Context-outcome associations underlie context-switch effects after partial reinforcement in human predictive learning

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Predictive value for continuously reinforced cues is affected by context changes when they are trained within a context in which a different cue undergoes partial reinforcement. An experiment was conducted with the goal of exploring the mechanisms underlying this context-switch effect. Human participants were trained in a predictive learning situation in which a cue received partial reinforcement while a target cue received continuous reinforcement in context A (C1) and another target cue was presented unreinforced in context B (U2). Participants in group Partial-One did not receive partial reinforcement in context B, while participants in group Partial-Both received the same training they received in context A, but with different cues. When target cues were tested in group Partial-One, greater responding in context A than in context B was found. Differences were smaller in cue U2 than in cue C1. No differences across contexts were found in group Partial-Both. These results are in agreement with the hypothesis that context-switch effects after partial reinforcement are mainly due to the formation of direct context-outcome associations, though the difference on the effect size on the reinforced and unreinforced cues suggests that a modulator mechanism may be also responsible for these context-switch effects.

The role of context in retrieval of information has generated a wide amount of interest in both human (Paredes-Olay & Rosas, 1999; Pineño & Miller, 2004; Rosas, Vila, Lugo, & López, 2001) and non-human research (see Bouton, 1993; Bouton, Nelson & Rosas, 1999, for review). In some situations contexts have shown to play an essential role on retrieving information. For instance when a cue is paired with an outcome in context A and subsequent extinction of the cue is carried out in a different context B, a recovery of response will be observed when the cue is tested back in context A. This ABA renewal effect has been broadly reported (e.g., Bouton & Bolles, 1979; Bouton & King, 1983; Paredes-Olay & Rosas, 1999). Similar results can also be found when acquisition and extinction take place in the same context, and the test is carried out in a different context (AAB renewal, Bouton & Ricker, 1994) or when acquisition, extinction, and testing are all conducted in different contexts (ABC renewal, Bouton & Swartzentruber, 1986).

In all these renewal situations, context-switch effects have been mostly explained by assigning a modulating role to the context that determines which information will be retrieved from memory. Bouton (1994, 1997) has proposed that an excitatory relationship between the representation of the cue and the representation of the outcome is established and stored in memory during acquisition. This relationship is assumed to remain intact throughout extinction, while a new inhibitory association is developed. As a result of this process, the representation of the cue maintains two different links with the representation of the outcome, and contextual information is needed for disambiguating the meaning of the cue; contexts are assumed to be processed in a way that they keep a hierarchical relation with the cue and the outcome, controlling the activation of cue–outcome or cue–no-outcome associations established along acquisition and extinction much like occasion setters (Bouton, 1993, 1994; Bouton & Swartzentruber, 1986).

However, contexts do not always exert their control through hierarchical relationships. Using simple acquisition procedures, León, Abad, & Rosas (2011) explored the role of the level of training on context-switch effects in a predictive learning task with human participants. Context-switches led to a decrease on performance after short training but no effect of switching the context was found when training was long. They found evidence that supports the idea that contexts may enter into competition with discrete cues for the prediction of the outcome early in training, rather than playing the role of controlling performance through an occasion setting mechanism. Similar results have been reported in animal literature. For instance, Murphy, Baker, and Fouquet (2001) used an

appetitive Pavlovian conditioning procedure to explore context conditioning in a predictive relative validity paradigm with rats, finding that the net conditioned response to a conditioned stimulus was determined not only by the stimulus, but also by the context in an additive way. When the meaning of the cues was ambiguous, contexts accrued excitatory predictive properties that add to the predictive properties gained by the stimulus.

