PSYCHOLOGY MISCELLANY

No.99 - September 2017

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ISSN: 1754-2200

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An independent academic psychologist, based in England, who has written extensively on different areas of psychology with an emphasis on the critical stance towards traditional ideas.

A complete listing of his writings at http://psychologywritings.synthasite.com/ and http://kmbpsychology.jottit.com.

CONTENTS

1. DETECTING LIARS BY LISTENING NOT WATCHING

1.1. INTRODUCTION

The ability to detect deception is crucial for the police. The traditional theoretical basis to detecting deception is "cue theories" (eg: Ekman 2001), which assume that lying and truth telling are psychologically different, and the observer looks for indirect cues to lying, say (eg: autonomic nervous system arousal; non-verbal cues) (Levine 2015).

But the accuracy at detecting lies/deception is marginally better than chance (50% accuracy) according to a meta-analysis of forty years of research (Bond and De Paulo 2006).

Levine (2015) reported work at his laboratory and elsewhere that challenged this view (eg: over 70% accuracy; Levine et al 2014a).

Levine (2015) explained the difference as down to a "recent change in theoretical perspectives", which has led to "changes in research design and research focus", and in turn to "improved findings" (p1).

The change in perspective depends in part on a survey by Park et al (2002), which asked individuals to think about a time when they had successfully detected deception. Two ways of doing this emerged from the answers - comparing what is said to facts/evidence, and persuading the liar to confess the truth.

1.2. COMPARING WHAT IS SAID TO EVIDENCE

i) "Strategic use of evidence" (SUE) approach.

This compares what is said with factual information (ie: "fact-checking"). The interviewee is confronted with factual inconsistencies until they are trapped, and hopefully confess their lies.

But it does require the ability to fact-check to work.

Example of research: Hartwig et al (2006)

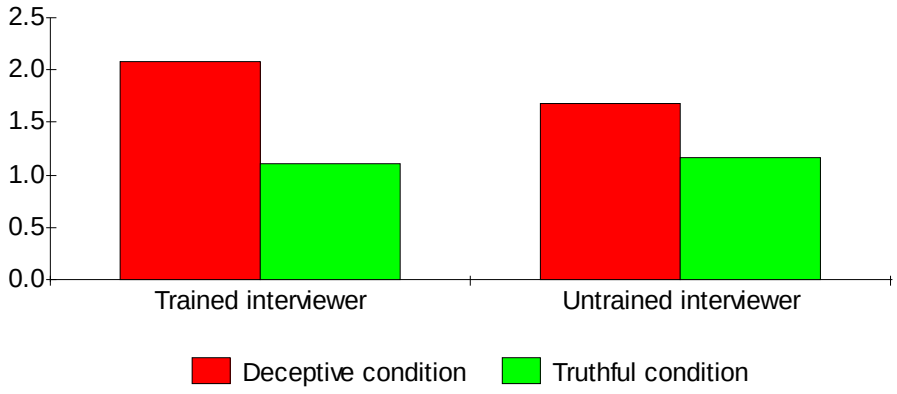
Eighty-two US undergraduates were instructed to individually go to a local bookshop and either steal a

particular piece of paper (deceptive condition) or look at it (truthful condition). The students were then interviewed for forty-five minutes by 82 police trainees, who had either received three hours of training on SUE or not.

The training encouraged the interviewer to plan questions based on the evidence they had, in order to trap the suspect with obvious lies (eg: witnesses see suspect but suspect denies in vicinity). Put simply, the "trained interviewers were taught to ask specific questions concerning the evidence without disclosing it. The reason for stressing this strategy in the training was that we believed this would make salient the differences in verbal strategies and consequently verbal behaviour between truth tellers and liars" (Hartwig et al 2006 p615).

All interviewers read a case-file before the interview, which included a "witness" to the "crime", and a fictitious copy of the suspect's fingerprints from the bookshop.

The interviewers in the trained condition had an overall accuracy of 85% compared to 56% in the non-trained condition. Trained interviewers were significantly better at detecting liars as these interviewers detected more statement-evidence inconsistencies (figure 1.1).



(Data from Hartwig et al 2006 table 3 p614)

Figure 1.1 - Mean number of statement-evidence inconsistencies found by interviewers.

Hartwig et al (2006) noted two key differences between trained and untrained interviewers - "we found that the untrained interviewers were more prone to disclose evidence at the outset of the interview than were the trained interviewers. Moreover, on the whole the trained interviewers asked more specific questions relating to the evidence (without disclosing the evidence in these questions)" (p615).

ii) "Content in context" (CiC) approach.

"Content refers to communication content; careful listening to what is said and assessment based on the meaning of words rather than communicator demeanour or cues. Context refers broadly to the situation in which the communication occurs. The key idea is that content is useful when what is said is understood in context but misleading when taken out of context or absent context" (Levine 2015 p3).

