Compound Remote Associate Problems and Insight Research: A Questionable Assumption

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Abstract

Bowden and Jung-Beeman (2003b) developed and normed 144 compound remote associate (CRA) problems for investigating insight problem solving. CRA problems have clear advantages, such as compactness and short time-to-solution, over problems more traditionally used in the study of insight. However, a common assumption, that any CRA problem may be solved *only* by insight or analysis, is doubtful given that some CRA problems have a stimulus word that strongly cues the solution word. Such problems likely are solved neither by insight nor by (standard) analysis, but rather by a memory-biased analysis (MBA). Problems solvable by MBA may lack the remoteness needed to be called compound remote associate problems and probably should be excluded from research on insight problem solving.

Compound Remote Associate Problems and Insight Research: A Questionable Assumption

Inspired by the Remote Associate (RAT) problems (Mednick, 1962) used to study creativity, Bowden and Jung-Beeman (2003b) developed and normed a set of compound remote associate (CRA) problems for use in the study of human insight problem solving. In a CRA problem, three stimulus words are displayed and a prospective problem solver, after reading the three words, must find a fourth word that, when combined with each of the three stimulus words, forms three different compound words or phrases. For example, given the three stimulus words *pie/luck/belly*, the solution word is *pot*: pot pie, potluck, potbelly. Both RAT and CRA problems have been widely used to study human insight problem solving (Ball & Stevens, 2009; Bowden & Jung-Beeman, 2003a, 2003b; Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Cranford & Moss, 2012; Cunningham, MacGregor, Gibb, & Haar, 2009; Haarman, George, Smaliy, & Dien, 2012; Penaloza & Calvillo, 2012; Salvi, Bricolo, Kounios, Bowden, & Beeman, 2016; Smith & Blankenship, 1991; Wegbreit, Suzuki, Grabowecky, Kounios, & Beeman, 2012; Wiley, 1998). Due to the large number and supposed homogeneity of CRA problems, as well as the capability for classifying these problems according to difficulty, some have endorsed CRA problems as a means to accelerate research progress on insight problem solving (Batchelder & Alexander, 2012; Chu & MacGregor, 2011).

A common assumption regarding CRA problems is that each CRA problem may be solved *only* with insight or analysis. Even so, means of solution other than insight or analysis have been considered. For example, Ball and Stevens (2009) conjectured "that the easy CRAs that we used may not, in fact, be insight problems at all, just straightforward cued-recognition tasks..." (p. 1065).[1] However, CRA problems have often been treated as *only* solvable by insight or analysis. As Weisberg (2013) put it:

> CRA problems are also of interest because people solving them report that solution can come about in one of two ways: as the result of a systematic search among the associations of the three stimulus words until a common associate is found [analytic solution]; or suddenly, without warning, "like a revelation" (Lehrer, 2008, p. 42; see also Sandkühler & Bhattacharya, 2008). [insight solution] (p. 4)

Thus, insight solution and analytic solution are commonly, if not universally, considered the *only* means of solving CRA problems.

It is not difficult to show, however, that there may be another way to solve CRA problems. For example, assume a hypothetical CRA problem, *word1/word2/word3/solution*, where a problem solver must respond *solution* when shown *word1*, *word2*, and *word3*. Now, assume that *word1*, presented by itself, has been previously shown to produce *solution* as a response with probability 0.6. Further assume that each of *word2* and *word3*, presented individually, has been previously shown to produce *solution* as a response with probability close to 0, in spite of the fact that each forms a compound word or phrase with *solution*. Now, suppose that a problem solver is shown all three stimulus words in a column that is centered on a computer screen (typical in experiments using CRA problems). It seems reasonable that *word1* might readily cue *solution*, perhaps even before the solver reads *word2* and *word3*. If *solution* occurs to the solver suddenly and with obviousness in this case, does it mean insight was involved? This seems unlikely. It seems more likely that the solver would respond *solution* simply because *word1* is such a strong cue.[2] On the other hand, did the solver arrive at the solution analytically? Consider again Weisberg's description (which I labeled "analytic solution" in the quotation above). The present hypothetical problem likely would not require "a systematic search among the associations of the three stimulus words until a common associate is found" (Weisberg, 2013, p. 4). It seems more likely that *word1* would cue *solution* directly. Then, the

solver would simply verify *solution* by checking that it also works with *word2* and with *word3*. This hypothetical example suggests a third option for solving certain CRA problems - a distinctly memory-biased type of analytic problem solving.[3]