Thus, the mechanism underlying context-switch effects is not necessarily the popular occasion-setter-like mechanism proposed by Bouton (1993, 1994) or, at least, this mechanism cannot be taken for granted before conducting the appropriate controls that allow discarding alternative explanatory mechanisms (e.g., Nelson, San Juan, Vadillo-Ruiz, Pérez, & León, 2010). This is the case with the context-switch effect after partial reinforcement reported by Abad, Ramos-Alvarez, and Rosas (2009). These authors found a context switch effect after partial reinforcement using a predictive learning task with human subjects in which participants had to predict whether different kinds of foods would produce a gastric malaise in people who ate at one of two different restaurants (see, for instance, García-Gutiérrez & Rosas, 2003). They found that predictive judgments given to continuously reinforced cues (foods that were always followed by the gastric malaise) trained within a context in which another cue was partially reinforced (being followed by the gastric malaise only half of the times it was presented) was higher if they were tested within the training context than if they were tested in an alternative, but equally familiar context, in which no cue received partial reinforcement.

To explain the deleterious effect of context switching on cues that were continuously reinforced within the partial reinforcement context, Abad et al. (2009) followed the idea proposed by Pearce, Redhead, and Aydin (1997), suggesting that partial reinforcement could have increased the salience of the internal context because of an hypothetical N-state corresponding either to frustration (e.g., Amsel, 1958, 1992) or to a memory trace of non reinforced trials (e.g., Capaldi, 1967, 1994). Alternatively, their results could be also explained if ambiguity on the meaning of the cues within the partial reinforcement situation would encourage participants to pay attention to the context looking for a better predictor of the outcome, so that any information presented in that partial reinforcement situation should become context-dependent (Rosas, Callejas-Aguilera, Ramos-Álvarez, & Abad, 2006; see also Bouton, 1997; Darby & Pearce, 1995). Note that any of these explanations would work for the context exerting control upon performance either through a direct association with the outcome or through a hierarchical control of cue-outcome associations.

The results reported by Abad et al. (2009), with the context-switch effects disappearing when partial reinforcement is conducted in both, the test and training contexts, are in agreement with the idea that contexts exert their control by entering into a direct associations with the outcome in this situation. However, the support for this explanation is weak, as Abad et al. (2009) did not find a context-switch effect in a cue trained within a context of continuous reinforcement (allegedly neutral) and tested within the context of partial reinforcement (allegedly excitatory). If partial reinforcement would have made the context a direct predictor of the outcome, an increase on responding to the cues trained outside that context should be observed when they were tested inside it. Abad et al. (2009) reasonably argued that this effect could not be observed because of a ceiling effect on performance. As the continuously reinforced cue trained outside the partial reinforcement context is already excitatory and shows a high level of responding, the scale would not allow detecting a summation effect when the cue is tested within an excitatory context as responding to that cue is compared with responding to a cue that has been trained to the asymptotic level within that context. However, as reasonable as this claim may be, it renders the explanation of the results reported by Abad et al. (2009) as speculative, given that the allegedly associative value of the contexts was not directly tested in their experiments.

The main goal of the experiment that we report here was to test the assumption of Abad et al. (2009) about context-switch effects after partial reinforcement being due to direct associations between the context and the outcome. The design of the experiment is shown in Table 1. Two groups of participants were trained in context A with a cue being continuously reinforced while another cue was partially reinforced. Groups differed in the treatment they received in context B: In group Partial-One, none of the cues received partial reinforcement –each of them was consistently paired with the presence or the absence of the outcome. However, in group Partial-Both one of the cues in context B received partial reinforcement. After this training, the continuously reinforced (C1) and the non reinforced (U2) target cues were tested in both contexts A and B.

Contexts could play the role of modulators of cue-outcome relationships (e.g., Bouton, 1993). Alternatively, contexts could exert its influence on responding through direct context-outcome associations (e.g., Rescorla & Wagner, 1972). Finally, contexts could control behavior being part of a configuration that establishes a predictive relationship with the outcome (e.g., Pearce, 1987). The design of this experiment allows for testing these three alternative explanations for context-switch effects after partial reinforcement.

