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Shakers and Maracas:
Action-based Categorisation Choices in Triads Are Influenced by Task Instructions

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Abstract

The forced-choice triad task has become increasingly popular in use over recent years. While it is seen as being a categorisation task (Lin & Murphy, 2001) variation in task instructions often leads to different results. Shipp, Vallée-Tourangeau, and Anthony (2014) used the triad task to show that when participants are asked to choose an option that 'goes best with the target', they are more likely to select the choice that shares an action relation when it also shares taxonomic information. However using the instruction to select the item that "goes best" is vague and might encourage a strategy other than a categorical decision. The present experiment used the same triads as in Shipp et al. to test whether participants would match items based on shared actions or shared taxonomic relations when given specific categorisation instructions. The task instructions were manipulated so that participants either selected the item that "goes best", "goes best to form a category" or is "most similar" to the target. The results found instances where the instructions of "goes best to form a category" led to a higher probability that participants would select the action choices over the instructions of "goes best". However when participants were encouraged to use similarity overall action choices were lower. Therefore the triad task does encourage a natural categorisation strategy and differences in task instructions across research are a result of the stimuli used.

**Keywords:** Action; Triads; Context; Instructions.

Introduction

Over years of research a variety of tasks have been used to measure the way in which objects are categorised including feature/exemplar listing tasks and sorting tasks. The forced-choice triad task has become a more popular tool in categorisation research over recent years and has been successfully used to show the influence of thematic relations in conceptual knowledge (Lin & Murphy, 2001; Mirman & Graziano, 2012; Kalénine & Bonthoux, 2008; Simmons & Estes, 2008).

Triad tasks are formed from a target word presented with one of two choice options sharing a particular relation to the target. The choice that participants select is seen to reflect how information is mentally organized. Lin and Murphy (2001) researched thematic choices in adults' conceptual knowledge where previously it was thought that only young children make use of thematic relations (Inhelder & Piaget, 1964; Kalénine & Bonthoux, 2008; Olver & Hornsby, 1967; Smiley & Brown, 1979). Lin and Murphy manipulated the choices where one shared a taxonomic relation to the target and one shared a thematic relation. For example the target of *bee* presented with *flies* (taxonomic relation) and *honey* (thematic relation). The results showed that when participants were asked to select the item that "goes best" with the target to form a category, the majority of choices were for the thematically related item (62%). In a second experiment Lin and Murphy used the same triad task adjusted the task instructions. When participants were instructed with "which two best form a category" the percentage of participants selecting the thematically related item decreased (49%).