One may object that CRA problems, by definition, involve associative memory processes. That is, this hypothetical example offers nothing new. However, such an objection misses the point. Based on the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 1998), one or more stimulus words in some CRA problems from the Bowden and Jung-Beeman (2003b) problem set may cue the solution word with non-zero probability. For example, consider the CRA problem *show/life/row*, with solution word *boat*. The stimulus word *row* has FSG = 0.73 with respect to the solution word *boat* (by contrast, *show* has FSG = 0.02 and *life* has FSG = 0 with respect to *boat*). FSG is "forward strength", or cue-to-target strength, and was calculated by dividing the number of people who responded with the target word by the total number of people involved in norming the cue word. Nelson et al. (1998) inferred that FSG may be used as a rough proxy of the probability of a cue word producing a target word "in the absence of studying either of these words in an experimental context." Next, consider the CRA problem, presented earlier, from the Bowden and Jung-Beeman problem set: *pie/luck/belly* with solution word *pot*. The FSG of each stimulus (cue) word with respect to the solution (target) word is 0. This demonstrates that CRA problems may not be as homogeneous as supposed (Batchelder & Alexander, 2012; Chu & MacGregor, 2011), at least with respect to one important attribute, namely, the FSG or cue-to-target strength of stimulus (cue) words to a solution (target) word. If this line of reasoning is correct, it suggests that there may be at least three, not two, ways that CRA problems are solved: insight solution, analytic solution, or memory-biased analytic (MBA) solution. The next section explains how to identify CRA

problems potentially solvable by memory-biased analysis (MBA) using the University of South Florida Free Association Norms (Nelson et al., 1998).

Identification of CRA Problems Potentially Solvable by MBA

The University of South Florida Free Association Norms (Nelson et al., 1998) is a large database of English word association pairs constructed with the help of over 6000 subjects. A subject was shown a subset from a set of 5019 stimulus words chosen by the authors. For each stimulus (cue) word, a subject was requested to write down the first associated word that came to mind in a discrete association task. Nelson et al. also tabulated a number of characteristics for these norms. For example, as mentioned previously, FSG is "forward strength", or cue-to-target strength, from a stimulus word to a target word. It was calculated by dividing the number of people who responded with the target word by the total number of people involved in norming the stimulus word. Nelson et al. inferred that FSG may be used as a rough proxy of the probability of a stimulus word producing a target word "in the absence of studying either of these words in an experimental context."

These norms, as well as useful information about them, may be found at http://w3.usf.edu/FreeAssociation/. Conveniently, Nelson et al. (1998) also alphabetized the norms according to target word. This made it possible to take the solution (target) word for a CRA problem and find those words which cue it with FSG > 0. For the purposes of this report, a CRA problem from the set of Bowden and Jung-Beeman (2003b) was classified as potentially solvable by memory-biased analysis (MBA) if any of its three CRA stimulus words serves as a cue (i.e. has an FSG > 0) for the corresponding CRA solution word. I list the set of Bowden and Jung-Beeman CRA problems, with FSG information for each problem, in Appendix A. In

Appendix B, I supply the 32 CRA problems from the Bowden and Jung-Beeman set hypothesized as not likely to be solved by memory-biased analysis (MBA).

At this point, several comments are necessary. First, as stated previously, one may object that all CRA problems involve memory. However, CRA problems are not used exclusively in memory tasks. CRA problems are common stimuli in studies of human insight problem solving as well. Although all CRA problems involve memory processes, for such problems to be useful in the study of human problem solving, memory processes should not overwhelm problem solving processes. A weaker version of this objection might be that classifying CRA problems with even one stimulus word with FSG greater than 0 as being potentially solvable by memory-biased analysis (MBA) is too strict. This could be true. However, the point here is simply to illustrate that there seems to be a third way (e.g. MBA) to solve CRA problems. FSG information (Nelson et al., 1998) for the Bowden and Jung-Beeman (2003b) set of CRA problems is given in Appendix A, in order that researchers may adopt appropriate thresholds and procedures for applying FSG to the classification of CRA problems as potentially solvable or not by memory-biased analysis.