If partial reinforcement leads contexts to become occasion-setters, modulating cue-outcome relationships but without entering into direct associations with the outcome, no effect of context-switch would be expected in the unreinforced cue U2 in neither group. Responding to C1 is expected to be high when it is tested within a context that played the role of the occasion setter, regardless of whether it is the context of training or an alternative context –occasion setters have been shown to transfer to target stimuli that have been trained with other occasion setters (see Holland, 1992). According to Bouton (1997) this should occur only in situations in which the cues are ambiguous, because in the absence of ambiguity contexts would not be attended and would not control behavior (see Rosas et al., 2006). If that were the case, then the context-switch effect on C1 would be expected only in group Partial-One, in which the cue C1 is trained in the attended partial-reinforcement context A and tested in the non-attended continuous-reinforcement context B (but see Rosas & Callejas-Aguilera, 2006, whom show that once attention to a context is raised, attention to contexts in different tasks is maintained). In group Partial-Both, as both contexts are partial-reinforcement contexts, both would be attended, would become occasion setters, and no context-switch effect would be expected.

Alternatively, models that assume that contexts enter into associations with the outcomes either by themselves or as part of a configuration predict context-switch effects in both cues. Elemental (Rescorla & Wagner, 1972) and configural (Pearce, 1987) models were applied to the design presented in Table 1 under the assumption of equal salience for all the stimuli involved in the situation (.5), and under the assumption that contexts had lower salience (.2) than cues (.5). Predictions are essentially the same regardless of the salience, with the only exception that undermining the salience of the contexts relative to the cues makes the effects smaller. To simplify, only predictions under the equal-salience assumption are reported here. The top panel of Figure 1 presents the associative strength of each context-target cue combination tested in this experiment as predicted by Rescorla and Wagner's (1972) model (left) and by Pearce's (1987) model (right). Rescorla and Wagner's (1972) model predicts a slight effect of context switch in group Partial-One while no context-switch effect is expected in group Partial-Both. The context-switch effect in group Partial-One is expected to be symmetrical for cues trained in context A and cues trained in context B, as it depends on contexts A and B gaining differential associative strength in group Partial-One (39 and 29, respectively in the judgments' scale used in this experiment), while they gain the same associative strength in group Partial-Both (36). The difference between the

associative strength of the contexts across groups is due to the differential training received by U1 in group Partial-One and group Partial-Both. Alternatively, Pearce's (1987) configural model predicts a deleterious effect of context switching in both groups, though context-switch effects are expected to be somewhat smaller in group Partial-Both. Additionally, this model predicts a smaller context-switch effect in cue U2 than in cue C1.

METHOD

Participants. Forty-eight students of the University of Jaén (40 women and 8 men) participated in the study in exchange for course credits. All participants were naïve as to the purpose of the experiment and ranging in age from 18 to 43 years. All participants had normal or corrected-to-normal vision.

Apparatus and Stimuli. The task was a variation of the one used by García-Gutierrez and Rosas (2003), identical to the one used recently by Abad et al. (2009). The experiment was conducted on 8 Windows XP ® based personal computers. Responses were carried out through a standard mouse. The stimuli were generated and responses collected using the software SuperLab Pro (Cedrus Corporation). All stimuli were displayed on 17" TFT computer screens.

The stimuli were food names from the pool selected by García-Gutierrez and Rosas (2003). Garlic and cucumber were counterbalanced as unreinforced (U2) and continuously reinforced (C1) target cues. Tuna fish and caviar were used as partially reinforced cues (P1 and P2, respectively). Eggs (C2) and grouper (U1) were used as fillers with the aim of equating outcome experience across contexts. Two fictitious restaurant's names (The Canadian Cabin and The Swiss Cow), were counterbalanced as contexts A and B. Restaurant's sign "The Canadian Cabin" was a turquoise blue rectangle with the name of the restaurant written in capital cobalt blue fonts. Restaurant's sign "The Swiss Cow" was written in capital red font within a yellow oval. The outcome was a gastric problem (diarrhea) or the absence of it.

