional Control can be expected to interact with Ear Preference in the prediction of local and global knowledge tests given that studies suggest hemispheric asymmetry is important to conceptual attention (Derryberry & Reed, 1998; Friedman & Forster, 2005). The aim of this study is to determine if Attentional Control predicts objective measures of local and global conceptual knowledge. We propose that attentive people with a right ear preference should perform better on a local knowledge test and that attentive people with a left ear preference should perform better on a global knowledge test.

Participants

A total of 157 students in tertiary education (mean age = 20.61; $SD = 5.84$, 72.8% female) completed the questionnaire battery.

Measures

Attentional Control and Ear Preference. Both as Study 1.

Dependent variables. Two knowledge-based tests were developed by the first author to measure local and global knowledge relevant to students at The University of Queensland. The untimed tests were designed so that there was just a single correct answer. Participants selected their answer from a choice of four and were instructed to achieve the best score that they could. This is the first research to be conducted on these tests.

The local test measured knowledge of the School of Psychology in which students were undertaking their major and the global test measured knowledge of the university. Questions are shown in the Appendix.

Results

Means, standard deviations, alphas, and correlations are shown in Table 2. Alphas of Attentional Control and Ear Preference are both very high and similar to Study 1. We do not report the alphas of the knowledge tests since it is widely considered inappropriate for criterion referenced tests due to low within item variability (Shrock & Coscarelli, 2007). Both Local and Global Knowledge are not significantly correlated with either Ear Preference or

Attentional Control. As might be expected, there is a small but significant correlation between Local and Global Knowledge scores.

In the prediction of Local Knowledge, using moderated multiple regression, Ear Preference and Attentional Control were not significant, but Ear Preference × Attentional Control was significant ($B = .225$, $t = 2.583$, $p = .011$) with $R^2 = .05$. In the prediction of Global Knowledge, the main effects were not significant, but the Ear Preference × Attentional Control was significant ($B = -.163$, $t = -1.919$, $p = .05$) with $R^2 = .025$.

Simple slopes of the interaction terms were plotted. In the prediction of Local Knowledge, Attentional Control was marginally positively related to performance for individuals with a Right Ear Preference, $B = .079$, $t(135) = 1.842$, $p = .067$, whereas Attentional Control was negatively related to performance for individuals with a left Ear Preference, $B = -.107$, $t(135) = -2.071$, $p = .040$. In contrast, in the prediction of General Knowledge, Attentional Control was positively related to performance for individuals with a Left Ear Preference, $B = .050$, $t(151) = .049$, whereas Attentional Control was negatively related to performance for individuals with a Right Ear Preference, $B = -.043$, $t(151) = -1.987$, $p = .049$.

Results of this study generally support the hypotheses such that Attentional Control marginally predicts Local Knowledge for individuals with a right ear preference (i.e., a preponderance of left hemispheric activity) whereas Attentional Control predicts General Knowledge for individuals with a left ear preference (i.e., a preponderance of right hemispheric activity).

Interestingly, in this study an antagonistic effect was also found such that low Attentional Control in people with a left ear preference (i.e., opposite to the theory) were high performers in the prediction of Local Knowledge and Low attentional and right ear preference (again opposite to the theory) were high performers in the prediction of General Knowledge. Such results suggest that low Attentional Control can be a useful strategy when using the opposite hemisphere to the one that is most suited to the presented material. We believe that these opposite findings reflect an antagonistic system such that Attentional Control is not a predictor of Local or General Knowledge unless the moderating effect of Ear Preference is included in the model.

TABLE 2
Means, *SD*, alphas and intercorrelations of variables from Study 2 ($n = 157$)

	Mean	*SD*	*Alpha*	*LK*	*GK*	*AC*
Local Knowledge (LK)	10.54	2.27	–			
Global Knowledge (GK)	6.12	6.12	–	.18*		
Attentional Control (AC)	38.53	7.72	.83	−.03	.09	
Ear Preference	24.15	5.84	.91	−.07	.11	.08

*$p < .05$, two-tailed.

Jackson (2008) finds antagonistic effects in the prediction of Disinhibition from Neuroticism × Ear Preference interactions and Jackson (2005) reports how there are similar effects in the prediction of Extraversion and Neuroticism from cognitions in interaction with Ear Preference. Our results do suggest that there is more than one technique for doing well on knowledge tests and suggest that sometimes low Attentional Control (i.e., being easily distracted) can lead to greater knowledge. This may not be completely counterintuitive as our knowledge tests were designed to measure a collection of local and global facts which may be just as easily learned by "skimming and flitting" through information as opposed to focused attentional control.