Second, CRA problems have been attractive, in part, because there are a large number of them, making them useful in brain studies of human insight problem solving (Batchelder & Alexander, 2012; Bowden & Jung-Beeman, 2003b; Chu & MacGregor, 2011). Applying the procedure in this section to determine whether a CRA problem is potentially solvable by MBA leaves only 32 of the original 144 Bowden and Jung-Beeman (2003b) CRA problems classified as likely unsolvable by MBA. There are several ways to address this issue. CRA problems are considered generative problems, meaning that new ones can be created. The only additional twist in generating new CRA problems would be to apply the procedure in this section to filter out any

new CRA problems that are potentially solvable by memory-biased analysis. Another way to address the issue has already been mentioned: empirically determine appropriate thresholds and procedures for applying FSG to the classification process. For example, if only one of the stimulus words in a CRA problem cues the solution word and if this stimulus word only has an FSG = 0.01, then perhaps this CRA problem need not be considered as significantly susceptible to solution by MBA – maybe it could still be used in human insight problem solving studies. Finally, while human insight problem solving studies involving brain imaging may require large sets of problems, psychological studies without brain imaging often use only a relatively small number of CRA/RAT problems.

Third, Nelson et al. (1998) express two caveats about their work. The first caveat is due to their methodology of collecting data using a discrete association task. Specifically, Nelson et al. directed subjects to give just one associate for each stimulus word. They believe that this methodology may have led to underestimating the strength of the "very weak" (but not strong) associates. Research to determine appropriate thresholds and procedures for applying FSG to the classification process of CRA problems should take this caveat into account. Nelson et al. also offer a "generalizability" caveat, reminding "that free association norms, or norms of any kind, must be used with sensitivity to word usage in particular locations." One may add that "sensitivity to word usage" over time is also important.

Fourth, the Nelson et al. (1998) norms pre-date the Bowden and Jung-Beeman (2003b) set of CRA problems, meaning that these norms were not developed with this set of CRA problems in mind. So, the norms are incomplete with respect to this set of CRA problems. This leads to two separate issues. The first issue is isolated – just one of the CRA problems in the Bowden and Jung-Beeman set, *officer/cash/larceny*, has a solution word, *petty*, that is not a

target word in the Nelson et al. (1998) norms. That is, *petty* was never given as a target associate of any of the stimulus words tested (*officer* and *cash* were both explicitly used as stimulus words in the Nelson et al. norms; *larceny* was not). I did not include this CRA problem in the set of 32 CRA problems in Appendix B. The second issue is of somewhat wider scope and can be illustrated with the CRA problem: *time/blown/nelson*, solution word *full*. In Nelson et al., *time* was used as a stimulus (cue) word, but *blown* and *nelson* were not used as stimulus (cue) words. The problem is that if *blown* or *nelson* had been tested as stimulus words, either may have been shown to have an FSG greater than zero with respect to *full*. When a CRA stimulus word was not used as a stimulus word in Nelson et al., I did not include the CRA problem in my set (Appendix B). There were eight CRA problems affected by this issue.

Fifth, the 32 problems from the Bowden and Jung-Beeman (2003b) set hypothesized as not likely solvable by memory-biased analysis have a more restricted range in terms of proportion solved. For the full Bowden and Jung-Beeman problem set, the proportion solved in 15 seconds ranges from 0 to 0.96, with an average proportion solved equal to 0.307. For the 32 problems in Appendix B hypothesized as not likely solvable by MBA, the proportion solved in 15 seconds (according to the Bowden and Jung-Beeman, 2003b, norms) ranges from 0 to 0.49, with an average proportion solved equal to 0.16375. Although a wider range of CRA problem difficulty may be attractive from a methodological standpoint, the range of CRA problem difficulty is still reasonably wide for the non-MBA set of CRA problems in Appendix B. In addition, although a CRA problem set with a higher average proportion solved may be desirable for certain types of research, for other research projects, such as the study of unconscious thought (Zhong, Dijksterhuis, & Galinsky, 2008), more difficult CRA problem sets may be useful.