Procedure. Participants were tested within an approximately 15-minute session. All of them gave informed consent for their participation in the experiment before beginning with the experimental session. Instructions were presented using a black font against a white background. A grey button with the sentence "click here to continue" was presented at the right
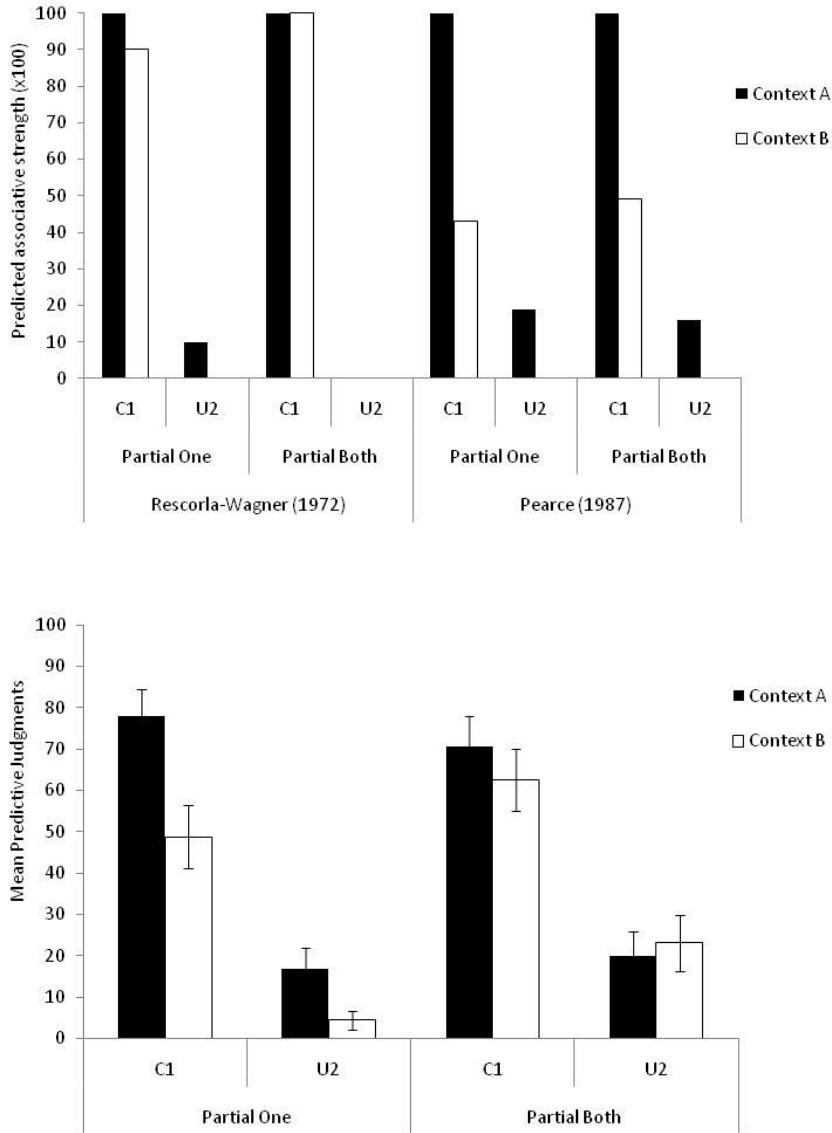
Figure 1. Predicted associative strength (x100) according to Rescorla and Wagner's (1972) and Pearce's (1987) models (top panel) and mean predictive judgments (bottom panel) on test phase to C1 and U2 in context A (training context for C1 and alternative context for U2) and in context B (training context for U2 and alternative context for C1) for groups Partial-One and Partial-Both of Table 1. C1 received continuous reinforcement in context A and U2 was an unreinforced cue presented in context B. Error bars denote standard errors of the mean.