Blair et al (2010) outlined three types of knowledge that aid "content in context". They stated: "Context can also provide information about what is normal or possible in a given situation. This normative information can come in a wide variety of forms. These include, but are not limited to: knowledge about the sender's normal activities; beliefs about how a given situation typically unfolds; the laws of physics and nature; and, information about how people normally perform in a given situation" (Blair et al 2010 p425).

As well as direct contradictory evidence, there is "idiosyncratic information", which "does not directly reveal deception; rather, it points to a higher probability of deception occurring" (Blair et al 2010 p425).

Example of research: Blair et al (2010)

Blair et al (2010) performed ten studies, five of them based around videotaped interviews with individuals who claimed to have not cheated on a trivia game. The interviews were created by Levine in 2007.

Study 1 (experiment) - Twenty-six US undergraduates watched twelve interviews (of which half were liars) and judged who was lying. Then the participants were "informed that the questions in the trivia game were difficult and that they should pay special attention to what the interviewees said about their performance" (p427), before watching the interviews again. Accuracy did not significantly improve, and in both cases was poor (56% and 59% correct respectively).

Blair et al (2010) commented that this "failed to support our prediction that the content in context is useful in enhancing deception detection accuracy. Alternative explanations for the results are that our thinking is simply wrong, that the content in context can be useful, but the tapes simply did not contain sufficient content, that the context information induction was too weak, or that the subjects simply did not take the experiment seriously and consequently failed to use available content because of a lack of effort" (p428).

Study 2 - The aim of this study was to code contextually useful content in the videotaped interviews. Two coders viewed one hundred of Levine's videos. Though the interviewees were never asked their score in the trivia game, the coders distinguished liars as making comments that inferred a high score more often and honest interviewees low scores. Using this "rule of thumb", accuracy around 70%.

Study 3 (experiment) - Forty-six US undergraduates on criminal justice courses watched the interviews used in Study 1, but were given an incentive to concentrate. After the first watch, the participants were told that the trivia questions were very difficult. There was a significant improvement in accuracy after the second watching with a mean of 77% (up from 61%). "The results of Study 3 suggested that when participants were made aware of useful contextual information, and when participants were motivated to attend to that information, improved deception detection accuracy was achieved" (Blair et al 2010 p433).

Study 4 (experiment) - Fifty-one students from a similar background to Study 3 performed an independent groups design-version of the experiment. Participants viewed ten videotaped interviews of confessions to a mock crime (half false), either in a control or context-informed condition. The latter condition included the participants reading a "case file" about the "crime" compared to no information in the control condition. Accuracy of detection of honest and lying interviewees was 33% in the control condition compared to 80% in the context-informed condition. "Access to contextual information improved overall accuracy and hit rates while reducing false alarms" (p434).

Study 5 (experiment) - Twenty-five students watched four videotaped interviews created by Horvath et al (1994) involving "real-life" employee theft of money from an employer. Tow interviewees were honest and two lying. Participants received background information or not. Overall accuracy was 69% in the context-informed condition compared to 42%.

Blair et al (2010) noted that the "suspects in these videos did not explicitly contradict the information in the case files at any time during their interviews. Although there is the possibility that the case file provided some normative information regarding the propensity of suspects to commit the theft (such as age, job title, and length of employment), the files were awash in idiosyncratic information about the activities of the suspects around the time of the theft, and we believe that it is this information that provided the relevant content in context cues" (p435).

Study 6 (experiment) - One hundred and twenty-seven students watched twelve videos as in Study 1 in one of four conditions (ie: with two independent variables) - context information or not, and contextually relevant content (asked about score on trivia game or not). Accuracy was highest in the condition of context information and score on trivia game known (73%) (figure 1.2). This showed that "both knowledge of context and context-relevant content are needed for enhanced accuracy. In the absence of either of the elements, lower levels of accuracy are observed" (p436).

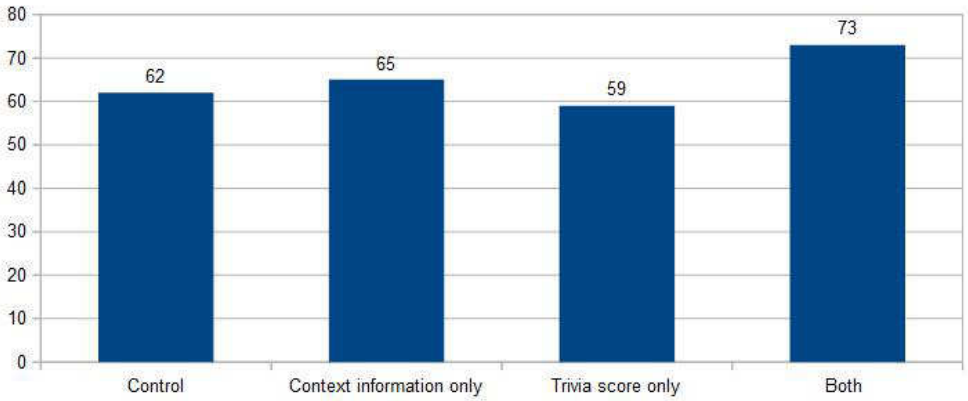


Figure 1.2 - Mean overall accuracy (%) in Study 6.