General Discussion

The present work addresses the assumption that each CRA problem may be solved *only* with insight or analysis.[4] Clearly, there are at least three ways to solve CRA problems – via insight, analysis, or what may be called memory-biased analysis (MBA). With some existing CRA problems, the potential influence of cue (i.e. stimulus word) strength is obvious. For the CRA problem with stimulus words, *cottage/swiss/cake*, *swiss* has FSG (cue-to-target strength) of .67 with respect to the solution word *cheese*. Similarly, for the CRA problem with stimulus words, *show/life/row*, *row* has FSG = .73 with respect to the solution word *boat*. Other examples are perhaps less dramatic, but still plausibly memory-biased: for the CRA problem with stimulus words, *duck/fold/dollar*, *dollar* has FSG = .23 with respect to the solution word *bill*; for the CRA problem with stimulus words, *aid/rubber/wagon*, *rubber* has FSG = .21 with respect to solution word *band*, and so forth. Such examples challenge the "remote" in "remote associate."

Other researchers seem to have observed this previously. As mentioned earlier, Ball and Stevens (2009) conjectured "that the easy CRAs that we used may not, in fact, be insight problems at all, just straightforward cued-recognition tasks…" (p. 1065). In addition, the phenomenon of "immediate-insight solution," reported by Cranford and Moss (2012), may have been caused by using some CRA problems solvable by memory-biased analysis. As is typical, they relied on subject report of solution type. Their instructions may have led to subjects reporting such solutions as due to insight.[5] The description of the Bowden and Jung-Beeman (2003b) CRA problems used in the Cranford and Moss (2012) experiment makes it likely that some reports of "immediate-insight solution" in this experiment were generated by CRA problems solvable by MBA. Specifically, CRA problems "were chosen based on information from a baseline study… The 60 problems with the highest solution rates that had been solved

with insight about half of the time were included in the set in order to get a large number of correct solutions per solution type" (Cranford & Moss, 2012, p. 137). By contrast, the 25 CRA problems with the highest solution rates (according to Bowden & Jung-Beeman, 2003b, 15-second norms) are not included in Appendix B, due to non-zero FSG of one or more stimulus words with respect to the solution word; of the 62 CRA problems with the highest solution rates, only four are included in Appendix B. Thus, it seems likely that Cranford and Moss (2012) used some CRA problems potentially solvable by memory-biased analysis. It is also possible that solvers in their experiment would have reported solution by insight for CRA problems actually solved by MBA. When the solution word was the first candidate given by a solver *and* the problem was reported as solved via insight, Cranford and Moss defined this to be "immediate-insight solution" (as opposed to insight solution that is not immediate). In actuality, however, many of these problems were likely solved by memory-biased analysis instead.

In conclusion, the assumption that there are *only* two ways of solving CRA problems, either involving insight or analysis, is not supported. Memory-biased analysis (MBA), where a CRA stimulus word strongly cues the solution word, appears to be a third distinct method of solving some CRA problems. CRA problems prone to MBA solution may not be useful in most studies of insight problem solving.

Notes

[1] In addition, M. Beeman (personal communication, October 29, 2014) stated that his lab has given problem solvers an 'other' option (in addition to the 'insight'/'not insight' options), but that solvers were directed to use this option "in limited cases (such as when you instantly recognize the answer, w/o even engaging in problem solving)." Further, Cranford and Moss (2012) included an 'other' option as well in their experiment.

[2] One may wonder what if a solver reads *word2* and *word3* before reading *word1*. Although *word2* and *word3* may trigger spreading activation which activates *solution* in memory, it seems plausible that when the solver reads *word1*, its associated cue-to-target strength with respect to *solution* might dwarf the effect of any activation of *solution* by *word2* and *word3*. Though plausible, this may not be correct. Baror and Bar (2016) reported the result of an experiment which suggests that, under conditions of low cognitive load, activation of a word's close associates may actually be inhibited, while activation of its remote associates is facilitated.

[3] Labeling this proposed new type of CRA problem solving "memory-biased analysis" (MBA) may seem controversial, not because of the implication that memory is heavily involved, but rather because of the implication that analysis is involved. But consider the example given in the text. Even though *word1* strongly cues *solution*, *solution* still must be systematically verified with both *word2* and *word3*, in order to ensure that *solution* is indeed the correct solution to the CRA problem. Granted, such verification may represent, at best, only a minimal form of analysis. However, the point of this report does not hinge on the precise name of this proposed new type of CRA problem solving. So, for the purposes of this technical report, I will continue to refer to this proposed new type of CRA problem solving as memory-biased analysis (MBA).