bottom of the screen. Participants had to click with the mouse in this grey button to continue with the next instructions screen. All instructions were presented in Spanish (see Appendix). After reading general instructions about the task, participants had to call the experimenter that continued giving the instructions by demonstration. The demonstration screen was similar to the screens that were used during training, except that a new cue (pasta) was presented as predictor in a restaurant (Bully) that was not used later during training. The experimenter showed participants how to respond in this screen. On the top of the screen there was a sentence that read, "One person ate at restaurant … (name of the restaurant). In the middle of the screen it was written, "This person ate . . . (name of the food). Press a button to indicate the probability that this person presents diarrhea." All foods were written in capital letters and in a cobalt blue font. At the bottom of the screen there was a 0 to 100 scale containing 21 small red buttons. Each button had a number representing a 5-point interval on the scale beginning on 0 (in a light red color) and finishing in 100 (colored in the darkest red). All buttons were equally separated from each other. The words "minimum" and "maximum" were written in bold font below the first and the last button of the scale, respectively. Participants were requested to respond by clicking first on one of the response buttons, and then (when a blue rectangle with the sentence "response recorded" covered the scale) they have to click on the screen change button ("click here to continue"). Then a 1500-ms feedback screen appeared indicating whether the person had diarrhea or had no problems. The intertrial interval (1500 ms) was indicated by a screen with the sentence "Loading file of … (a randomly chosen full name)". Full names were always different to keep the impression that each file was from a different person.

The experiment was conducted in two phases: Training and testing. In both phases participants were requested to rate the probability that the food produced gastric malaise (diarrhea) but they only received feedback (diarrhea or nothing) during the training phase. Participants were randomly ascribed to one of the two groups (Partial-One or Partial-Both) upon their arrival to the laboratory. The design of the experiment is presented in Table 1.

Training phase. All participants received 12 trials with each P1+, P1-, C1+, and U1- combination in Context A (P, C, and U represent the type of reinforcement received by the cues, Partial, Continuous, and Unreinforced; "+" and "-" represent the presence and the absence of the outcome, respectively). Groups differed in the treatment they received in context B. Group Partial-One received 24 C2+ trials, and 12 trials with each, U1- and

U2-. Meanwhile, group Partial-Both received 12 trials with each, P2+, P2-, C2+, and U2-. So, while the overall number of reinforced and non reinforced trials was identical, in group Partial-One partial reinforcement was conducted only in context A, while in group Partial-Both partial reinforcement was conducted in both, contexts A and B. Trials within each context were divided into two identical blocks with trials of each type randomly intermixed. The order in which those two training blocks with each context were presented to participants was counterbalanced (ABBA for half of participants and BAAB for the other half). Each context change was preceded by the sentence "Now you should analyze the files of people that ate at restaurant... (Restaurant's name)."

Table 1. Experiment Design

GROUP	TRAINING	TEST
Partial One	A: 12P1+, 12P1-, 12**C1**+, 12U1-	A: **U2, C1**
	B: 24C2+, 12U1-, 12**U2**-	B: **U2, C1**
Partial Both	A: 12P1+, 12P1-, 12**C1**+, 12U1-	A: **U2, C1**
	B: 12P2+, 12P2-, 12C2+, 12**U2**-	B: **U2, C1**

Note: Two different restaurant names (The Canadian Cabin and the Swiss Cow) were counterbalanced as Contexts A or B. Relevant cues (cucumber and garlic) were also counterbalanced as U2 or C1. P1, P2, C2 and U1 were always tuna fish, caviar, eggs and grouper. The outcomes were diarrhea (+) or its absence (-). Target cues are presented in bold.

Test phase. This phase was preceded by the sentence "Please answer these questions". Participants were asked about the probability of C1 and U2 being followed by the outcome in both contexts A and B. Trial order was counterbalanced across participants.

Dependent variable and statistical analysis

Predictive judgments to cues C1 and U2 were recorded during the test phase and analyzed with an ANOVA setting the rejection criterion at $p \leq .05$.