Using the same triad task and "goes best with" instructions, Shipp, Vallée-Tourangeau, and Anthony (2014) identified conditions under which participants would draw upon action knowledge. Shipp et al. matched items together because they share the same physical action to operate them. For example *rifle* and *water pistol* share an action where both are operated with a 'trigger' action. Shipp et al. designed three sets of triads to measure how often participants selected the item sharing an action to the target. In the first set of triads, referred to as the Same Category Object (SCO) triads, the objects came from the same taxonomic category. However one of the options also shared an action with the target. These were designed to test for the additive effects that action might have in the same way that previous research had shown that shared themes have an additive effect when presented with taxonomic relations (Wisniewski & Bassok, 1999). An example of an SCO triad shows the target of *pencil* presented with *elastic band* (taxonomic) and *paintbrush* (taxonomic + action). In the second set of triads only one of the choice options shared a taxonomic choice where the other only shared an action. These Different
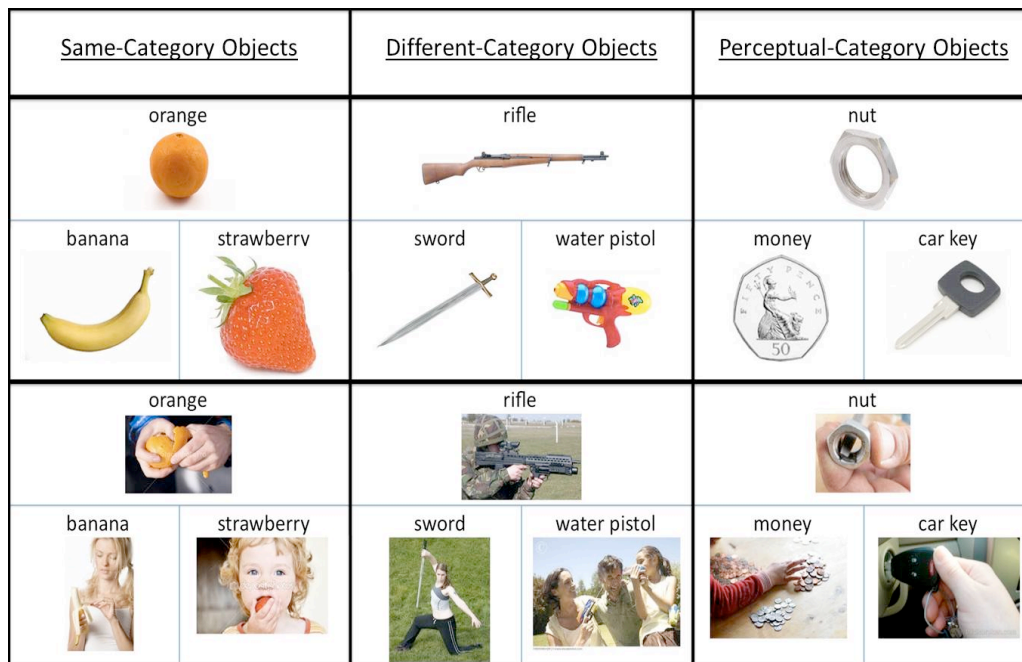
Figure 1. Examples of stimuli used in the experiment. From left to right: Same Category Object triad, Different Category Object triad, and Perceptual Category Object triad in the context-lean condition (top panels) and in the context-rich condition (bottom panels).

Category Object (DCO) triads were designed to test competition effects of action against taxonomic relations. For example the target of *rifle* was presented with *sword* (taxonomic only) and *water pistol* (action only). The triads were further manipulated by context whereby triad pictures were either shown to participants as three isolated objects against a white background (context-lean) or shown used by an agent for its functional purpose (context-rich). The results showed that participants were significantly more likely to select the action item on the SCO triads in either context (context-lean = 61%, context-rich = 70%). However the overall percentages of action choices on the DCO triads were low with a significant increase from the context-lean (32%) to the context-rich (53%) condition. This would therefore suggest that action is less likely to present as a basis for category membership on its own but has an additive effect when presented with taxonomic information. In addition a third set of triads were designed to assess the confounding variable that objects that share an action will invariably share perceptual properties. For example the *rifle* and *water pistol* look similar as they are designed around the trigger/handle component. Therefore it is possible that participants selected the action item because they looked similar rather than sharing an action. The Perceptual Category Object (PCO) triads were designed such that none of the three items shared a taxonomic relation, but one choice option shared perceptual properties to the target and the other choice shared an action to the target. If participants were selecting objects in the triads because of perceptual properties rather than shared action, then they would be less likely to select the action items on the PCO triads. The results deflected this possibility showing that in the context-

rich condition participants were more likely to select the action choice (69%) showing the strong role that action plays in the triad task, particularly when presented within a functional context. In a related study, Tsagkaridis, Watson, Jax and Buxbaum (2014) used a triad task to show that participants are more likely to select thematically related items when they are used together for a purpose, such as *wine bottle* and *corkscrew*.

Task instructions are particularly important in the experiments reviewed thus far, but these are inconsistently formulated. Research has shown that variations in the task instructions lead to different choices selected on the triad task as shown by Lin and Murphy (2001) when participants were asked to select the item that "goes best" or "which two form a category". Simmons and Estes (2008) also showed different levels of thematic preference across different experiments when participants were instructed to select the item "most similar to" (46%), "most different to" (39%) or "most like to" (57%). Mirman and Graziano (2012) specifically used the instructions of "goes best" so as not to cause a taxonomic bias within the task. While the triad task is seen as a categorisation task (Estes, Golonka & Jones, 2011; Golonka & Estes, 2008; Lin & Murphy, 2001; Murphy, 2001; Simmons & Estes, 2008) the task appears to favour a thematic strategy unless participants are given more explicit category instructions. However such instructions are somewhat unclear in what they ask participants to do. It could be that participants rather than categorising the objects are selecting the item most similar to the target. While categorisation and similarity are seen as related processes where models of categorisation rely on similarity (Medin & Schaffer, 1978; Rosch & Mervis;

