



Cognitive Dissonance: Neural Correlates and New Theoretical Approaches

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Cognitive Dissonance: Neural Correlates and New Theoretical Approaches

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I hereby certify that all material in this final year project which is not my own work has been identified and that no work is included for which a degree has already been conferred on me.

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Abstract

Cognitive dissonance has traditionally been defined as the negative affective state which accompanies inconsistent cognitions and motivates one to make the cognitions consistent. This thesis critically evaluates two theories about cognitive dissonance. The action-based model of dissonance argues that inconsistent cognitions have the potential to interfere with effective and unconflicted action. The new look model of dissonance, contradicting the traditional definition of dissonance, argues that it is aversive consequences rather than inconsistent cognitions that cause dissonance. Recent studies investigating the neural correlates of dissonance show that parts of anterior cingulate cortex and prefrontal cortex seem to be involved in the dissonance process. One of the major predictions of the new look model of dissonance has been undermined by recent evidence. In contrast, the action-based model of dissonance is supported by recent studies.

Keywords: Cognitive dissonance, action-based model of dissonance, new look model of dissonance, anterior cingulate cortex, prefrontal cortex

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Introduction

The theory of cognitive dissonance was introduced in 1956 by Leon Festinger (see Festinger, Riecken and Schachter (1956)). The theory claims that people will experience a negative affective state when they hold inconsistent cognitions (for instance attitudes, opinions or information which contradict each other) and that this state will motivate them to change one of the cognitions in order to reduce or eliminate the inconsistency. By inconsistent, Festinger means that the opposite of one cognition follows from the other. It can be a pre-existing attitude which is inconsistent with acquired information. For example, a smoker who acquires knowledge about the health risk with smoking might either stop smoking, or claim that the information is not true, not serious or in some other way make the cognitions consistent. The theory also predicts that people will avoid situations in which the dissonance would likely be increased – just like people will try to reduce hunger or frustration and avoid situations which would make them hungry or frustrated. Dissonance is a motivating factor just like hunger and frustration (Festinger, 1957).

It was suggested that cognitive dissonance has a magnitude, which means that a person will experience more dissonance and be more motivated to reduce the dissonance the more discrepant the cognitions are. If there are cognitions which are consonant (i.e. consistent) with one of the cognitions, they will reduce the magnitude of the dissonance. For instance, the smoker's dissonance will be reduced by the cognitions that he enjoys smoking, he experiences that it has a calming effect and it is an important social activity. The more important the consonant cognitions are, the more the dissonance will be reduced (Cooper, 2007; Festinger, 1957). Since the early work by Festinger, a number of theories of how dissonance operates have been proposed. The aim of this essay is to review the concept of cognitive dissonance and to evaluate the theoretical approaches to dissonance and their possible neural basis.

Important Studies about Cognitive Dissonance

Festinger, Riecken and Schachter (1956) followed a group of people who believed that a cataclysmic flood was going to strike the Earth on a specific date in 1955. They believed that only the ones who believed in this, and thus had reached a higher spiritual level, would be saved and sent to a different planet. Although the level of commitment varied between the believers, some gave away everything in their lives – their houses, possessions and jobs – and some divorced their spouses if they did not believe in the flood. It was consequently important for them that their belief would be true. However, the flood never came and this of course resulted in an inconsistency between their great conviction with their sacrifices and their new knowledge that the flood did not occur as expected. The authors hypothesised that the believers would experience cognitive dissonance and try to reduce it by making the cognitions consistent in some way. Their prediction was right – when the time for the believers rescue was passed by four hours, the leader of the group said that the Earth had been spared because of the faith of the believers. The believers accepted this explanation, which made their cognitions consistent again (Cooper, 2007; Festinger, Riecken, & Schachter, 1956). One year later, Festinger wrote the book *A Theory of Cognitive Dissonance*, where he presents the theory in detail and reviews studies supporting the theory (Festinger, 1957).

The first real experimental study which tested the theory of cognitive dissonance was carried out by Jack Brehm in 1956 (Cooper, 2007). He let 225 female participants rate 8 objects (a portable radio, a sandwich grill, a desk lamp etc.) and told them that they would receive one of the objects as compensation for participating in the study. They got to choose between two of the objects. In the low dissonance group, the participants chose between two objects with differently rated desirability. In the high dissonance group, the participants chose between two similarly rated objects. A control group was also included, in which the

participants did not get to choose but were instead given an object. All participants then got to read four reviews of some objects with two or three positive and negative statements about each of the reviewed objects. All participants in the control group got a review on the gifted object and half of the participants in the dissonance groups got reviews on the choice alternatives. All participants were then asked to rate the objects a second time and this time the objects were taken away, so they could not see them. The results showed that participants rated the chosen object higher and the rejected object lower. The difference was higher in the high dissonance group. This supported the predictions of the theory cognitive dissonance that choosing between two alternatives would cause dissonance (since there are positive things about the rejected alternative and negative things about the chosen alternative), that people would be motivated to reduce the dissonance by considering the chosen object as more desirable and the rejected as less desirable and that the degree of dissonance would be higher when the alternatives was more equal in level of desirability (Brehm, 1956).

