A Literature Review of Polygraph Countermeasures and the Comparison Question Technique

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Abstract

We reviewed the research of countermeasures effect on the comparison question technique. We provide a consolidation of countermeasure literature as well as an operational definition and taxonomy of countermeasures. We surveyed the pertinent literature regarding the effectiveness and limitations of certain countermeasure tactics. We offer evidence-based answers are to common countermeasures questions and make recommendations for reporting countermeasures.

Keywords: *countermeasures, polygraph comparison question technique*

A Literature Review of Polygraph Countermeasures and the Comparison Question Technique

In order for a countermeasure to be effective in a Comparison Question Technique (CQT), it must satisfy two requirements. First, it must create a sufficient difference in the polygraph measurements to comparison and relevant questions to produce a truthful or inconclusive outcome. Secondly, it must be done covertly as to not be identified by the examiner, an observer, or any quality control review. In considering what information would be most helpful to examiners we provide evidence-based answers to some important questions about countermeasures.

Our operational definition of "countermeasure"?

There have been a number of proposed definitions from within and outside of the profession for the term countermeasure (CM). We needed to operationally define CM as it applies to polygraph testing. For our purposes, we considered a CM to be anything a test subject does in an attempt to alter the test data so as to produce a truthful (negative) test result. This definition encompasses the truthful subjects trying to ensure a True Negative (TN) result and the deceptive subjects trying to produce a False Negative (FN) outcome. One could ostensibly argue that all subjects engage in some form of behavior to produce truthful outcomes and are thus attempting CMs - the truthful tell the truth and the deceptive lie, but we feel these actions don't fit our definition for altering the test data. To alter means *to change or make different* in a meaningful way.

What type of CMs do people use?

We followed Honts' (1987) taxonomy as it breaks down CMs into categories that have been researched, though others have produced different recommendations for CM categorization (see Krapohl, 2009). In following Honts (1987) we break CMs down into the following categories;

1. General State CMs- actions intended to alter the subject's psychological state and/or measured physi-

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ological responses throughout the entire examination. They include such things as; drugs, relaxation, or interfering agents. They are not focused on any specific point in the testing.

2. Specific Point CMs- as their name suggests, these are actions the subject takes at specific points in the testing process. They can be attempts to reduce responses to relevant questions but are usually efforts to increase responses to comparison questions. They can be employed physically, mentally or in combination.

3. Spontaneous CMs- these are CMs that subjects report doing without planning or forethought. A number of laboratory studies debriefed subjects about efforts to produce truthful outcomes. These debriefs are the source of most of our knowledge of spontaneous CMs. Subjects report trying such things as; relaxation, rationalization, imagery, attempts to control their breathing or heart rate, trying to stay calm, biting their tongue and pressing their toes at random places.

4. Information CMs- people who know they are going to take a polygraph examination (both guilty and innocent) often seek information about polygraph techniques and CMs from the internet or other sources. This information-seeking can be motivated by an attempt to satisfy curiosity, to try and hide deception, or in an effort to ensure that truthfulness is obvious.

Given our operational definition and taxonomy we sought to provide evidence-based answers to some important questions about CMs. Evidence-based answers and practices concerning CMs are not simple. They have to be based upon research and not on anecdote or dogma. Evidence-based answers and practices have to be qualified by the limitations of the research upon which they are based. Those qualifications depend on such things as whether the subjects were coached or if they received practice on an instrument. Who were the subjects? Did the examiner use some sort of activity sensor? The following is a summary of some findings from the peer-reviewed published studies we examined for this paper.

1. Rovner (1986) is a rewrite of his 1979 doctoral dissertation in which he trained subjects on the principles of CQT testing, including giving them pictorial examples of reactions. He called these the *Info group*. He also gave the *Info group* Specific Point CM training using a variety of physical and mental CMs known to produce reactions. He had a second group called the *Info + Practice group*. He gave them the same material but allowed them to practice their CMs on a polygraph before their real test. The accuracy of the results for the control and the *Info group* was about 88%. However, the *Info + Practice group* accuracy results were about 62%. He did not report using an activity sensor or making attempts to identify CM subjects.