1975; Rosch, Simpson & Miller, 1976) there are dissociations between them (Goldstone, 1994; Iachini, Borghi & Sense, 2008; Rips, 1989; Smith & Sloman, 1994). A potential criticism of Shipp et al. is that the instruction of "goes best" could favour an action strategy, and participants are not engaging in a categorisation task. Therefore it is an empirical question as to whether the same pattern would be found in performance on the same triads when the instructions favoured a categorisation strategy. The aim of the present experiment was to test the effects of varying instructions on the action choices made in the triad task previously used by Shipp et al. (2014). The same triads from Shipp et al. were used and presented either in the context-lean or context-rich conditions previously used. However three sets of instructions were used where participants were asked either to select the item that "goes best", "goes best to form a category", or "is most similar to the target". If it is the case that participants on the triad task use a categorisation strategy then there should be little difference in action-based choices between "goes best to form a category" and "goes best". If however participants are completing the triad task using a similarity strategy then there should be little difference between "goes best" and "is most similar to". Several predictions can be made based on the findings of Shipp et al. as follows; it was predicted that (i) selection of the action-related item would be highest in the SCO triads and lowest in the DCO, replicating the 'additive' effect found previously, and (ii) the action choice percentages would be higher in the context-rich than context-lean conditions. Given that previous research views the triad task as a categorisation task (Estes et al., 2011; Lin & Murphy, 2001) it was predicted that no differences would be found between the "goes best" and "goes best to form a category" instructions in terms of the influence on action choices.

Method

Participants

Ninety undergraduate Psychology students (65 females, $M_{age} = 21.19$, $SD = 6.12$) took part in the experiment in return for course credit.

Materials

The same 30 triads (10 x SCO, 10 x DCO, 10 x PCO) triads used in Shipp et al. (2014) were used here presented within subjects to participants (see Fig. 1). The SCO triads consisted of a target with two choice options sharing a taxonomic relation to the target, but one also sharing an action with the target. The DCO triads consisted of a target with a choice option sharing a taxonomic relation only, and one sharing an action relation only. The PCO triads consisted of a target with one choice option sharing an action with the target, and one sharing perceptual properties. The triads were once again presented in a between subjects manner either in the context-lean or context-rich conditions. No differences were present in the program used except for

Table 1. *Full list of the Same Category Object (SCO) triads used in the experiment*

Target Item	Choice Items	
	Taxonomic Choice	Taxonomic and Action Choice
Pencil*	Elastic band	Paintbrush
Glass	Jug	Cup
Spatula	Grater	Saucepan
Pin**	Screw	Plug
Orange*	Banana	Strawberry
DVD player*	Television	CD player
Bed*	Wardrobe	Sofa
Leaflet	Poster	Newspaper
Spade*	Shears	Trowel
Ketchup*	Vinegar	Salt

Table 2. *Full list of the Different Category Object (DCO) triads used in the experiment*

Target Item	Choice Items	
	Taxonomic Choice	Action Choice
Fax machine*	Telephone	Photocopier
Screwdriver	Hammer	Key
Drink bottle**	Mug	Jam jar
Rifle**	Sword	Water pistol
Computer**	Printer	Piano
Calculator*	Set square	Mobile phone
Book	Ipod	Wallet
Paperclip*	Ruler	Clothes peg
Deodorant*	Hair gel	Insect repellent
Knife*	Ladle	Saw

Table 3. *Full list of the Perceptual Category Object (PCO) triads used in the experiment*

Target Item	Choice Items	
	Perceptual Choice	Action Choice
Axe	Cane	Tennis racket
Baseball bat*	Wrapping paper	Mace
USB pen*	Chewing gum	Phone charger
Clarinet	Wooden spoon	Balloon
Nut	Money	Car key
Present**	Storage box	Shoe
Cocktail shaker*	Vase	Maracas
Gun	Hairdryer	Cleaning spray
Peppermill**	Spray paint	Hair wax
Handbag*	Cheese grater	Cookie jar

Note. *Indicates those triads where choice selection significantly differed from chance with greater selection for the action choice. **Indicates those triads where choice selection significantly differed from chance with greater selection for the taxonomic (SCO/DCO) or perceptual choice (PCO).

the instructions given at the beginning.