In 1959, Festinger and Carlsmith conducted a study to test the theory of cognitive dissonance. Each participant got to spend one hour on two boring tasks, which included putting spools onto a tray and turning pegs repeatedly. Participants were then told that they were measuring performance difference in participants with no expectations and participants with positive expectations (all were told that they were in the first group). However, the person who was supposed to induce the positive expectations in the second group did not show up, so they asked the participant if he could take his place. His task was to convince the “next participant” (who was not really a participant, but a confederate of the experimenter) that the tasks were fun and interesting. This meant that he was supposed to lie, since the tasks were boring. He was offered an incentive of either 1 dollar or 20 dollars to do this (the participants in the control group were not asked to perform this task). Then the participant got interviewed by another person, but he did not know that this was part of the study. He was

only told that they were interviewing people who had participated in experiments. The interviewer asked if the tasks were interesting and enjoyable (on a scale from -5 to +5), if he got an opportunity to learn something about his own performance on these tasks (scale 0-10), if he thought the experiment measured something important (scale 0-10) and if he would participate in a similar experiment in the future (scale -5 to +5). The results supported the theory of cognitive dissonance. The participants in the 20 dollar group (who had much justification to lie) rated the tasks less enjoyable than the participants in the 1 dollar group (who had less justification to lie) (Festinger & Carlsmith, 1959).

In 2007, Egan, Santos and Bloom showed that monkeys (capuchins) and young children can experience dissonance. In their first experiment, they let children rate stickers with different pictures and then choose between two similarly rated stickers. They were then asked to choose between the rejected sticker and another similarly rated sticker. In a control condition the experimenter was the one choosing between the two stickers instead of the child. In their second experiment, capuchins underwent a similar procedure, with M&Ms instead of stickers. The results showed that the rejected alternative was more frequently rejected once more in the normal condition than the control condition – this was true for both the children and the capuchins, and shows that the attractiveness of the rejected alternative was reduced as a consequence of the hard decision. The study suggests that dissonance is innate and a result of an evolutionarily constrained system. Dissonance reduction may be a more automatic process than previously thought independent of higher level capacities such as language (Egan, Santos, & Bloom, 2007).

Experimental Paradigms

The predictions of the theory of cognitive dissonance, at least in the early versions of the theory, are very broad and can be seen in different contexts. However, there are three main ways to test the theory: the free choice paradigm, the induced compliance paradigm and the

effort justification paradigm. All three paradigms create inconsistency and give a chance to express an attitude change (dissonance reduction/elimination) afterwards. In the *free choice paradigm*, the participants get to choose between two objects and then get their attitudes toward the objects measured. The positive aspects of the rejected object and the negative aspects of the chosen object is what generate the dissonance. The level of dissonance is greater when the objects' level of desirability is close, on condition that there are several distinguishable features of each object. The participants in these studies have changed their attitudes to the rejected objects to be more negative and their attitudes to the chosen objects to be more positive. The *induced compliance paradigm* makes participants perform actions contrary to their attitudes. The level of dissonance is typically greater when there is less justification for the action. The dissonance reduction can occur in different ways. The attitude toward the action can be changed or the participants can, as in Festinger and Carlsmith's experiment, come to believe the lie they have told. In the *effort justification paradigm*, the participants take part in an unpleasant activity, in order to reach a desired goal. The more effort they put in the unpleasant activity, the more dissonance they feel. They can reduce the dissonance by regarding the goal as even more desirable (Harmon-Jones, Amodio, & Harmon-Jones, 2009).

History of the Theory of Cognitive Dissonance

The theory of cognitive dissonance was very controversial, because it challenged the leading theory in psychology at the time, which was the learning theory, led by B. F. Skinner among others. The learning theory stated that organisms learn things to a different extent depending on how much they are rewarded for a desired behaviour and punished for an undesired behaviour. The research was often performed with non-human animals. Festinger and Carlsmith showed that people adopt an opinion to a *greater* extent if they get *less* reward and that contradicted the learning theory. Many people found it hard to believe in the strange

results, replicated the studies and got the same results. Some tried to find other explanations for the results, consistent with the learning theory, but their explanations got falsified and cognitive dissonance persisted. This helped the theory of cognitive dissonance to become a well-researched and strong theory (Cooper, 2007).

There are currently various theories relating to cognitive dissonance, one is the *action-based model of dissonance*, which was first presented by Harmon-Jones (1999) and attempts to give an answer to what the adaptive value of cognitive dissonance is (Harmon-Jones, Amodio, & Harmon-Jones, 2009). Another theory is the *new look theory of dissonance*, originally presented by Cooper and Fazio (1984), which tries to explain some anomalies which have emerged in some studies about cognitive dissonance and claims that inconsistency is not what produces cognitive dissonance – rather, it is aversive consequences (Cooper, 2007; Stone & Cooper, 2001). In recent years, dissonance has also been studied in the field of cognitive neuroscience, to find out the neural correlates of the phenomenon and to test the predictions of theories about cognitive dissonance.