2. Dawson (1980) used Stanislavsky trained actors to attempt General State CMs in a mock-crime lab study. They were not trained in polygraph principles and they did not receive practice. The CM group actors were motivated to appear innocent to display their superior acting skills. CM deceptive subjects said they used imagery and prior memories as strategies. The General State CM effects were ineffective. Excluding inconclusive results, all CM subjects were found deceptive.

A side note, Dawson conducted an interesting additional experiment. He had subjects answer the polygraph questions in two ways, immediately after the question and delayed by 8 seconds. He measured responses in three ways; after the question without an answer, after the immediate answer and after the delayed answer. Based on numerical scores he reported the following. Immediate answers accuracy was 75%correct, 12% incorrect, and 12% inconclusive. The mea-

surements following the question but before the delayed answer produced 83% correct, 8% incorrect, and 8% inconclusive. The measurements taken after the delayed answer resulted in 29% correct, 8% incorrect, and 62% inconclusive.

3. Bradley & Ainsworth (1984) tested General State CMs by using alcohol intoxication during a crime act and also during polygraph testing. They tested subjects with the CQT and the CIT. We limit our discussion to the CQT findings. They measured heartrate, respiration and electrodermal responses during a mock-crime robbery and shooting. They reported alcohol intoxication during the crime decreased detectability with electrodermal activity. Intoxication during the testing was ineffective.

4. Honts, Hodes & Raskin (1985) in experiment 1 trained the CM group on the principles of polygraph CQT and Specific Point CMs. They coached the subjects on physical (press toes to floor) and pain (bite tongue) CMs. They did not get any practice on an instrument. They used a photoelectric plethysmograph instead of a cardio cuff. They reported no significant effects for the CM group. They were unable to detect which subjects used CMs by either direct observation or reviewing the charts. They did not use an activity sensor.

5. Honts, Hodes & Raskin (1985) in experiment 2 trained the CM group on the principles of polygraph CQT and Specific Point CMs. There they coached the subjects on physical (press toes to floor) and pain (bite tongue) CMs. However, unlike experiment 1, these CM subjects got to practice on an instrument. They used a standard cardio cuff in this experiment. They reported there was a 47% FN rate for the CM group. Again they were unable to detect which subjects used CMs by either direct observation or reviewing the charts. They did not use an activity sensor.

6. Honts, Raskin, & Kircher (1987) trained subjects in physical (press toes to floor) and pain (bite tongue) Specific Point CMs. They gave the subjects training on CQT principles and coaching on when and how to apply the CMs to the comparison questions. They did not give any practice on an instrument. They measured muscle movement by electromyography (EMG) on the subjects' jaw and calf. They reported no FNs with the guilty control group who did not use any CMs. They identified 78% of the truthful subjects correctly. Seventy percent of the guilty CM group produced FN results. They identified 90% of the CM subjects by EMG tracings.

7. Honts, Raskin, Kircher & Hodes (1988) included 65 deceptive subjects from four studies who were debriefed about any use of Spontaneous CMs. Sixty percent (39/65) of the deceptive subjects admitted to Spontaneous CMs. The strategies included: relaxation, rationalization, self-deception, disassociation, imagery, attempts to control breathing or heartrate, biting tongue, attempts to control general physiological responses and pressing toes to the floor. Blind scoring accuracy was 80% correct, 3% wrong and 17% inconclusive. The use of Spontaneous CMs did not affect the test results. Examiners were unable to differentiate CM users. No activity sensor was used.

8. Raskin and Kircher (1990) trained subjects in physical (muscle contraction) and mental (counting backwards) Specific Point CMs. They taught them the principles of polygraph testing and when they should employ the CMs. They coached them and they had prac-

tice on an instrument. They used a seat activity sensor. The CMs produced about 50% FNs when scored by the computer. All of the physical CMs were identified by reviewing the seat sensor data.

They also trained a "relaxation" group on the principles of polygraph. This group used autogenic relaxation as a General State CM throughout the entire examination. The relaxation General State CMs were not effective.

9. Honts, Raskin & Kircher (1994) trained subjects in Specific Point CMs and CQT polygraph principles. Here they used physical (muscle contraction), pain (bite tongue) and mental (counting backwards) CMs during the comparison questions. The subjects were coached but not given any practice on the polygraph instrument. They measured EMG on the jaw and calf. The CM group produced a 50% FN rate and were not detected by direct observation or by looking at the polygraph charts. They were able to identify the pain and physical CM groups by EMG scores which were significantly larger than the other groups.