Procedure

The procedure was the same as that used in Shipp et al. (2014). The triads were presented using Superlab on a 15" Macintosh laptop. The program began with a single practice triad followed by the 30 test items. A fixation cue was presented at the top of the screen on each trial for 1000ms. The fixation cue was replaced by the target word and picture (dependent on the condition the participant were assigned to). After 1500ms the two choice options appeared beneath the target alongside the appropriate images. Participants were either instructed to select the choice item that "goes best with the target", "goes best with the target to form a category" or "is most similar to the target". In the same manner as Lin and Murphy (2001) participants in the category instruction condition were presented with a definition in order to emphasise the categorical nature of the task. The instructions stated, "A category is defined as a set of things that share some commonalities - be it functions, purposes, physical and perceptual characteristics, or behavioural predispositions". Participants were instructed to press the 'a' key to choose the item on the left-hand side of the screen and the 'l' key for the item on the right-hand side of the screen. The action item was counterbalanced so that in half of the trials it appeared on the left side or right side of the screen. After they had made their choice the triad disappeared and the fixation cue appeared again for the next triad. Thus the design of the current experiment was a 3 (instructions) x 2 (context) x 3 (triads) mixed design with instructions and context as between subjects factors and triads as a repeated measures factor.

Results

The mean proportion of action responses was calculated for the SCO, DCO and PCO triads across context and instructions. As was found in Shipp et al., (2014) participants showed a tendency to select the action choice more with the SCO (66%) than with the PCO (57%) and DCO (54%) triads, and more so in the context-rich (67%) condition than context-lean (51%). In addition action choices were higher following the Goes Best to Form a Category (GBFC, 63%) instructions than in the Goes Best (GB, 58%) and the Most Similar (MS, 56%) instructions. Due to the dichotomous nature of the dependent variable the proportions of the choices made on the triads was initially analysed using single sample t-tests with a theoretical mean of 0.5. The results showed that in only nine (of thirty) triads did the choices not significantly differ from chance (see Tables 1, 2 and 3). In order to make the data fully comparable with the previous work of Shipp et al. (2014) these triads were left in for the remainder of the analysis.

A 3x2x3 mixed analysis of variance was conducted on the mean percentage of action choices across the triads. The analysis revealed a significant main effect of Context with a higher number of action choices in the context-rich condition, $F(1, 84) = 44.70$, $p < .001$, $\eta^2 = .35$. The main effect of Triads was also found to be significantly different, $F(2, 168) = 17.91$, $p < .001$, $\eta^2 = .18$. Post hoc analysis using the Bonferroni adjustment found that the action responses on the SCO triads were significantly higher than both the DCO triads ($p < .001$) and the PCO triads ($p < .001$). No difference was found between the DCO triads and the PCO triads ($p = .86$). The main effect of Instructions was not significant, $F(2, 84) = 2.70$, $p = .073$, $\eta^2 = .06$, nor was the two-way interaction between Context and Instructions, $F < 1$. The two-way interaction effect between Context and Triads was significant, $F(2, 168) = 11.47$, $p < .001$, $\eta^2 = .12$. In all three triads the mean percentage of choices was higher in the context-rich condition than in the context-lean condition, but the effect was stronger in the SCO ($p < .001$) and PCO triads ($p < .001$) than in the DCO triads ($p = .035$). The two-way interaction between Instructions and Triads was also significant; $F(4, 168) = 2.51$, $p = .044$, $\eta^2 = .06$. Post hoc analysis revealed that the only differences were found on the PCO triads where GBFC led to a higher mean proportion of action choices compared to GB ($p = .033$) and MS ($p < .001$). The difference between GB and MS was marginally significant ($p = .051$).
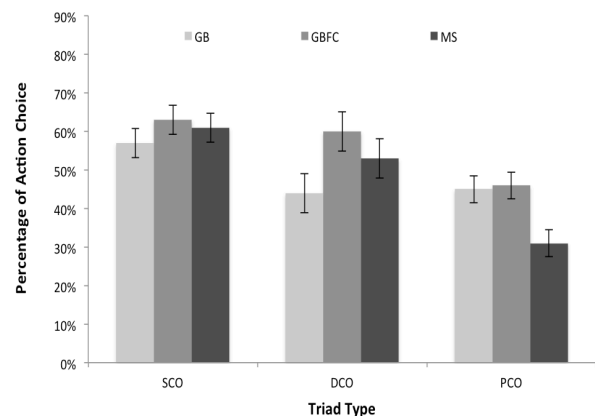
Figure 2. Mean percentage of action choices in the context-lean condition with the Same Category Object (SCO), Different Category Object (DCO), and Perceptual Category Object (PCO) triads between the Goes Best (GB), Goes Best to Form a Category (GBFC) and Most Similar (MS) instructions. Error bars are standard errors of the mean.