Study 2 examines how Derryberry and Reed's (2002) Attentional Control was a predictor of local and general knowledge over the short term. Study 3 focuses on how Barrick et al.'s ADIAS is moderated by Ear Preference in the prediction of supervisor ratings of performance. This is interesting since supervisor ratings of performance are known to provide a global assessment of subordinate performance compared to self-ratings of performance (Heneman, 1980; Holzbach, 1978; Sulsky & Balzer, 1988).

STUDY 3: INTERACTION BETWEEN ADIAS AND EAR PREFERENCE IN THE PREDICTION OF SELF AND SUPERVISOR RATINGS OF PERFORMANCE

It has been observed that supervisors and a follower tend not to agree perfectly about that follower's job performance (e.g., Bernardin & Beatty, 1984; Borman, 1974; Harris & Schaubroeck, 1988; Mount, 1984; Murphy & Cleveland, 1995). A meta-analysis of supervisor and self-ratings provides evidence that employees' self-ratings are only modestly correlated with supervisor-rated performance (Harris & Schaubroeck, 1988). According to DeNisi, Cafferty, and Meglino (1984), performance appraisal consists of observation of behaviour by a rater, formation of some cognitive representation of this behaviour, storage of this representation in memory, retrieval of the stored information at the time of evaluation, reconsideration and integration of the retrieved information with other items of information, and finally the assignment of a formal evaluation to the individual. Given the relative complexity of the above process, and the known limitations on human information-processing capacity (March & Simon, 1958; Newel1 & Simon, 1972; Simon, 1981), researchers have concluded that supervisors typically simplify the appraisal task. In particular, Cooper (1981) argued that supervisors will tend to recall an overall impression of the follower rather than the specific behaviours in an attempt to cope with the task's cognitive demands.

Rating according to a global impression is known as the halo error (e.g., Jackson, 1996; Landy & Farr, 1980) and arises when a rater fails to distinguish specific job dimensions in the appraisal process and instead employs global assessment. A rating source that produces large intercorrelations indicates greater halo effect and research shows that intercorrelations of supervisor ratings are consistently higher than corresponding intercorrelations for self-ratings (Heneman, 1980; Holzbach, 1978; Sulsky & Balzer, 1988). Evidence, therefore, firmly argues that supervisor ratings of performance are more global then self-ratings of performance.

Study 3 predicts that ADIAS will be positively associated with supervisor ratings of performance for followers who have a left ear preference. It is considered that followers with a left ear preference attend to global issues and may therefore focus their work efforts on generalised work behaviours similar to those used by supervisors who provide ratings based on global assessments.

Strengths of this study are that Barrick et al.'s (2002) ADIAS is conceptualised as the average of self and supervisor ratings to provide a more objective measure of attention that is not biased by a single perspective. Moreover, the use of supervisor ratings of performance provides another opportunity to use a criterion that is not self-report, thereby minimising the potential biasing effects of common method variance. Finally, use of supervisor ratings as the criteria will demonstrate the utility of the proposed model in the applied setting of work.

Method

Participants and procedure. The study was conducted in three Australian organisations: (1) a not-for-profit aged care and retirement facility which provides a range of accommodation options for approximately 400 senior and aged persons; (2) a community-based healthcare organisation that provides human service activities, and (3) a metropolitan council.

In the first organisation employees were either personally handed a survey by the researcher at team meetings, or received the survey by post. Reply-paid, university-addressed envelopes were included so that surveys were directly mailed back to the university researchers. In this organisation a total of 174 surveys were administered and a total of 78 employees participated, which represents a 44.8% response rate. The supervisors of 67 of these 78 employees provided ratings. Thus complete employee–supervisor data were obtained for 67 employees, which equates to a 38.5% response rate. Of the employees, 55 were female and 8 were male. The age range was 19 to 68 years, with a mean age of 45.09 years ($SD = 10.03$ years). The amount of

time the employees had worked in the organisation ranged from 1 to 24.75 years, with an average of 6.94 years ($SD = 6.04$ years).