10. O'Toole et al., (1994) was a partial replication of the Bradley & Ainsworth (1984) study on General State CMs using alcohol. Here the deceptive CM group were intoxicated only during the mock-crime theft. They measured skin conductance, respiration and finger pulse amplitude. They did not provide any information on polygraph principles, they did not coach or practice any CMs with the CM subjects. Alcohol intoxication during the crime had no effect on polygraph results.

11. Honts, Amato and Gordon (2001) did not train any of their subjects but debriefed them on what actions they took to help pass their polygraph tests in a large lab study. Overall 68% of the subjects reported they attempted a Spontaneous CM. Almost half of the truthful subjects (46%) reported using at least one Spontaneous CM. These Spontaneous CMs included altered breathing, mental and physical strategies. The Spontaneous CMs did not affect the deceptive scores but it shifted the truthful scores in a negative direction. In other words, the truthful subjects who tried to help increase their chance of a TN result had less truthful scores than those who did not attempt Spontaneous CMs. These subjects were not coached, nor were they given practice tests on an instrument. There was no activity sensor used in any of these cases.

    Later, three federally certified instructors reviewed the charts in an effort to identify the presence of CMs. None of the three federally trained instructors could identify the CM subjects at better than chance levels by reviewing the test data.

12. Oglivie & Dutton (2008) reanalyzed unpublished data from a CM lab experiment with and without the activity sensor tracing. In this case the activity sensors included, seat, feet and arm sensors. The CM polygraph subjects in these cases received a copy of the internet publication of *The Lie Behind the Lie Detector* (Maschke & Scalabrini, 2002) as a reference. This material has detailed descriptions of CQT polygraph principles and CM strategies. The CM subjects had to pass a written examination on the CM material before proceeding. They used physical (toe curling) Specific Point CMs during the presentation of the comparison questions. A subset of the CM group was allowed to practice on an instrument while receiving real-time feedback from an experienced examiner.

    Five experienced polygraph examiners reviewed the polygraph charts in two conditions; with and without the activity sensor data. The examiners were asked; a) to score the test data using a 7-po-

sition federal scoring rules, and b) using a 5-point Likert scale rate the absence or presence of CMs.

Mean CM present/absent scores were statistically significant between the sensor and no-sensor conditions. Without the activity sensor, the CM present/absent scores were near zero. Examiners did not perform above chance levels when relying on the traditional polygraph channel data to identify CMs without the activity sensor data. Adding the activity sensor data made identifying the CM group more likely.

Of note, the average guilty CM total scores with the activity sensor was similar to the truthful scores (they were positive). The average guilty CM total scores without the activity sensor was double the average truthful scores. This suggests that the Specific Point CM strategies can create increased FN results.

13. Honts & Reavy (2015) did not train any of their subjects but debriefed them on what actions they took to help pass their polygraph tests in a large lab study. Overall 48% of the subjects reported they attempted a Spontaneous CM. About 50% of the subjects who received probable lie comparison questions (PLC) reported Spontaneous CMs. For the directed lie comparison question variant (DLC) subjects, about 46% reported Spontaneous CMs. Breaking it down by guilt, overall 78% of the deceptive group reported Spontaneous CM attempts (DLC=72%, PLC=83%). Within the truthful group 18% overall reported attempts at Spontaneous CMs (DLC=20%, PLC=15%). None of the differences were significant.

    The investigators did not make any attempt to identify CMs either through direct observation or data review. Just like in Honts, Amato, & Gordon (2001) the scores for the truthful CM groups were less positive. Once again this suggests truthful subjects who use Spontaneous CMs hurt their chances of passing the test.

14. Stephenson & Barry (1998) was not a CQT study but is discussed here due to the findings. The subjects were polygraph examiners so they had extensive knowledge about the CQT polygraph procedures and CMs. They tested whether they could identify when a subject makes a "physical movement between the toes and shoulder" while collecting polygraph test data. They used an activity sensor mounted to the front of the test subject's chair. They collected test data in a mock acquaintance test during which the examiner counted from 1 through 10. At some point the test subject was to make a covert physical CM attempt and remember the number at which they attempted the CM. They stationed an "observer" directly in front of the test subject who watched for movement. The overall CM detection rate for the examiner observing the subject was 9%. The "observer" identified the Specific Point CMs in 36% in of the cases. When they used the movement sensor tracing, the experimenters identified 85% of the CM attempts.