[4] Some may feel that this assumption is stated too strongly. After all, subjects are typically asked to report whether insight was involved or not (as opposed to whether insight or analysis was involved). Even if researchers do not explicitly invoke insight versus analysis when instructing subjects on how to report solution, the literature itself seems to reflect the "insight"/"analysis" distinction with respect to solution of CRA problems.

[5] For example: "…A noninsight rating is when you strategically searched for the answer by combining possible solutions with each of the three problem words until you felt you had the correct solution. *The answer did not just pop into your head, and you felt you had to search for the answer* [italics added]" (Cranford & Moss, 2012, p. 137). A CRA problem with a stimulus word that has a strong FSG in relation to the solution word may cause the solution word to immediately "pop into one's head," even if the solution word then must be verified with respect to the two remaining stimulus words (a form of analysis). Thus, their subjects may have reported solution by insight after solving CRA problems by memory-biased analysis.

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Appendix A: Bowden and Jung-Beeman (2003b) norms with FSG information from Nelson et al. (1998).

B&J-B p: Bowden and Jung-Beeman (2003b) proportion solved, 15-second column.

SolPrefix: number of CRA stimulus words for which the CRA solution is a prefix.

CRA1	CRA2	CRA3	CRAsol	B&J-B p	SolPrefix	CRA1 FSG	CRA2 FSG	CRA3 FSG	Notes
cottage	swiss	cake	cheese	0.96	1	0.2	0.67	0	
cream	skate	water	ice	0.92	3	0.37	0.24	0.02	
loser	throat	spot	sore	0.86	3	0.03	0.16	0	
show	life	row	boat	0.82	0	0.02	0	0.73	
night	wrist	stop	watch	0.82	0	0	0.34	0	
duck	fold	dollar	bill	0.8	1	0.01	0	0.23	
rocking	wheel	high	chair	0.8	0	0	0.01	0	rock/.03
dew	comb	bee	honey	0.8	3	0	0	0.22	
fountain	baking	pop	soda	0.78	2	0.01	0	0.43	
preserve	ranger	tropical	forest	0.76	2	0	0	0.06	
aid	rubber	wagon	band	0.75	2	0	0.21	0	
flake	mobile	cone	snow	0.71	3	0.25	0	0.02	
cracker	fly	fighter	fire	0.68	3	0	0	0.1	
safety	cushion	point	pin	0.66	2	0.03	0.05	0.03	
cane	daddy	plum	sugar	0.66	3	0.27	0	0.02	
dream	break	light	day	0.64	3	0	0	0.05	
fish	mine	rush	gold	0.63	3	0.03	0.04	0	miner/.11
political	surprise	line	party	0.61	1	0	0.24	0	
measure	worm	video	tape	0.58	2	0.04	0	0.07	
high	district	house	school	0.55	2	0.01	0	0	B&J-B combines this entry and next.
high	district	house	court	0.55	1	0	0	0	***See above entry.
sense	courtesy	place	common	0.54	3	0.06	0	0	
worm	shelf	end	book	0.53	3	0	0.36	0	
piece	mind	dating	game	0.53	1	0	0	0	pieces/.01
flower	friend	scout	girl	0.51	2	0	0.07	0.13	
river	note	account	bank	0.5	2	0.03	0	0.27	
print	berry	bird	blue	0.49	3	0	0	0.02	blueprint/.01
pie	luck	belly	pot	0.49	3	0	0	0	
date	alley	fold	blind	0.47	3	0	0	0	
opera	hand	dish	soap	0.47	2	0	0	0	dishes/.04;dishwasher/.12
cadet	capsule	ship	space	0.47	3	0	0	0	
fur	rack	tail	coat	0.46	2	0.32	0.02	0.02	
stick	maker	point	match	0.46	3	0	0	0	
hound	pressure	shot	blood	0.42	3	0.01	0.08	0.02	
fox	man	peep	hole	0.42	0	0.04	0.02	0	
sleeping	bean	trash	bag	0.41	0	0	0	0.02	
dust	cereal	fish	bowl	0.41	0	0	0.03	0.01	
light	birthday	stick	candle	0.41	2	0	0.06	0	lit/.07
food	forward	break	fast	0.41	3	0	0	0	
shine	beam	struck	moon	0.41	3	0.01	0	0	
peach	arm	tar	pit	0.41	0	0.12	0	0	
water	mine	shaker	salt	0.41	3	0	0	0	mineral/.04
palm	shoe	house	tree	0.41	1	0.25	0.01	0	