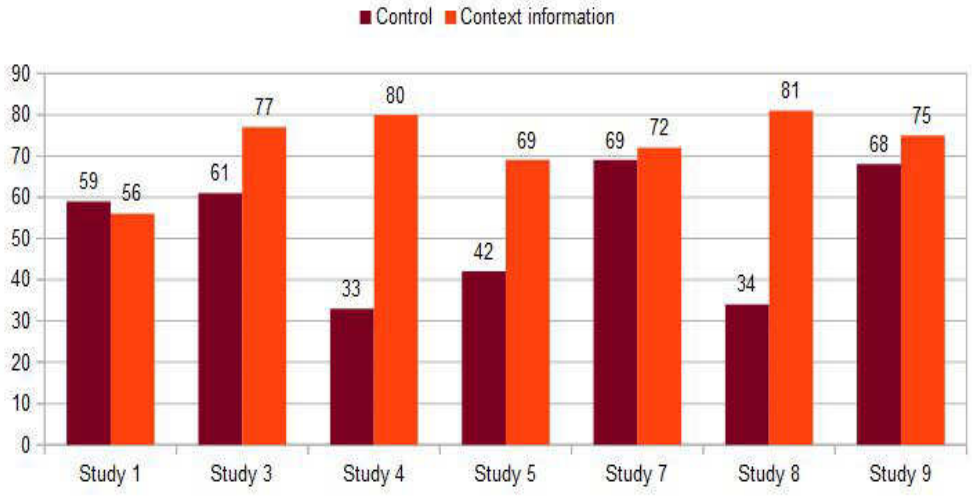
Study 7 (experiment) - Sixty-six experienced criminal investigators watched the videos from Study 1 either with context information or not. Overall accuracy did not vary between the two groups, but the context information condition had significantly more hits (ie: spotted lying) (71% vs 58%).

Study 8 (experiment) - The participants from Study 7 watched the videos used in Study 4. Overall accuracy was 81% in the context information condition compared to 34%.

Study 9 (experiment) - The same participants watched the videos used in Study 5. There was no significant difference between context and control groups, and this was because the control group was highly accurate (68%) (figure 1.3). Blair et al (2010) explained the findings thus: "It could be that that the experienced investigators inferred contextual relevance without being given explicit information, or that they picked up on other types of useful information" (p438).

Study 10 - This final study was a mini-meta-analysis of all the other studies (except Study 2). The average level of accuracy was 75% for the context information

conditions compared to 57% in the control conditions.



(Data from Blair et al 2010 table 1 pp429-430)

Figure 1.3 - Mean overall accuracy (%) in Studies 1, 3, 4, 5, and 7-9.

Discussing the studies overall, Blair et al (2010 noted the difference in context information available, which they conceptualised as a continuum. "At the origin of the continuum are those contexts that do not provide the deception judge with information that can assist his or her judgments. At the extreme right-hand side of the continuum are those contexts that provide the judge with so much information as to make veracity judgments trivial. A situation wherein a judge is asked to determine whether or not a nurse is lying about the content of a video would lie near the origin. Situations wherein a6'10'', heavily muscled individual with a deep voice, thick beard, and other masculine features claims to be female would be located toward the right side of the continuum" (p439).

But how much information is available t in real-life as all the studies were artificial, particularly in the sense that the experimenters knew the correct answer? For example, a police officer interviewing a suspect does not have the right answer available. Blair et al (2010) were upbeat: "we believe that outside the controlled conditions of the deception lab, a substantial number of contexts are located to the right of the origin of the continuum. That is, many (if not most) everyday deception contexts provide the judge with at least some meaningful contextual information" (p439).

c) "Situational familiarity" approach.

Interviewers familiar with a topic and context are better to assess the truth of content.

According to Stiff et al (1989), individuals judge the honesty of information based on verbal content in familiar situations, but in "unfamiliar situations, when people feel unable to do so, they use cultural expectations (heuristics) for what a liar 'looks like' (eg: the frequency of movements) to come to a decision" (Reinhard et al 2013 p54). This is also the case with perceived familiarity (ie: the subjective feeling of familiarity) (Reinhard et al 2013).

Example of research: Reinhard et al (2013)

Ninety-eight students at a German university watched short videos of individuals describing their driving test, of which half were truthful (ie: already done) and half false (ie: would take in future). The familiarity was manipulated by using the local town as the site of the reported driving test or another city far away. Each participant watched four videos and rated the truthfulness on a scale of 1 (deceptive) to 10 (truthful), along with their confidence in the judgment.