In the second organisation a research assistant administered surveys at group meetings in the central office, and posted surveys to all employees based at other locations. Reply-paid, university-addressed envelopes were included so that surveys were directly mailed back to the university researchers. In this organisation a total of 500 surveys were administered and a total of 234 completed surveys were received which represents a 46.8% response rate. A total of 44 supervisors provided job performance ratings for 179 of these 234 employees. Due to missing data on the variables of interest in this study, nine cases were removed. Thus complete employee–supervisor data were obtained for 170 employees, which equates to a 34% response rate. Of the employees, 145 were female and 23 were male (2 non-respondents). The age range was 15 to 79 years, with a mean age of 45.63 years ($SD = 12.96$ years). The amount of time the employees had worked in the organisation ranged from 0 to 30 years, with an average of 5.90 years ($SD = 6.36$ years).

In the third organisation a research assistant again administered surveys at group meetings in the central office, and posted surveys to all employees based at other locations. Reply-paid, university-addressed envelopes were included so that surveys were directly mailed back to the university researchers. Complete employee–supervisor data were obtained for 47 employees, which equates to a 41% response rate. Of the employees, 22 were female and 25 were male. The age range was 21 to 57 years, with a mean age of 38 years ($SD = 8.48$ years). The amount of time the employees had worked in the organisation ranged from 0.08 to 55 years, with an average of 13.03 years ($SD = 12.07$ years).

Measures. The measurement of attention, Ear Preference, and the outcome variables of interest were separated within a nine-page questionnaire and interspersed with other variables of interest to a larger applied project.

Self-ratings of Barrick et al.'s ADIAS Scale. As Study 1.

Supervisor ratings of Barrick et al.'s ADIAS Scale. In this scale the items were slightly altered to reflect the supervisor's rating of the individual. For example the first item was: He/she frequently thinks about getting her work done.

Ear Preference scale. As Study 1.

Supervisor-rated job performance. The same five items developed by Gould (1979) and six items adapted from Viswesvaran, Schmidt, and Ones (2005) were used to measure job performance. Using a 5-point Likert scale (1 = poor to 5 = excellent), supervisors were asked to respond honestly

and openly to statements concerning the work standards of all of their direct reports.

Supervisor-rated Altruism. Altruism was measured with three items by MacKenzie, Podsakoff & Fetter (1993). Supervisors were asked to rate the following statements in relation to the work conduct of each of his/her direct reports: "Helps others who have heavy workloads", "Helps others who have been absent", and "Willingly helps others who have work related problems". This measure provides a second measure of performance and is notable because altruistic performance is about seeing the "bigger picture" of how helping others provides for likely greater success than simply focusing on the smaller picture of just one's own performance.

Statistical analysis. We used multi-level modelling procedures to analyse the data (Bryk & Raudenbush, 1992) and the effect of organisation was modelled as fixed effect dummy variables at Level 2 (i.e., the supervisor level). Consistent with moderation procedures outlined by Aiken and West (1991), Ear Preference and ADIAS were grand mean-centred. We compare the empty or variance components model with an unconditional model containing the explanatory variables at the individual level. The reduction in magnitude of the individual and supervisor level variance values (R^2 explained) between these models is comparable to effect sizes (Zickar & Slaughter, 1999).

Results

Table 3 reports the descriptive statistics, intercorrelations, and internal consistency reliability of the variables. As might be expected, ADIAS is significantly positively correlated with the self-rated and supervisor rated performance variables, which indicates at the most simple level the importance of attention as a predictor of work-related outcomes. Ear Preference is unrelated to work-related outcomes.

Tables 4 and 5 show the results of the multi-level models for the outcome variables. The first model fitted was the variance components model without any predictors and this is shown in Table 4. In the second model, shown in Table 5, the fixed effect variables were added as explanatory variables.

For supervisor-rated job performance the variance at the individual level was 78.67% and at the supervisor level it was 21.33%. The fixed effect variables and interaction term were added and, in combination, these variables accounted for 74.80% of the variability at the supervisor level, and 18.66% of the variability at the individual level. The change in deviance also was significant, $\Delta\chi^2(5) = 302.57$, $p < .001$. As indicated by the significant beta weight associated with "Organisation 2 Dummy", employees in Organisation 2 had a significantly lower level of supervisor-rated job

TABLE 3
Descriptive statistics, intercorrelations, and reliability coefficients of Study 3 variables

	Mean	*SD*	*Alpha*	*ADIAS*	*EP*	*SUP-JP*
ADIAS	19.91	3.41	.80 /.90 ~			
Ear Preference (EP)	22.57	7.41	.92	0.08		
Supervisor-rated Job Performance (SUP-JP)	41.99	8.41	.83	0.51***	−0.01	
Supervisor-rated Altruism	16.78	3.46	.95	0.40***	−.02	0.65***

***$p < .001$, two-tailed.
~the reliability for self-rated attention was 0.80 and the reliability for supervisor-rated attention was 0.90.
Total $n = 284$.

performance compared to Organisation 3. ADIAS was a significant, positive explanatory variable of job performance. The interaction between Ear Preference and ADIAS was significant, $\beta = -1.01$, $t(275) = -2.28$, $p = .023$.