RESULTS

The bottom panel of Figure 1 presents the mean predictive judgments to C1 and U2 given by participants in group Partial-One and group Partial-Both in contexts A and B during the test phase. Ratings in group Partial-One seem to be higher in context A (the context in which P1 was trained under a partial reinforcement schedule) than in context B (in which no partial reinforcement took place), though this difference seems to be somewhat smaller in cue U2 than in cue C1. No differences across contexts seem to appear in group Partial-Both. A 2 (Group) x 2 (Cue) x 2 (Context) ANOVA found significant main effects of Context, $F (1, 46) = 13.67$, MSE $= 477.90$, $\eta^2_p = 0.229$, and Cue, $F (1, 46) = 68.64$, MSE $= 1668.99$, $\eta^2_p = 0.599$. The interactions Group x Context, $F (1, 46) = 8.44$, MSE $= 477.90$, $\eta^2_p = 0.155$, and Context x Cue, $F (1, 46) = 7.43$, MSE $= 314.65$, $\eta^2_p = 0.139$ were also significant. However, neither the three-way interaction Group x Context x Cue nor the Group x Context interaction were significant, Fs < 1.

Subsequent analyses conducted to explore the Group x Context interaction found that the simple effect of context was significant in group Partial-One, $F (1, 23)$, 14.93, MSE $= 697.65$, $\eta^2_p = 0.394$, but not in group Partial-Both, $F < 1$. These analyses show that context-switch effects only were reliable when partial reinforcement was conducted in one of the contexts of training, and that these effects did not depend on the cue, as the lack of a three-way interaction suggests. However, note that there was a significant Context x Cue interaction indicating that, overall, the simple effect of context was significant in cue C1, $F (1, 47) = 14.19$, MSE$= 587.63$, $\eta^2_p = 0.232$, but not in cue U2, $F (1, 47) = 1.91$, MSE$= 275.75$, $\eta^2_p = 0.039$. This result suggests that context-switch effect in the unreinforced (U2) and reinforced (C1) could be of different size. However, Rescorla and Wagner (1972) predict that the effect of context change should be symmetrical for both cues. With the goal of testing this specific prediction in the only group

that showed reliable context-switch effects, group Partial-One, we conducted a Context x Cue ANOVA that revealed a significant two-way interaction, $F (1, 23) = 4.47$, MSE $= 372.64$, $\eta^2_p = 0.163$. Although subsequent analyses conducted to explore this interaction found that the simple effect of context was significant in both cues C1 and U2, $Fs (1, 23) = 12.68$ and 7.07, MSE $= 805.07$ and 265.22, the effect size was smaller in cue U2 ($\eta^2_p = 0.355$ for C1 and 0.235 for U2) showing an stronger context switch effect for the continuously reinforced cue (C1) than for the unreinforced one (U2).

In summary, a context-switch effect was found in both cues, C1 and U2, but only in group Partial-One. Complementary analyses found that the size of the context-switch effect was smaller in the unreinforced cue U2 than in the reinforced cue C1.

DISCUSSION

A context-switch effect on participants' reports about the predictive value of a cue with respect to an outcome was found only in those participants that received partial reinforcement in one of the two contexts of training. In general, responding within the context in which partial reinforcement took place tended to be higher than in the continuous-reinforcement context for participants in group Partial-One. The context switch effect found on the continuously reinforced cue C1 when trained in a partial-reinforcement context and tested in a continuous-reinforcement context replicates the result reported by Abad et al. (2009). The interesting and novel result in this experiment is that the context switch effect was also found on cue U2, and that the context-switch effect in this cue involved an increase in responding, rather than the decrease observed in cue C1 (remember that for U2 the context change involved being tested in context A, while for cue C1 the context change involved being tested outside context A).

Combined results obtained with C1 and U2 are not easy to explain if contexts were playing a hierarchical control over cue-outcome relationships. If contexts were acting as occasion setters, as Bouton (1993) suggests, the context-switch effect should appear only in the cue that was related to the outcome (C1) but no context-switch effect would be expected on the unreinforced cue (U2). However, these results are easily explained by assuming that contexts play the role of competing cues in this situation. If context A would have enter into a direct association with the outcome, then any cue tested within context A should show a higher level of responding