For accuracy classification, the ten-point scale was divided into two (ratings of 1-5 = deceptive and 6-10 = truthful). Individuals in the high-familiarity condition had a mean accuracy of 72% compared to 51% in the low-familiarity condition (figure 1.4). Participants were also more confident about their judgment in the high-familiarity condition.

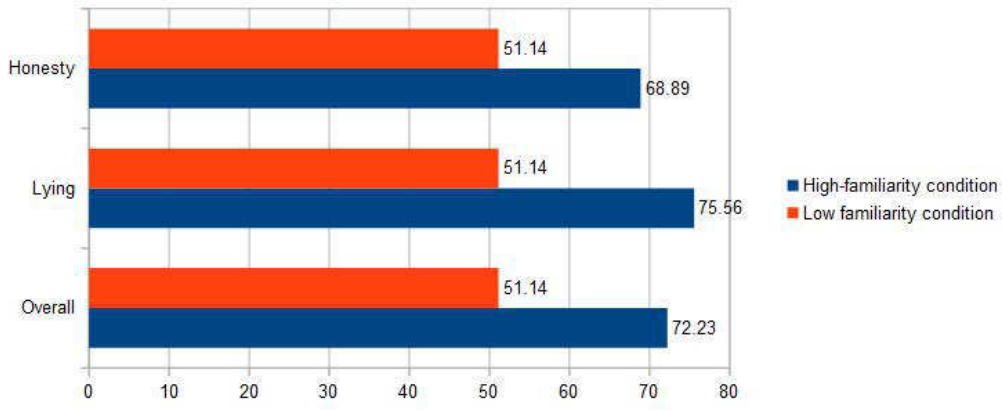


Figure 1.4 - Accuracy (%) in judging lying and honesty.

Greater accuracy has also been by Reinhard et al (2011) with an alibi situation, a job interview, and

another driving test scenario, and by Reinhard et al (2012) with police officers and perceived familiarity of a mock theft.

d) "Projecting motive" approach (or knowledge of incentives).

Individuals lie for a reason, and finding the motive and/or incentives help in assessing the accuracy of the information given.

Example of research: Bond et al (2013)

Experiment 1 - Sixty-one US students watched videos of thirty-two other students talking about their most and least favourite courses at school. Half lied and half told the truth. The individuals in the videos were given incentives to say what they said, and the observers were told about these incentives. Accuracy at spotting who was lying or telling the truth was almost 100%.

Bond et al (2013) summed up: "Sixteen individuals received motivational instructions to lie, and all 16 lied. Sixteen individuals received motivational instructions to tell the truth, and all 16 told the truth. Afterward, research participants with access both to incentive information and the speakers' behaviour were able to ascertain who had lied and who had told the truth, presumably because they focused heavily on motivational instructions and presupposed that people would follow those instructions" (p214).

Experiment 2 - This experiment was performed to rule out the use of cues to detect lying/honesty, and to confirm the use of knowledge of incentives to lie/be honest. Sixty-two undergraduates watched the videos from Experiment 1 either after receiving information about incentives, or being told to focus on audio-visual cues of honesty. The latter group had an average of 59% correct compared to 97% in the incentives-known group. Thus, "access to the liar's non-verbal displays does not yield an impressive accuracy rate in judging veracity, information about a liar's incentives has the potential to enable perfect lie/truth discrimination" (Bond et al 2013 p216).

Experiment 3 - This experiment investigated whether participants used knowledge of incentives and non-verbal cues.

One hundred and twenty-one undergraduates were divided into three groups to watch the videos from Experiment 1:

(i) Video with no sound (focus on non-verbal cues): 51% correct;
(ii) Video with no sound but information about incentives (focus on incentives): 97% correct;
(iii) Video with sound and information about incentives (focus on both cues and incentives): 76% correct.

The researchers interpreted the lower level of accuracy in condition (iii) as supporting the idea "that people believe so strongly in the usefulness of non-verbal deception cues that they even forego perfectly diagnostic incentive information to let fallible behavioural cues taint their judgments" (Bond et al 2013 p217).

Bond et al (2013) noted that not all incentives to lie/be honest are equally strong, and knowledge of them is not equally effective in spotting lying/honesty. "In any case, in predicting a speaker's veracity from incentives, it may be helpful to know the individual's moral scruples, his or her construal of colourable claims, and other potentially relevant variables. Once all of these variables are identified and entered into the equation, an incentive-based lie detection algorithm might be capable of fairly accurate a priori prediction" (Bond et al 2013 p218).

e) "Diagnostic questioning" approach.