basket	eight	snow	ball	0.39	0	0.13	0.05	0.01	basketball/.04
wheel	hand	shopping	cart	0.39	1	0	0	0.03	
right	cat	carbon	copy	0.39	2	0	0	0.37	
home	sea	bed	sick	0.38	1	0.05	0	0	
nuclear	feud	album	family	0.37	2	0	0.12	0	
sandwich	house	golf	club	0.36	2	0	0	0.15	
cross	rain	tie	bow	0.34	1	0.02	0	0.1	
sage	paint	hair	brush	0.34	0	0.03	0.32	0.2	painter/.11;painting/.06;hairspray/.01
french	car	shoe	horn	0.34	0	0	0	0.05	
boot	summer	ground	camp	0.33	1	0.14	0	0	
chamber	mask	natural	gas	0.33	2	0.1	0	0	
mill	tooth	dust	saw	0.33	3	0.1	0	0	
main	sweeper	light	street	0.33	2	0.31	0	0	
pike	coat	signal	turn	0.33	3	0.09	0	0.09	
office	mail	hat	box	0.32	1	0	0.13	0.01	
fly	clip	wall	paper	0.32	1	0.02	0	0.07	paperclip/.31;clippers/.01
age	mile	sand	stone	0.32	1	0	0.01	0	
catcher	food	hot	dog	0.3	2	0.12	0	0.01	
wagon	break	radio	station	0.3	2	0.02	0	0.09	
tank	hill	secret	top	0.3	1	0.03	0.05	0	
health	taker	less	care	0.29	2	0.02	0	0	
lift	card	mask	face	0.29	3	0	0	0.19	
dress	dial	flower	sun	0.29	3	0	0.01	0.01	
force	line	mail	air	0.28	3	0.04	0	0.01	
guy	rain	down	fall	0.28	1	0	0	0.02	
eight	skate	stick	figure	0.28	2	0	0	0	
down	question	check	mark	0.28	1	0	0.04	0.06	
animal	back	rat	pack	0.28	2	0	0	0	
officer	cash	larceny	petty	0.28	3	NA	NA	NA	
pine	crab	sauce	apple	0.26	1	0	0.04	0.01	
house	thumb	pepper	green	0.26	3	0	0	0	
carpet	alert	ink	red	0.26	3	0.04	0.09	0	
master	toss	finger	ring	0.26	3	0	0.03	0.06	
hammer	gear	hunter	head	0.25	2	0.01	0.02	0	
knife	light	pal	pen	0.25	3	0.01	0	0.03	
foul	ground	mate	play	0.25	2	0.1	0	0.02	
change	circuit	cake	short	0.25	3	0	0	0	
way	board	sleep	walk	0.25	1	0	0.02	0	walkway/.01
blank	list	mate	check	0.24	2	0.01	0.02	0	
tail	water	flood	gate	0.24	0	0.01	0	0	
marshal	child	piano	grand	0.24	3	0	0	0	
cover	arm	wear	under	0.24	3	0	0	0	
rain	test	stomach	acid	0.22	2	0	0	0.01	
time	blown	nelson	full	0.22	3	0	0	0	
pile	market	room	stock	0.22	3	0	0.01	0	
mouse	bear	sand	trap	0.22	0	0.02	0	0	
cat	number	phone	call	0.21	1	0	0	0.28	