However of main interest here is the three-way interaction between Context, Instructions and Triads which was significant, $F(4, 168) = 5.01$, $p = .001$, $\eta^2 = .11$. Figures 2 and 3 show the mean proportion of action choices in each triad across the different instructions, spilt across the two contexts. Looking at the proportion of action choices in the context-lean condition (see Fig. 2) no differences were found between the instructions on the SCO triads. Post hoc analysis found that on the DCO triads the category instructions (GBFC) led to higher action choices than GB ($p = .028$). In addition on the PCO triads the similarity instructions (MS) led to

lower action choices than GB (p = .006) and GBFC (p = .003).
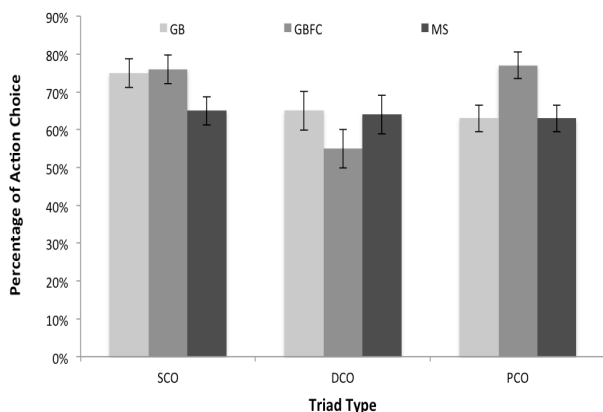
Figure 3. Mean percentage of action choices in the context-rich condition on the Same Category Object (SCO), Different Category Object (DCO), and Perceptual Category Object (PCO) triads between the Goes Best (GB), Goes Best to Form a Category (GBFC) and Most Similar (MS) instructions. Error bars are standard errors of the mean.

Examining the context-rich condition (see Fig. 3) no instruction related differences were found on the DCO triads. On the SCO triads the MS instructions led to significantly lower action choices than GB (p = .049) and GBFC (p = .0.36), but no difference was found between GB and GBFC (p = .90). In addition on the PCO triads the category instructions (GBFC) led to higher action choices than GB (p = .006) and MS (p = .006). The data here show that under no conditions did the GB instructions lead to statistically higher action choices than the GBFC instructions, and the similarity instructions led to proportionally lower action choices overall.

The overall mean proportion of action choices on the triads were recalculated without those triads which did not significantly differ from chance (see Tables 1, 2 and 3). The analysis was repeated and while the means across all of the triads increased, the exact same pattern was found overall with a significant three way interaction between Triads, Context and Instructions, $F(4, 168) = 3.11$, p = .017, η^2 = .07.

Discussion

The results reported here replicate Shipp et al. (2014) where participants were more likely to select the action choice when it also shared taxonomic information. This can be seen in the triads where the highest mean proportion of action choices was seen in the SCO triads compared to the DCO. In addition action choices were higher presented in a functional context. This effect was stronger for the SCO and PCO triads compared to the DCO triads.