The use of good quality and appropriate questions. "The keys to effective questioning are that the questioning needs to be context sensitive and needs to focus not only on lie detection but also on providing exoneration for honest interviewers. Poorly worded questions can make honest people look deceptive and produce below-chance accuracy" (Levine 2015 p3).

Levine et al (2014a) used the term "diagnostic utility" as "a catch-all description of a dimension on which various units of information can be arrayed depending on the extent to which the information can be used to distinguish truths from lies. On one end of the continuum would be highly diagnostic information such as statements that are consistent or inconsistent with a known fact. On the other end of the continuum is misleading, negative utility information that produces systematic errors. In the middle is information that lacks utility and leads to chance-level judgments" (p285).

There is also "negative utility", where questions make a honest interviewee appear deceptive. "Disbelieved senders, relative to their honest-appearing counterparts, lack confidence, convey uncertainty, are slower to respond, exhibit less verbal and vocal fluency, appear

nervous, and so forth. We believe that these interpreted-as-indicative-of-deception behaviours can occur in honest responses as a result of certain questions or lines of questioning. Theoretically, any question that is disproportionally disruptive to the confidence and natural communication flow of honest communicators more so than liars has the potential to make the honest person appear deceptive" (Levine et al 2014a).

Levine et al (2014a) used this example to make the point: "Suppose a person is asked what they were doing on November 11 between 3 pm and 5 pm. It is possible that an innocent person has no memory of that date precisely because nothing memorable happened. Because they are honestly trying to remember but cannot, their behavioural display may well be indicative of increased cognitive effort, uncertainty, and a lack of confidence. They may also realise that they are under suspicion and do not have an alibi, which makes them anxious. Consequently, they self-present in just the sort of way as to be disbelieved. A guilty person, in contrast, may expect suspicion and have an alibi prepared. Their answer is, relative to the honest person's answer, plausible, composed, confident, and fluent" (p276).

Example of research: Levine et al (2014a)

Experiment 1 - This was a test of "diagnostic utility" (as with Experiments 2 and 3). Thirty-five US undergraduates watched fourteen videotaped interviews with other students answering questions about whether they had cheated in a trivia game. A set of questions were devised for the interview that produced answers that had diagnostic utility. For example, asking potential cheaters what their partner in the trivia game would say as "honest cheaters had more certainty about what their partner would say than did lying cheaters" (Levine et al 2014a p276).

The mean accuracy of detecting the half of interviewees who were lying and the seven who were honest was 71%.

Experiment 2 - Twenty students who were familiar with cheating research watched the videos from Experiment 1, and achieved a mean accuracy of 78%.

Experiment 3 - Forty-seven highly trained US government investigators (eg: FBI) watched the videos from Experiment 1, and achieved a mean accuracy of 75%, including two participants who were 100% correct.

Experiment 4 - This was a test of "negative utility" (along with Experiment 5). Sixty-seven polygraph

examiners from the US Department of Defence and sixty-five students watched twelve videotaped interviews similar to those in Experiment 1, but half included the question as to why an individual should be believed (ineffective question). It was felt that honest individuals might appear nervous and uncertain in response to such a question (ie: perceived signs of guilt), and expert observers will pay more attention to this.

Experts in the ineffective questioning condition had a mean accuracy of 41% (ie: significantly below chance) compared to 48% for the students. Where this question was not included (effective questioning condition), accuracy of detecting lying and honesty was 69% for the experts and 65% for the students.

Experiment 5 - The Department of Defence staff from Experiment 4 watched thirty-two interviews either with the ineffective question or not. If the participant had been in the ineffective question condition in Experiment 4, this was changed. Accuracy was 40% (ineffective question) and 66% (no ineffective question).

The researchers asserted that Experiments 4 and 5 showed that "questioning can have a dramatic impact on deception detection accuracy" (Levine et al 2014a p281).

Experiment 6 - Two hundred and seven law enforcement professionals and ninety-three students watched twelve videotaped interviews of students denying cheating (as used in the previous experiments). In an independent groups design, participants saw effective or ineffective questioning versions. Mean accuracy was 30% for experts and 40% for students in the ineffective question condition, and over 65% in the other condition.

1.3. CONFESSION SOLICITATION

Simply, liars are persuaded to be honest, either consciously or unconsciously by skilled interviewers.

Example of research: Levine et al (2014b)

Study 1 - Thirty-three US undergraduates played a trivia game for small cash prizes with the opportunity to cheat, before being interviewed by an experienced criminal justice interrogator for around four minutes using a structured interview format. The interviews were videotaped and later watched by 136 students.

Four participants cheated in the game and all confessed subsequently. The expert interviewer was 100% accurate in detecting who cheated and who did not. The

students watching the interviews had an average accuracy of 79% for detecting who was lying or telling the truth.

Study 2 - This was a replication of Study 1 with 89 students playing the trivia game before being interviewed by one of five federal agents. The videotaped interviews were later watched by 34 students. The interviews in this study were unstructured with no time limit.