The interaction indicates the slopes are significantly different from each other. Simple slopes analysis shows that the slope for Left Ear Preference is significantly steeper than the slope for Right Ear Preference although both are significantly different from zero: Right Ear Preference: $\beta = 3.40$, $t(278) = 5.02$, $p < .001$; Left Ear Preference: $\beta = 5.42$, $t(278) = 6.44$, $p < .001$.

For supervisor-rated altruism, 70.80% of the variance was distributed at the individual level, and 29.20% of the variance was distributed at the supervisor level. The fixed effect variables and interaction term were added and, in combination, these variables accounted for 55.37% of the variability at the supervisor level, and 9.38% of the variability at the individual level. The change in deviance was significant, $\Delta;\chi^2(5) = 54.83$, $p < .001$. As indicated by the significant beta weight associated with "Organisation 1 Dummy", employees in Organisation 1 had a significantly higher level of

TABLE 4
Variance components models for each of the response variables in Study 3

	Variance components		
	Level 1: Individual	*Level 2: Supervisor*	*Deviance (parameters estimated)*
Supervisor-rated Job Performance	57.52921	15.60188	1977.610277 (3)
Supervisor-rated Altruism	8.90629	3.67383	1469.614735 (3)

TABLE 5
Multi-level analysis for interaction effects between attention and ear preference on supervisor-rated response variables in Study 3

	Supervisor-rated job performance	*Supervisor-rated altruism*
	Parameter estimate (SE)	*Parameter estimate (SE)*
Fixed effects		
Intercept	43.439481 (0.816235)***	17.064335 (0.393503)***
Organisation 1 Dummy	0.489706 (0.888437)	0.866993 (0.433247)*
Organisation 2 Dummy	−2.387388 (1.06227)*	−0.731363 (0.494778)
Ear Preference (EP)	−0.317941 (0.369363)	−0.217876 (0.157884)
ADIAS	4.407498 (0.621561)***	1.399353 (0.223284)***
EP x ADIAS	−1.010042 (0.443126)*	−0.437391 (0.215371)*
Random effects		
Supervisor-level variance	3.93161	1.63955**
Individual-level variance	46.79198	8.07076
Deviance	1881.660859	1414.786556
Parameters estimated	8	8

Organisation 1 Dummy compares Organisation 1 to Organisation 3; Organisation 2 Dummy compares Organisation 2 to Organisation 3.
*$p < .05$, two-railed; **$p < .01$, two tailed ***$p < .001$, two-tailed.

altruism compared to Organisation 3. ADIAS was a significant, positive explanatory variable of altruism. The interaction between Ear Preference and ADIAS was significant, $\beta = -0.44$, $t(275) = -2.03$, $p < .05$.

Simple slopes analysis of this interaction shows that people with a left ear preference had a stronger relationship with supervisor rated altruism than people with a right ear preference. There was a positive association between ADIAS and Supervisor-rated Altruism for followers with a right ear preference, $\beta = 0.96$, $t(278) = 3.42$, $p < .001$. And for individuals who had a left ear preference, this association also was significant, $\beta = 1.84$, $t(278) = 5.46$, $p < .001$.

In summary, in predicting supervisor ratings of job performance and Altruism, the ADIAS ratings of people with a left ear preference were more predictive than the ADIAS ratings of people with a right ear preference. Supervisor ratings that are known to be general in perspective are significantly more related with the attention of followers with a *global* perspective (left ear preference, right hemispheric preference). Moreover there was some evidence of differences between organisations, but these differences were controlled by the use of dummy variables.

Results provide reasonably strong evidence in support of attention being an important predictor of work related outcomes such that it was a

significant main effect for all dependent variables, and in support of the hypotheses, more strongly related to ratings of global tasks for individuals with a left ear preference. Such findings support evidence concerning the neuropsychological basis of attention (e.g., MacNeilage et al., 2009). Such findings suggest that the way to get ahead in the workplace (as indicated by supervisor assessment) is be attentive to strategic and global as opposed to focusing on more minor and specific issues.