However of main interest was the effect of task instructions. A potential criticism of the results reported in Shipp et al. (2014) was that whilst claims were made by those authors regarding the role of action in a categorization task, the instructions "goes best with" might have not have encouraged participants to see the task as one of categorization and, on the contrary, encouraged the use of a non-categorical strategy and more reliance on action. The significant three-way interaction reported here deflects this criticism. If it were the case that participants were not using a categorisation strategy then action choice preferences with GBFC instructions would be significantly lower than with the GB instructions. Overall the GB instructions did not lead to significantly higher action choice frequencies than the GBFC instructions. In contrast there are examples within the conditions where GBFC instructions actually led to higher action choice frequencies than GB instructions. Therefore rather than the more ambiguous GB instructions inflating action choice frequencies, it appears that these instructions are, if anything, reducing the probability of picking the action item. In addition, if it were the case on the triads that GB promoted a similarity strategy rather than a categorisation then the MS instructions would result in choice preferences more similar to those obtained with the GB instructions. However the results show that action frequencies were lower when participants were invited to select the most similar item. This further suggests that the triad task is a categorisation task and whilst it may draw on the participants understanding of similarity, performance does not rely solely on this.

An interesting finding here relates to the use of the GBFC instructions on the DCO triads. With these triads and instructions selection of the action choice was fairly high in both the context-lean (60%) and the context-rich (59%) conditions. Theoretically speaking it would be predicted that action choice frequencies should be fairly low with the DCO triads when participants are asked to group by category as the taxonomic item was designed to share category membership with the target, and the action choice was not. For example *rifle* and *sword* are both weapons and therefore when asked "goes best to form a category" participants should be more likely to select *sword* over *water pistol* as they are both members of the same category of 'weapons' (see Rosch, 1975). There are two possible explanations for the unexpected pattern. The first is due to the fact that taxonomic information contains not only information about category membership and functional information, but also perceptual information. If participants are directed to form a category between the target and choice item they should be influenced by perceptual information. Objects which are operated in a similar manner method such as *rifle* and *water pistol* will often share perceptual characteristics as they are designed to work within the ergonomic confines of the human body (i.e., designed around a handle and 'trigger' action). Therefore the action item, to some extent, shared perceptual characteristics with the target object. Further research using the same triad task where participants gave written protocols supports this explanation (Shipp, Vallée-Tourangeau, & Anthony, in prep). On the DCO triads participants often gave either an action *or* perceptual reason for matching the action-related item

to the target, particularly in the context-lean condition. Participants gave fewer perceptual reasons in the context-rich condition compared to the context-lean, possibly due to the reduced visual aspects of the objects themselves when they are held by an agent. For example, the handle of the rifle can no longer be seen in the context-rich condition because the hand of the agent blocks it. As such participants report selecting the action choice in the context-lean condition because of the shared perceptual aspects, but in the context-rich report selecting it because of the shared action between them.

The second possible explanation is that participants are creating goal-derived categories. For example some participants might be grouping *water pistol* with *rifle* because of the general goal of "things used for shooting" in preference to the functional category of weapon. This type of goal is highlighted by the context shown and therefore this, in combination with fewer obvious shared perceptual features, might increase the salience of such goal-derived categories. This would also explain why a high percentage of action choices were seen in the PCO triads where none of the items shared a standard category membership with the target. An example of this would be with *cocktail shaker* as the target and *maracas* as a choice option where participants might derive a sense of category membership based on the goal of "things that make a noise when shaken". The most likely option however is that both of these explanations work together when participants make their choices.

In conclusion, the results show previous concerns that action choices were inflated by the "goes best" instructions have been alleviated following the comparison of such instructions with choice preferences elicited with "goes best to form a category" instructions. However what is not clear here and needs further investigation is the type of category participants create on the fly when engaging with a triad tasks, whether these are categories that cohere in terms of their semantic or goal-derived features. There is yet more to be understood about performance on the forced-choice triad task.

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