Forty participants cheated, of whom 34 confessed in the subsequent interview. The expert interviewers were accurate for 87 interviews (ie: 98%). The mean accuracy for the students viewing the videotaped interviews was 94%.

Levine et al (2014b) explained the success of the experts as related to "the ecology of the deception-detection task". "In the current studies, the experts were active and adaptive agents in a familiar context. The experts were able to ask questions that promoted diagnostic responses. The critical aspect of expertise was not in the expert's ability to read body language or micro-facial expressions; but instead, was knowing what questions to ask and how and when to ask those questions. The responses to the experts' questions were sufficiently diagnostic that even non-experts passively watching the interviews on videotape were able to distinguish guilt from innocence at rates well above meta-analytic levels" (Levine et al 2014b p455). It is key that "the right questions are asked in the right way" (Levine et al 2014b).

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2. SUPERTASKERS AND ATTENTION

2.1. SUPERTASKERS

Research on dual-task attention has shown that the performance of two or more attention-demanding tasks at the same time leads to a decline in performance of one of them (appendix 2A). That is apart from a small group of people (approximately 2.5% of the population) who can do both tasks without detriment. These individuals are "supertaskers" (Watson and Strayer 2010) [1].

Watson and Strayer (2010) used a simulated driving task while recalling digits and doing number problems (operation span task; OSPAN) over a hands-free mobile phone. The general pattern is that brake reaction time increased significantly with the dual task, for instance, and memory for the digits declined significantly. Supertaskers, however, showed little difference in performance between single-task and dual-task conditions.

Medeiros-Ward et al (2015) studied supertaskers in a magnetic resonance scanner (building on Watson and Strayer's 2010 work). Sixteen volunteers were tested, of which half were identified as supertaskers. The measure of attention was the dual N-back task [2], where simultaneous visual and auditory stimuli are presented. The visual element was spotting a particular shape in one of eight positions and pressing a touchscreen, while listening to a string of letters and saying when a particular letter had occurred. For example, a blue square is presented for 500 ms in the top left corner of the screen, while listening for the letter "Q".

Both groups showed a decline in performance as the task became harder, but differences were observed in the brain activity. "Supertaskers had less activity than matched controls in aspects of the attentional control network at higher cognitive load, more efficiently recruiting anterior cingulate and posterior frontopolar

[1] In a different situation, crowds can be better than individuals (appendix 2B).

[2] "The dual N-back task should exert a cognitive load that has similarities to having a cell phone conversation while driving as both situations encourage mental juggling of different task goals, requiring the simultaneous processing of parallel but arbitrarily related streams of auditory/verbal and visual/spatial information" (Medeiros-Ward et al 2015 p877).

PFC [prefrontal cortex]" (Medeiros-Ward et al 2015 p882).

Medeiros-Ward et al (2015) suggested that the differences in performance of supertaskers in their experiment and in Watson and Strayer (2010) may be due to the different tasks used or the classification of supertaskers. The sample was also very small.