15. Honts & Alloway (2007) was a constructive replication of Rovner (1986) using the Test for Espionage and Sabotage (TES). They gave half of the truthful and deceptive subjects the book *The Lie Behind the Lie Detector* (Maschke & Scalabrini, 2000) to study for one week. They found no significant effect of providing the Information CM material on validity of the TES. Once again, however, those subjects who reported using CMs had significantly lower probabilities of truthful scores. This included both the truthful and the deceptive subjects.

Here we will provide some common CM questions along with evidence-based answers.

1. *Do both truthful and deceptive subjects attempt CMs?*

The simple answer is "Yes." Research shows that both truthful and deceptive subjects report attempting Spontaneous CMs. From study 9 (Honts, Raskin & Kircher 1994) which was limited to deceptive subjects, 65% of them attempted Spontaneous CMs. From study 13 (Honts & Reavy, 2015) about half of the subjects overall reported attempting Spontaneous CMs. A larger proportion of deceptive subjects reported attempting Spontaneous CMs but 18% of truthful subjects also reported attempting Spontaneous CMs. From study 11 (Honts, Amato and Gordon, 2001) we see about 68% overall and about 50% of truthful subjects attempted Spontaneous CMs.

2. *What type of CMs do subjects attempt?*

From a number of studies above Spontaneous CMs include a variety of reported strategies; relaxation, rationalization, self-deception, disassociation, imagery, attempts to control breathing or heartrate, biting tongue, attempts to control general physiological responses and pressing toes to the floor. Specific Point CMs generally included physical (press toes, curl toes, etc.) or pain (biting tongue) and mental (counting backwards) activities. Some Information CM sources suggest such actions as squeezing the anal sphincter (http://www.polygraph.com/). More sophisticated advice about examination behavior and chart recording CMs is offered at https://antipolygraph.org/ (Maschke & Scalabrini, 2005). Some examinees reported attempting a form of General State CMs when they describe attempts at rationalization, relaxation, disassociation, imagery, etc.

3. *What type of CMs are effective at increasing TN results, creating a FN result, or resulting in an inconclusive outcomes- and to what degree?*

Spontaneous CM produced no effects for the deceptive subjects in terms of increased TN or inconclusive outcomes, nor were there reliable effects found in the numerical scores. Deceptive subjects in study 15 shifted the scores away from a truthful result. Spontaneous CMs by truthful subjects decreased their chances of being found truthful. Information CMs that lead to Spontaneous CMs simply shifted truthful scores in the negative direction (see study 15). General State CMs have not been shown to be effective, see study 2 and 10. Study 3 reported some effect for intoxication during the mock crime act. Specific Point CMs have been shown to be effective in shifting differential response measurements and increasing FN results (see studies 1, 4, 5, 6, 8, 9, & 12) following specific training, but not just information. Specific Point CMs thus seem to be most dangerous when coupled with hands-on training and practice.

4. *Do polygraph test subjects attempt CMs more with Directed Lie Comparison questions versus the Probable Lie variant?*

This has not been shown by the relevant research (see study 13).

5. *Can examiners identify examinees using CMs at better than chance rates? And does the addition of activity sensors make a difference?*

Without an activity sensor there are no studies that support examiners can identify CMs at better than chance rates (see studies 4, 5, 7, 11, & 12). In fact, the research indicates that when examiners try to identify countermeasure they falsely accuse a substantial number (47% or more) of innocent non-countermeasure users of using CMs (study 5). With an activity sensor (or EMG) polygraph examiners are able to significantly identify CM users (see studies 6, 8, 9, 12, & 14) who use CMs that required movement (for example, pressing the toes to the floor.) Finally, there is no evidence that current training in countermeasure detection is effective. In fact the alleged respiratory countermeasure signatures caused by the countermeasure materials produced by Williams (http://www.polygraph.com/) have been shown to occur naturally in a substantial number of actually innocent subjects who were not using CMs (Honts & Crawford, 2010).