DISCUSSION

The role of attention has been extensively studied by neuropsychologists in the laboratory with the relatively robust findings that attention is worthy of study and that the left hemisphere represents and processes information in a calculating, detailed manner, while the right hemisphere represents and processes information in a more global style (Banich, 2004; Hellige, 1993; MacNeilage et al., 2009). Most studies concerning these robust findings are laboratory based, in which the implications for real-life behaviour are quite limited. This is probably because many of the techniques used to measure laterality and attention are difficult to use outside the laboratory. Indeed, our literature review indicates that the role of attention in organisational psychology has been generally overlooked with more work focusing on effort.

We present three studies concerning the role of conceptual attention. We utilise two scales of attention. Attentional Control measures focused attention to a task as opposed to distractors such as theats etc., and has been used in the neuropsychological literature (see Derryberry & Reed, 2002). ADIAS is one of the few attention scales to be found in the organisational literature (Barrick et al., 2002). We consider the effects of hemispheric asymmetries through the use of ear preference, which has a recent history of use for this purpose by Jackson and colleagues (Gullo et al., 2010; Jackson, 2005, 2008, Jackson, 2010; Jackson et al., 2001).

The studies report our research programme, which aimed to test our model of attention in a controlled laboratory setting (Study 1), in a task that specifically measures local versus global criteria (Study 2), and in the workplace (Study 3). The current research presents a way of measuring these variables in a way that can easily be used in the workplace. Our use of questionnaires provides a methodology that provides easy and economically priced administration in an acceptable format to people in a work environment (or similar) who would be unwilling or unable to come to a laboratory.

Study 1 was a laboratory study designed to test our model of how attention interacts with ear preference. We chose a criterion that we thought would be predicted by both attentional control and ADIAS in interaction

with Ear Preference. In Study 1 attention was positively related to the total number of stops in maze completion for people who are locally attentive. This was shown to be true for attentional control and ADIAS such that someone who can focus their attention needs to stop more if they have a right ear preference and therefore a local focus. This result indicates that that attentive but locally directed people need to stop more frequently while focusing attention on the next stage of the maze. The interpretation of total number of times fixated follows that of Crowe et al. (2000) who made a similar case in terms of eye fixation.

Study 1 might be interpreted as a mainly perceptual attentional study, but the study shows that knowledge tests specifically designed to measure global and local conceptual knowledge can also be explained by an Attentional Control × Ear Preference interaction. Results showed that high attention and a bias to the left hemisphere (right ear preference) provided higher scores on a local knowledge test, while high attention and a bias to the right hemisphere (left ear preference) provided higher scores on a global knowledge test. Study 1 and Study 2 support the neuropsychological literature (MacNeilage et al., 2009; Mevorach et al., 2005) and begin to show that our proposed mechanism might predict variables of interest within the organisational domain.

Study 3 tests the proposed model in the prediction of supervisor ratings of performance. Study 3 used two criteria. The first was a straightforward measure of supervisor-rated work performance, and the second was a measure of supervisor-rated follower altruism or how likely the follower was to help others. We think both measures are indicative of a global perspective and show the importance of lateral preference effects on attention in the workplace. With regard to supervisor ratings of work performance, these are known to be globally based (Heneman, 1980; Holzbach, 1978; Sulsky & Balzer, 1988). Altruistic performance by followers is also likely to be global because it shows a focus on group as opposed to personal performance.

This study first demonstrated the importance of conceptual attention as a practically relevant predictor of organisational outcomes. Secondly, it showed that people with left ear preference (right hemispheric bias or global focus) and who are high in ADIAS are rated as being good workers by supervisors. Such a finding provides support for the proposed theoretical model. Third, our results highlight an interesting mechanism related to the halo rating error in supervisors. Generally, the halo rating error is understood to be a function of the rating process or due to limited information-processing capacity of leaders (DeNisi et al. 1984; Jackson, 1996; March & Simon, 1958; Newel1 & Simon, 1972; Simon, 1981). Our findings suggest that supervisors have a global perspective and that they will tend to rate highly the followers who are attentive and who have a global perspective. From this perspective the halo rating error is a self-fulfilling tendency, as this

means that global thinking followers will tend to get promoted. Nevertheless, a global tendency is a useful perspective in supervisors who will need to see the "bigger picture" compared to followers.