2.2. SKILLED PERFORMANCE

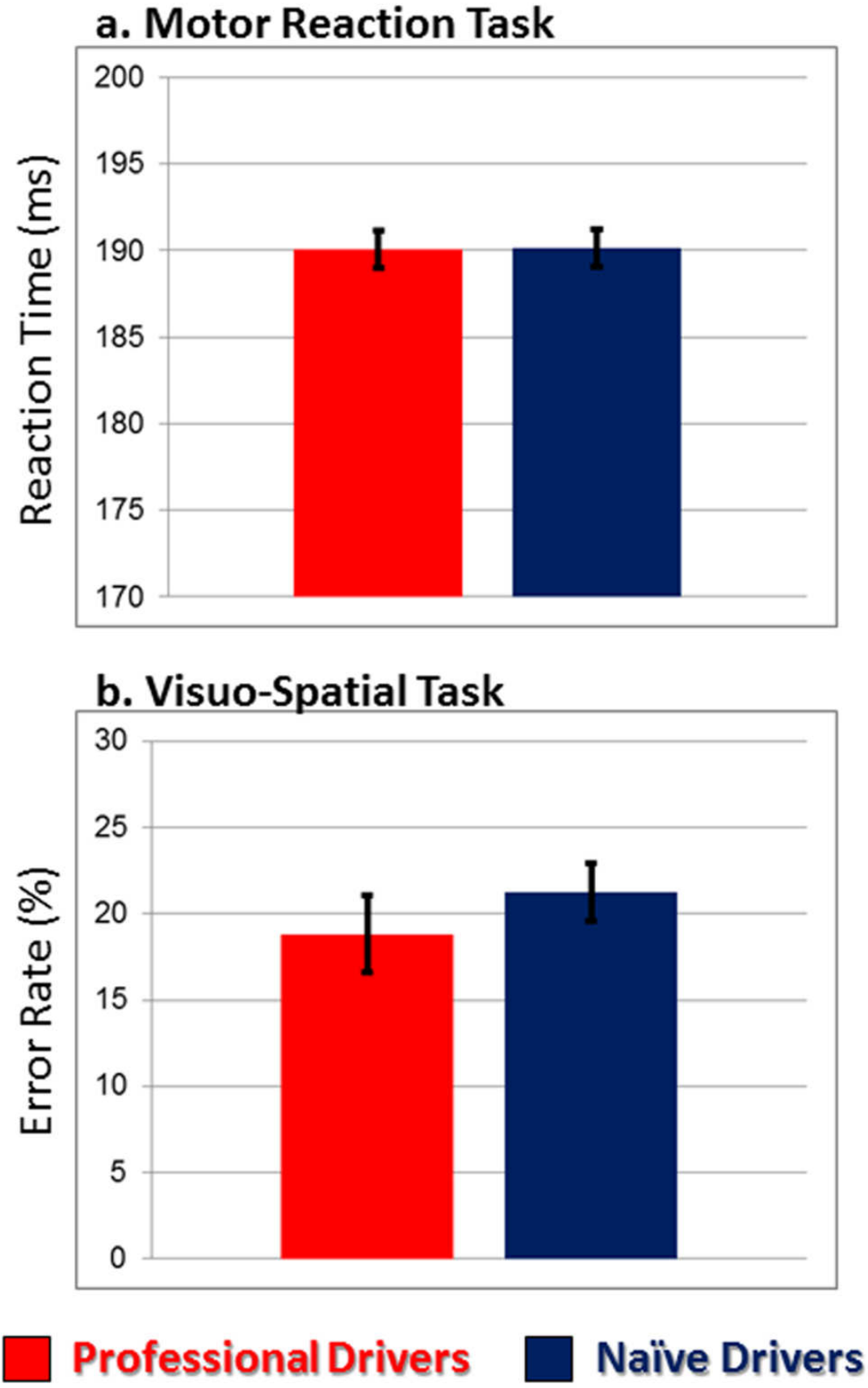
Becoming skilled in an activity leads to cortical function reorganisation, according to neuroimaging studies, including the expansion of the auditory and motor cortex of musicians, or, for example, the reduction of neural responses in skilled archers compared to novices (Bernardi et al 2013).

"Moreover, functional and effective connectivity analyses revealed that these functional changes in brain response may be accompanied also by modifications in the way task-related regions interact, usually with a strengthening of the essential couplings and a pruning of the 'unnecessary' ones" (Bernardi et al 2013 p2). This has been called the "neural efficiency" hypothesis.

Bernardi et al (2013) showed this idea in a study of professional racing-car and naive drivers. They found that "as compared to naive subjects, the brain functional architecture sustaining visuo-motor processing in professional racing-car drivers, trained to perform at the highest levels under extremely demanding conditions, undergoes both 'quantitative' and 'qualitative' modifications that are evident even when the brain is engaged in relatively simple, non-demanding tasks" (Bernardi et al 2013 p1).

Eleven professional racing-car drivers involved in Formula 1 or 3 or related tournaments underwent functional magnetic resonance imaging (fMRI) scans along with eleven healthy males with limited car driving experience in Italy. During the scan, participants performed a motor reaction task (press a button as quick as possible when a red light turned green) and a visuo-spatial task (press a button when different coloured moving balls of the same colour met). Both groups showed similar reaction times in the first task (mean 190 ms), and similar error rates in the second task (mean 20%) (figure 2.1).

But there were differences in brain activity during the tasks. During both tasks, "professional drivers recruited task-related brain areas, including sensorimotor, parietal, and prefrontal regions, to a significantly smaller extent as compared to naïve subjects. These findings are in agreement with results obtained in other skilled groups, including musicians,



(Source: Bernardi et al 2013 figure 2)

Figure 2.1 - Mean scores on two tasks.

golf players and pistol shooters, and indicate an increased efficiency in attentional and sensory information processing along with a reduced 'resource consumption'" (Bernardi et al 2013 p7).

2.3. APPENDIX 2A - MULTI-TASKING AND BRAIN INJURY

Dreher et al (2008) made this opening observation: "Some of the most complex cognitive abilities of humans, such as planning, are commonly attributed to a disproportionate enlargement of the human frontal lobe during evolution. However, recent comparative studies of the relative size of the frontal cortex taken as a whole indicate that the human frontal cortex is not larger in comparison to those of the great apes. Rather, the specific cognitive capacities of humans may be due to differences in specific individual cortical areas (such as the fronto-polar cortex), as well as to richer interconnectivity between the frontal lobe and other higher-order association areas, none of which require an increase in the overall relative size of the frontal lobe during hominid evolution" (p1) [3].