6. *How does using CMs affect the scores of truthful and deceptive subjects?*

Specific Point CMs increase FN outcomes following training by producing significant effects in all of the polygraph components depending upon the countermeasure used (see studies 1, 5, 6, 8, 9, & 12). It is unclear what their effect would be for increasing TN outcomes, though there is no reason to think they would not be effective.

Spontaneous CMs don't increase FN and probably decrease TN results. Information

CMs that lead to Spontaneous CMs would be expected to have similar results. Spontaneous CMs are extremely common with examinees and there does not appear to be any evidence that such CMs are effective. Therefore, as the evidence seems to suggest, if the data simply appears to be messy, and there is *sufficient* uncontaminated data to conduct an analysis, the scorer should attempt to analyze the uncontaminated data, and a decision should be rendered by the scorer if conclusive scores are reached (ex. NDI/NSR, DI/SR). Examiners should report when data quantity and quality are insufficient to complete a standardized numerical evaluation. An example of reporting language is:

> *After assessing the quantity and quality of the test data collected in this examination, I determined that the test data were of insufficient interpretable quantity and/or quality as a result of numerous artifacts to conduct a standard numerical evaluation. In other words, there was insufficient data to evaluate in order to render a reliable decision on this examination.*

General State CMs are unlikely to create a differential response between relevant and control questions that would increase TN or FN results. At worst they might be expected to cause an inconclusive result due to mitigating the overall responsivity to all test questions, but even increases in inconclusive outcomes have never been demonstrated in a published peer-reviewed study. An unpublished study (Gatchel et al., 1983) tested the General State CM effects of the beta-blocker drug propranolol. The only significant finding was an increase in accuracy with the innocent. Study 3 reported no effect for alcohol intoxication during a polygraph test. However, as mentioned, they reported an effect for intoxication at the time of the crime. The replication of that study failed to find an effect for alcohol and FN results for intoxication at the time of the crime (see study 10). In study 2 experienced actors try to produce FN results using General State CMs but produced no effect.

In summary the CM research base is incomplete and additional research is needed. However, the limited research shows trained CMs are something that should concern examiners as under certain circumstances they have produced substantial numbers of FN errors. Moreover when trained deceptive subjects use CMs, examiners have not shown an ability to identify those subjects at better than chance rates without some sort of activity sensor (and then only for CMs that require physical movement). Regardless of any alleged anecdotal successes at detecting CMs, no research has shown that any examiner can reliably detect CMs from simple pattern recognition. In fact, as mentioned, research has shown that the respiratory patterns that are allegedly linked to some internet training approaches occur naturally in the respiration recordings of a substantial number of actually innocent subjects (Honts & Crawford, 2010).

We realize a number of things that might be CMs appear spontaneously among truthful examinees. What may distinguish these events from CMs, though, is the frequency or the targeting of the behaviors. For example, both truthful and deceptive examinees move during polygraph tests. This does not, in and of itself, mean that movements are not useful in detecting CM attempts. Indeed, research shows that movements can be strong indicators in that regard. The mere presence of hyperventilation, as another example, does not confirm CMs, but if they persist despite examiner warnings or they seem to appear only on one category of question, then they can be useful indicators. Ultimately we hope further research will help develop improved objective measures of anomalies among groups of questions. Future CM detection efforts should probably seek such an objective measurement approach.

The research clearly shows that when examiners do try to detect CMs they falsely accuse a substantial number of actually innocent subjects. Examiners should be extremely cautious about reporting CMs based on their ability to intuit a subject has used CMs. Doing so puts the innocent at risk. The upside to this literature is that when deceptive subjects engage in CMs that require movement they can be reliably identified when examiners use an activity sensor. Finally, there is no published research that information provided by internet CM websites is at all dangerous to the validity of the CQT.

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Examiners may find Table 1 a quick reference for a consolidation of the CM study data. Note Honts et al., 1988 is not included in the table as those results were derived from included studies.

Table 1 – Breakdown of CM study findings.