than the same cue tested in context B, and that is exactly what it was observed in group Partial-One. The lack of context switch effect found in group Partial-Both is also consistent with the idea that partial reinforcement leads contexts to become predictors of the outcome (see also Murphy et al., 2001). As both contexts should be equally associated with the outcome in group Partial-Both, any change on the associative strength produced by leaving an excitatory context would be compensated by the excitatory properties of the testing context, so that no changes in responding should be observed with the context change, as it was the case. Note that this result fits quite well the prediction of Rescorla and Wagner's (1972) model presented at the end of the introduction. This model predicts that context A will gain more associative strength than context B (39 and 29, respectively) in group Partial-One because P1 in context A is a poor predictor of the outcome, so that predictive validity of context A increases with respect to predictive validity of context B. In group Partial-Both, both contexts would gain the same associative strength (36) as in both cases the predictive validity of the context is the same, and no context-switch effects should be discovered according to this approach. These results are in contradiction with the predictions of Pearce's (1987) configural model of learning, as this model predicts a context-switch effect in group Partial-Both that is not found in the data. Accordingly, the results of this experiment seem to reflect that contexts control behavior through direct associations with the outcome that compete with the associations formed between the cues and the outcomes.

However, there is an aspect of these results that cannot be explained by Rescorla and Wagner's (1972) model. This model predicts a symmetrical effect of switching contexts for cues C1 and U2. As the net result on responding should reflect the sum of the associative strength of contexts and cues, decreases on responding observed to a cue that is being tested in context B after being trained in context A should match the increase on responding observed to a cue that is being tested in context A after being trained in context B. The lack of the three-way interaction in the overall analyses suggests that this prediction is also backed up by our results. However, complementary analyses showed that the context-switch effect was smaller for the unreinforced cue (tested in context A after being trained in context B) than for the reinforced cue. This result reflects the prediction given by Pearce's (1987) configural model of learning for group Partial-One. However, this model predicts a context-switch effect in group Partial-Both that was not observed in the data. Accordingly, neither the role of contexts as competing cues, nor the role of context as part of a configuration can account for the whole pattern of results found in our

experiment. The difference on the size of the context-switch effect between the reinforced and the unreinforced cue suggests that, aside entering into a direct association with the outcome, contexts may control behavior through an additional mechanism. The most likely candidate in is the one proposed by Bouton (1993) whom suggests that contexts maintain a hierarchical control over cue-outcome relationships setting the occasion in which such relationships are in effect (see also Bouton & Swartzentruber, 1986). Note that the idea that contexts act as occasion setters in this situation predicts no effect of context-switching in group Partial-Both. Thus, it seems reasonable to suggest that the context-switch effect found in cue C1 in group Partial-One is due to the combined effect of the loss of the associative strength of context A when the cue is tested in contexts B and the loss of performance produced by cue C1 being tested outside the context that set the occasion in which C1 was followed by the outcome.

Finally, it should be noted that the partial success of the associative mechanism proposed here to explain these data depends on the contexts being presented always with a cue, and never alone. If contexts were presented in the absence of the cues, as it is usually the case in animal conditioning experiments, any associative strength gained by the contexts will be extinguished when contexts are presented alone, and no context-switch effects would be expected. However, Bouton and Sunsay (2001, Experiment 3) reported a context-switch effect after partial reinforcement in a cue that was trained under continuous reinforcement in animal appetitive conditioning that would not be easily explained through direct context-outcome associations. This kind of result, together with the fact that the same contexts used in this experiment have been shown to play the role of occasion setters within other experimental designs (e.g., Callejas-Aguilera & Rosas, 2010) points out the need of conducting direct tests of the mechanisms involved in context-switch effects in both human and non-human animals as a way to establish the conditions that lead contexts to exert their control over behavior one way or the other. This is a challenge that the main theories about context-switch effects should tackle in the following years in order to be able to account for the variety of context-switch effects that are reported in the literature.