keg	puff	room	powder	0.21	3	0	0.05	0	
trip	house	goal	field	0.18	3	0	0	0.02	
fork	dark	man	pitch	0.18	3	0	0	0	salesman/.02
fence	card	master	post	0.18	2	0.07	0.01	0	
test	runner	map	road	0.18	3	0	0.02	0.22	
dive	light	rocket	sky	0.18	3	0	0	0.04	moonlight/.03;lightning/.02
man	glue	star	super	0.18	3	0	0	0	
tooth	potato	heart	sweet	0.18	3	0	0	0	
illness	bus	computer	terminal	0.18	1	0	0	0.02	
type	ghost	screen	writer	0.18	0	0.13	0.01	0	typist/.01
mail	board	lung	black	0.17	3	0	0.01	0	
teeth	arrest	start	FALSE	0.17	3	0	0	0	
iron	shovel	engine	steam	0.17	3	0	0	0	
wet	law	business	suit	0.17	0	0	0	0.03	
rope	truck	line	tow	0.17	3	0	0	0	
off	military	first	base	0.16	0	0	0.01	0	
spoon	cloth	card	table	0.16	2	0	0.01	0.01	
cut	cream	war	cold	0.14	3	0	0	0	ice cream/.27
note	chain	master	key	0.14	2	0.02	0	0	
shock	shave	taste	after	0.13	3	0	0	0	
wise	work	tower	clock	0.13	3	0	0	0	clockwise/.11
grass	king	meat	crab	0.13	2	0	0	0	
baby	spring	cap	shower	0.13	1	0	0	0	
break	bean	cake	coffee	0.12	3	0	0	0	
cry	front	ship	battle	0.11	3	0	0	0	
hold	print	stool	foot	0.11	3	0	0	0.02	
roll	bean	fish	jelly	0.11	3	0	0.01	0	
horse	human	drag	race	0.11	1	0.03	0	0.21	Note: racehorse, not horserace, in Oxford Pocket Dictionary and Thesaurus, 2nd American edition.
oil	bar	tuna	salad	0.11	2	0	0	0.02	
bottom	curve	hop	bell	0.09	3	0	0	0	
tomato	bomb	picker	cherry	0.09	3	0	0	0	
pea	shell	chest	nut	0.09	1	0	0	0	peanut/.02
line	fruit	drunk	punch	0.09	2	0	0	0	
bump	egg	step	goose	0.08	3	0	0	0	bumps/.02
fight	control	machine	gun	0.08	2	0	0	0.02	
home	arm	room	rest	0.08	2	0	0	0	
child	scan	wash	brain	0.07	3	0	0	0	
nose	stone	bear	brown	0.07	3	0	0	0.02	
end	line	lock	dead	0.07	3	0	0	0	
control	place	rate	birth	0.05	3	0.01	0	0	
lounge	hour	napkin	cocktail	0.05	3	0	0	0	
artist	hatch	route	escape	0.05	3	0	0.01	0	
pet	bottom	garden	rock	0.05	2	0	0	0	
mate	shoes	total	running	0.05	3	0	0	0	
self	attorney	spending	defense	0.04	2	0	0	0	
board	blade	back	switch	0.04	3	0	0.03	0	
land	hand	house	farm	0.03	3	0	0	0	

hungry	order	belt	money	0.03	3	0	0	0	
forward	flush	razor	straight	0.03	3	0.03	0	0	
shadow	chart	drop	eye	0.01	3	0.04	0.01	0	
way	ground	weather	fair	0.01	3	0	0	0	grounds/.02
cast	side	jump	broad	0	3	0	0	0	
back	step	screen	door	0	1	0	0	0.04	
reading	service	stick	lip	0	3	0	0	0	
over	plant	horse	power	0	1	0	0	0	overcome/.01

Appendix B: 32 CRA problems where CRA stimulus words have FSG = 0 wrt CRA solution word. CRA problems are from Bowden and Jung-Beeman (2003b). FSG = 0 according to Nelson et al. (1998).

CRA triple 1	CRA triple 2	CRA triple 3	CRA solution	B&J-B 15-sec. p
pie	luck	belly	pot	0.49
date	alley	fold	blind	0.47
stick	maker	point	match	0.46
food	forward	break	fast	0.41
eight	skate	stick	figure	0.28
animal	back	rat	pack	0.28
house	thumb	pepper	green	0.26
cover	arm	wear	under	0.24
fork	dark	man	pitch	0.18
man	glue	star	super	0.18
tooth	potato	heart	sweet	0.18
teeth	arrest	start	FALSE	0.17
iron	shovel	engine	steam	0.17
rope	truck	line	tow	0.17
cut	cream	war	cold	0.14
shock	shave	taste	after	0.13
grass	king	meat	crab	0.13
baby	spring	cap	shower	0.13
break	bean	cake	coffee	0.12
cry	front	ship	battle	0.11
bottom	curve	hop	bell	0.09
line	fruit	drunk	punch	0.09
home	arm	room	rest	0.08
end	line	lock	dead	0.07
lounge	hour	napkin	cocktail	0.05
pet	bottom	garden	rock	0.05
mate	shoes	total	running	0.05
land	hand	house	farm	0.03
hungry	order	belt	money	0.03
cast	side	jump	broad	0
reading	service	stick	lip	0
over	plant	horse	power	0