Concentrating on the fronto-polar cortex (Brodmann's area 10), which is larger in humans relative to the rest of the brain compared to an ape, Dreher et al (2008) proposed its role in multi-tasking. The researchers studied thirteen patients with damage to the frontal lobe, of which five had damage to the fronto-polar cortex.

While in a fMRI scanner, the participants performed a visual task in conditions. The task involved responding if any letter from the word "tablet" appeared in the screen for 500 ms. This was done after another letter (delay condition), also responding to the case of the letter (dual-task condition), and a combination of both the previous conditions (multi-task condition) (table 2.1).

The individuals with damage to the fronto-polar cortex were poorer at multi-tasking.

[3] "Hebbian plasticity" (proposed by Donald Hebb in the 1940s) is "the mechanism by which information can be coded and retained in the neurons in the brain" (Fox and Stryker 2017).

CONDITION	TASK	STIMULUS EXAMPLE
Standard condition	Any letter from "tablet"	t
Delay condition	Previous letter from "tablet"	a L
Dual-task condition	Any letter from "tablet" in upper case	Q
Multi-task condition	Previous latter from "tablet" in lower case	p X

(Respond with right hand button if yes or left hand button if no)

Table 2.1 - Basic principles of task used by Dreher et al (2008).

2.4. APPENDIX 2B - WISDOM OF THE CROWD

The "wisdom of the crowd" suggests that a group will be superior to an individual in answering a question. The most common way is to harness the crowd's knowledge in the "democratic voting procedure" (ie: the most popular choice).

But this method has limitations for specialised knowledge, so a weighted method is used, which takes into account the confidence of the answer as well (Prelec et al 2017).

Prelec et al (2017) proposed an alternative called the "surprisingly popular" (SP) algorithm - ie: "select the answer that is more popular than people predict".

The researchers give this example of two questions:

a) Is Philadelphia the capital of Pennsylvania - yes/no? ("No" is the correct answer);

b) Is Columbia the capital of South Carolina - yes/no? ("Yes" is correct).

For question (a), the majority of the people say "yes" (eg: 60%), and predict that others would say "yes" (eg: 90%), while 40% say "no" and predict that 10% will say "no". Using the SP algorithm, the actual "no" choice is more popular than the prediction, so "no" is the crowd's answer.

In the case of question (b), for example, 90% say "yes" and predict that 60% will say "yes", but 10% say "no" and predict 40% will say "no". Here, "yes" is the crowd's answer because the actual choice is greater than the predicted.

In four different types of questions, Prelec et al (2017) reported that the SP algorithm was superior to individuals, majority vote, and weighted methods.

Individuals within the crowd make decisions on the basis of high-correlation cues (information known to the majority of group members) and low-correlation cues (information known to a minority). If the form is wrong, then it will lead to a situation where the "wisdom of the crowd" is wrong (Douglas 2015).

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3. THERAPY CHANGES PERSONALITY

Roberts et al (2017) investigated this question: "can personality traits be changed through intervention?". In other words, treatment or therapy for mental disorders leads to improvements in mental health and personality change.

Roberts et al (2017) noted two theoretical positions on this issue:

i) The state-artefact position (eg: Du et al 2002) - Any personality changes through therapy are related to the state of the trait. For example, a depressed individual shows a reduction in extraversion and anti-depressants in reducing the depression lead to an increase in extraversion. "Therefore, what looks like personality trait change... would only be temporary state changes..." (Roberts et al 2017 p118).

ii) The cause-correlation hypothesis (eg: Soskin et al 2012) - Treatments for mental disorders produce changes in personality traits - eg: an anti-depressant reduces both depression and the personality trait of neuroticism.

Roberts et al (2017) found 207 relevant studies from 1959 to 2013 for their meta-analysis. Each study measured personality traits in some way, included a pre- and post-treatment design, and involved therapy and/or selective serotonin reuptake inhibitor (SSRI) anti-depressants. The most common disorders were depression, anxiety, and eating disorders.

Overall, personality traits changed between one-fifth and one-third of a standard deviation between pre-treatment and post-treatment. These changes appeared not to be short-lived (in studies with an average follow-up of six months), and this supported the cause-correction hypothesis.

The traits showing the largest positive changes were emotional stability, and extraversion, and individuals with anxiety disorders changed the most (and those with personality disorders the least).

Roberts et al (2017) summed up: "the data found in this set of studies provides tentative support for the idea that interventions do lead to personality trait change over time. Nonetheless, the data are not complete and without evidence such as the long-term efficacy of change interventions in non-clinical samples, we believe it would be prudent to be cautious in making a strong case that clinical interventions change personality traits" (p129).

The data were also heterogeneous with great variety between individual studies. Furthermore, note that most studies used self-reported measures of personality (and rarely observer-rated measures).

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