RESUMEN

Las asociaciones contexto-consecuencia subyacen a los efectos de cambio de contexto después del reforzamiento parcial en aprendizaje predictivo humano. El valor predictivo que se asigna a claves reforzadas de forma continua se ve afectado por el cambio de contexto cuando éstas se entrenan en un contexto en el que otra clave diferente recibe reforzamiento parcial. Se llevó a cabo un experimento con el objetivo de explorar el mecanismo que subyace a este efecto de cambio de contexto. Se entrenó a participantes humanos en una situación de aprendizaje predictivo en la que una clave recibía reforzamiento parcial mientras que una clave objetivo (C1) recibía reforzamiento continuo en el contexto A y una segunda clave objetivo (U2) no era reforzada en el contexto B. Los participantes del grupo Parcial-Uno no recibieron reforzamiento parcial en B, mientras que los participantes del grupo Parcial-Ambos recibieron el mismo entrenamiento que en el contexto A, pero con claves distintas. Cuando las claves objetivo se probaron en el grupo Parcial-Uno, se observó mayor respuesta en el contexto A que en el contexto B, aunque las diferencias fueron menores ante la clave U2 que ante C1. No se encontraron diferencias entre contextos en el grupo Parcial-Ambos. Estos resultados están en consonancia con la hipótesis de que el cambio de contexto tras el reforzamiento parcial se debe principalmente a la formación de asociaciones contexto-consecuencia, aunque la diferencia entre el tamaño del efecto sobre la clave reforzada y no reforzada sugiere que también podría estar implicado un mecanismo modulador en estos efectos de cambios de contexto.

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APPENDIX

Instructions in Spanish		Instructions in English
[First screen] Los últimos avances en "Tecnología de los alimentos" apuntan hacia la síntesis química de los mismos. Esto supone un avance puesto que su coste e muy bajo, y son de fácil almacenamiento y transporte. Esta revolución en la industria alimentaria podría solucionar el problema del hambre en países del tercer mundo.		[First screen] Recent developments in food technology lead to chemical synthesis of food. This creates a great advantage as its cost is very low, and it is easy to store and transport. This revolution in the food industry may solve hunger in third world countries.
[Second screen] No obstante, se ha detectado que ciertos alimentos producen trastornos gastrointestinales en algunas personas; por este motivo queremos seleccionar un grupo de expertos que identifiquen los alimentos que conllevan algún tipo de malestar, y cómo se manifiesta en cada caso.		[Second screen] However, it has been detected that some foods produce gastric problems in some people. For this reason we are interested in selecting a group of experts to identify the foods that lead to some type of illness and how it appears in each case.
[Third screen] A continuación, se te hará una prueba de selección donde aparecen los expedientes de personas que han ingerido distintos alimentos en un determinado Restaurante, con objeto de que indiques si se producirá o no trastornos gastrointestinales. Para contestar deberás hacer click con el ratón, primero sobre la opción que consideres oportuna, y después sobre el botón que aparece en la esquina inferior de la pantalla. Es muy importante respetar este orden ya que sólo será registrada la primera opción que pulses. Al principio tus respuestas serán al azar, pero no te preocupes, poco a poco te irás convirtiendo en un experto.		[Third screen] You are about to receive a selection test in which you will be looking at the files of persons that have ingested different foods in a specific restaurant. You will have to indicate whether gastric problems will appear. To respond you should click the option that you consider appropriate and then click on the button that appears at the bottom corner of the screen. It is very important to respect this order, given that only your first choice will be recorded. Your response will be random at the beginning, but do not worry; little by little you will become an expert.
[Cue screen] Una persona comió en el restaurante "LA CHOCITA CANADIENSE". Esta persona comió ATÚN. Pulsa un botón para indicar la probabilidad de que la persona presente… DIARREA.		[Cue screen] One person ate at restaurant "THE CANADIAN CABIN". This person ate TUNA FISH. Press a button to indicate the probability that this person presents...DIARRHEA.
[Outcome screen] Una persona comió en el restaurante "LA CHOCITA CANADIENSE". Esta persona tuvo… DIARREA.		[Outcome screen] One person ate at restaurant "THE CANADIAN CABIN". This person presented … DIARRHEA