This research is not without its limitations. We do not think that the idea of local versus global biases in both visual and conceptual attention across the hemispheres is overly controversial given the strong evidence in its favour (MacNeilage et al., 2009; Mevorach et al., 2005), nevertheless it needs to be noted that controversy exists. Some researchers advocate that hemispheric asymmetries are more associated with language, visual and auditory perception, emotion, and motor control rather than attentional processes (Banich, 2004; Bryden, 1982; Hellige, 1993; Ivry & Robertson, 1998).

Perhaps a more important limitation concerns how we have operationalised asymmetry across the hemispheres as self-reported ear preference. This is because ear preference is an indirect measure of hemispheric biases of activity. We have good reason to use this method based on prior research by Jackson (2005, 2008, Jackson (2010)) and Gullo et al. (2010). Other researchers agree. Furnham, Richardson, and Miller (1997) investigated and rejected many of the possible confounding variables that might cause differences in ear preference such as differences in number of incoming calls and time spent on the telephone between left- and right-preference users. Furnham et al. (1997) also dismiss a link between ear preference and handedness. One further limitation to our research is our use of two new measures of global and local knowledge that have not been used previously. To minimise potential issues here we have presented the items in full in the Appendix. One further important limitation is that we have proposed a model in which ear preference interacts with attention to predict work-related outcomes. This provides a useful statistical model of how these variables operate but does not provide physiological information about how this might happen in the brain. Nevertheless, it is important to recognise that this research brings into the organisational domain two new, important and unusual predictors, which the literature seems to have overlooked.

However, there are also some major strengths with the research as well. Our three studies measure a range of objective criteria (Study 1: maze performance; Study 2: global and specific knowledge; Study 3: supervisor ratings of job performance) and Study 3 also benefits from attention being measured as the average of supervisor and follower reports, as opposed to simply being measured by follower self-reports. Our use of objective measures across all studies ameliorates concerns about the inflationary effects of common method bias. Moreover, we have demonstrated the effect with two different measures of attention already available in the literature. We demonstrate the effectiveness of attentional control in the prediction of performance in a short-term knowledge test and ADIAS as a predictor of workplace performance.

In summary, this research provides an initial examination of the interaction between attentional asymmetries and attention in the prediction of various different outcomes within the organisational domain. Our research demonstrates that attention is an important variable in predicting outcomes in the field of organisational psychology, and that attention to global and specific criteria is crucial in understanding how attention predicts performance. The research builds on, and applies, the neuropsychological literature to the field of organisational psychology.

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APPENDIX

The Local Knowledge Test measured knowledge of the School of Psychology with the following questions:

1. Who is the course coordinator for PSYC 1030?
2. How long is the Bachelor of Psychological Science degree?
3. What is required in order for someone to practice as a registered psychologist?
4. Who is the head of the psychology department at UQ?
5. What is the GPA requirement for Bachelor of Psychological Science student to undertake the Honours programme?
6. Can you become a registered psychologist without completing an Honours degree?
7. How many core second year subjects are there?
8. Which of the following is NOT a course component for either PSYC1030 or PSYC1020?
9. The mid-semester exam for PSYC 1020 and PSYC 1030 is worth?
10. What is the minimum requirement for studying second year psychology courses?
11. Which of the following is NOT a first year psychology course?
12. The final examination for both PSYC 1020 and 1030 is worth?
13. Which second year course is only available to Bachelor of Psychological Science students?
14. To enter forth year students must complete?
15. How many core third year subjects are there?
16. The School of Psychology is part of which university school?
17. Who is the course coordinator for PSYC 1020 in semester 1, 2006?

18. The essay assignment for PSYC 1020 and PSYC 1030 is worth?
19. What is the maximum number of credit points you can receive for research participation?
20. There are _____ specialisation areas at the third year level.

The Global Knowledge Test measured knowledge of the University with the following questions:

1. Student Support Services provide?
2. The name of the campus bar?
3. In what year was UQ established?
4. Parking is free at the St Lucia and Ipswich campuses?
5. Where is the Student Centre located?
6. Which is the newest UQ campus?
7. Which one of the following services is NOT provided as part of the UniSafe program?
8. Is UQ a member of the Group of Eight?
9. In semester 1, 2006, who pays the Student Services Charge?
10. How many libraries does UQ have over the three campuses?
11. Which of the following sporting facilities is NOT located at your campus?