Study	Test type	Type of CM	Training Y/N	Coached/ Practice on inst. Y/N	Activity Sensor Y/N	Findings reported
Rovner (1986)	CQT	Practice CM group used physical and mental CMs. They got to practice and received feedback.	Info group and info + practice group All given extensive training on polygraph principles and CN strategies	Coached-yes Practice-yes	No	Accuracy of scoring: Standard group = 87.5%; Info group = 87.5%; Info+practice group = 62.5%
Dawson (1980)	CQT	General State CMs	No	No	No	General State CMs had no effect.
Bradley & Ainsworth (1984)	Limited to CQT part	General state CMs-alcohol intox during crime and during polygraph	No	No	No	No effect for intox during testing. EDA responses were reduced for intox during crime scenario.
Honts, Hodes & Raskin (1985) Experiment number 1	CQT	CM groups used: 1.Bite tongue or 2.muscle contraction press toes to floor	All given extensive training on polygraph principles and CN strategies	Coached-yes Practice-no	No Also no BP cuff used in experiment 1	No significant effects for CMs found. Unable to detect CM subjects through chart interpretation or observation.
Honts, Hodes & Raskin (1985) Experiment number 2	CQT	CM groups used: 1.Bite tongue or 2.muscle contraction press toes to floor	All given extensive training on polygraph principles and CN strategies	Coached – Yes Practice-Yes	No	47% FN for CM groups. Unable to detect CM subjects through chart interpretation or observation.
Honts, Raskin & Kircher (1987)	CQT	CM group used: bite tongue & press toes to floor	Yes CM group trained on polygraph principles and CM strategy	Coached-yes Practice-no	Yes EMG on the jaw and leg.	No FN with Guilty control. 78% innocent correct. 70% FNs. 90 % of CM subjects identified with the EMG tracings.
Raskin & Kircher (1990)	CQT	CM group used: Physical-muscle contraction PLUS Mental Counting backwards Relaxation group used: mental imagery	Yes CM group and relaxation group trained on polygraph principles and CMs. Practice recording, practice logs,	Coached-yes Practice-no	Yes seat sensor	Computer: CM group =50% FN. Relax not effective. All physical CM subjects identified by activity sensor.
Honts, Raskin & Kircher (1994)	CQT	CM group used: Physical-muscle contraction Pain bite tongue Mental group: Counting backwards	All given extensive training on polygraph principles and CN strategies	Coached-yes Practice-no	EMG-jaw and calf	FN= 50% for Mental & Phys. CM Unable to detect CMs by observation or chart tracing EMG measures for CM groups were significantly larger than controls.
O'Toole et al. (1994)	Limited to CQT part	General state CMs-alcohol intox during crime	No	No	No	No effect for intox during crime
Study	Test type	Type of CM	Training Y/N	Coached/ Practice on inst. Y/N	Activity Sensor Y/N	Findings reported

Study	Test type	Type of CM	Training Y/N	Coached/ Practice on inst. Y/N	Activity Sensor Y/N	Findings reported
Honts, Amato & Gordon (2001)	CQT	All CMs were spontaneous- Some subjects used more than one. 32%-breathing 76%-mental 10% physical	No	Coached-no Practice-no	No	3 DoDPI instructors did not identify presence of CMs above chance level. 47% of CM present decisions were on truthful subjects.
Oglivie & Dutton (2008	CQT	Physical CMs: Toe curling	All given extensive training on polygraph principles and CN strategies	Coached-yes Practice yes for a subset	Compared with and without seat, feet, and arm activity sensor data. 15 Innocent. & guilty control and 38 CMs. Charts printed with and without activity trace.	Five scorers looked at 68 cases Mean activity sensor scores significant for CM group with and without sensor. Unable to determine presence of CMs without the sensor data.
Honts & Reavy(2015)	CQT	spontaneous	no	no	yes	No attempt to identify CMs. 48% attempted CM PLC=50%; DLC=46% 78% Guilty attempted PLC 83%; DLC 72% 18% Innocent attempted PLC 15%; DLC20% Truthful scores less positive when CMs attempted
Stephenson & Barry (1988)	Examiner counted 1-10 and	Subject made a physical movement between the toes and shoulder	Info yes because it was an examiner.	Coached-yes because it was an examiner. Practice-yes	Yes-used Lafayette chair with activity sensor bar under the front legs	Had an observer in front of subject in addition to examiner. CM detection rates were: Examiner=9%; observer=36%; movement sensor tracing= 85%
Honts & Alloway (2007)	CQT	Information and Spontaneous CMs	No	No	Yes under the chair legs	No effect on FN Deceptive and Truthful CM subjects' probabilities scores moved away from truthfulness.