The remainder of this essay will critically evaluate the action-based model of dissonance followed by the new look model of dissonance and discuss their plausibility. In addition, the neural correlates of cognitive dissonance and what they can reveal about the phenomenon of dissonance will be discussed. Finally, these two theories will be compared and contrasted; both in terms of their predictive strengths and neural correlates, and suggestions for further research will be discussed.

The Action-Based Model of Dissonance

The action-based model of dissonance attempts to answer the question why cognitive dissonance exists. In contrast to other theories, this theory argues that the phenomenon has an adaptive function and that dissonance is beneficial in the majority of

cases, even if it can lead to adverse consequences sometimes. The theory argues that choices can be based on cognitions and that conflicting cognitions can interfere with effective and unconflicted action. The function of dissonance is thus to motivate a person to get consonant cognition in order to carry out actions effectively (Harmon-Jones, Amodio, & Harmon-Jones, 2009). In more recent discussion of cognitive dissonance, it is claimed that the concept 'cognitive dissonance' can refer to both the inconsistency between cognitions and the unpleasant state it produces. This theory, however, suggests that one distinguishes the two processes and refer to the inconsistency as cognitive discrepancy and the emotive state as cognitive dissonance (Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008). The negative affect experienced during dissonance has the function of motivating people to reduce or eliminate the dissonance.

In the free choice paradigm the dissonance occurs, as mentioned earlier, because there are positive aspects of the rejected alternative and/or negative aspects of the chosen alternative. The benefit of viewing the chosen alternative as more attractive is, according to the action-based model of dissonance, that it is easier to fulfil the chosen alternative if one does not doubt that it was the best choice.

For instance, there are both positive and negative aspects to the decision to start exercising – health benefits, more energy but also muscle soreness and less time for other things. When a person decides to start exercising that decision will be easier to follow through if the person does not think that muscle soreness is very cumbersome and if the person finds the health benefits even more valuable.

The theory states that it is possible to continue to have inconsistent cognitions and this means that the negative emotion may persist. It is also possible to realise that one made the

wrong decision and to select another alternative instead – although the negative emotion may persist in such cases too (Harmon-Jones, Amodio, & Harmon-Jones, 2009).

Predictions Derived from the Action-Based Model of Dissonance

The theory predicts that when a choice is made, one is motivated to follow through the chosen alternative and behave in a way effective to the chosen alternative. The more action oriented a person is, the more he or she will reduce the dissonance. Regarding the neural correlates, the theory predicts activation in anterior cingulate cortex (ACC) during dissonance arousal. This is because the ACC has been assumed to represent action tendencies for potential conflicts and this is consistent with what the theory predicts about dissonance. The theory also predicts activity in prefrontal cortex following activation in ACC, since the prefrontal cortex has been associated with the implementation of a controlled response when a conflict has been detected by ACC. This is consistent with the prediction that discrepancy reduction engages approach-oriented motivational processes. Specifically the left frontal region should be activated, since it has been associated with approach (Harmon-Jones, Amodio, & Harmon-Jones, 2009). The studies about neural correlates will be presented in another section and will then be discussed in relation to this theory in the conclusions.

Behavioural Studies Testing the Action-Based Model of Dissonance

Harmon-Jones and Harmon-Jones (2002) tested the prediction that an action-oriented mindset would increase discrepancy reduction. They conducted a free choice paradigm study where they let 80 participants rate eight different exercises and thereafter choose between two similarly (both highly rated) or differently rated exercises. Some of the participants then got to write about how they could improve their performance on the chosen exercise, to put them in an action-oriented mindset. The others got to write about things they do on a typical day, to

put them in a neutral mindset. All participants then rated the exercises once more, to measure attitude change.

The results revealed that significant attitude change occurred (1) with a difficult choice and a neutral mindset, (2) with a difficult choice and action-oriented mindset and (3) with an easy choice and action-oriented mindset (although in this condition, the attitude changed in the opposite direction). When the choice was easy and the mindset neutral, there was no significant change. The results also showed that the conditions with action-oriented mindset generated more attitude change than the neutral mindset. This confirms the prediction derived from the action-based model of dissonance that an action-oriented mindset produces more discrepancy reduction. The fact that attitude change only occurred in the expected direction in the difficult choice conditions indicates that the change was due to dissonance and not some other factor.

However, to confirm that the results were not due to the participants' opportunity to think more about the decision or that negative affect was induced by the mindset and was the real cause of the attitude change, a second experiment was conducted, which was similar to the first. In this study, the choice was between different psychological research projects, instead of exercises. Only the difficult choice conditions were included and the mindsets were induced in a different way. The neutral mindset was induced by letting the participant describe a typical day in detail, while the participants in the action-oriented mindset condition were asked to write about the most important steps of a project they intended to complete in a period of a few months. In this study, a third mindset condition, the deliberative mindset condition, was included. In this condition, the participants described an unresolved problem which they did not yet know if they would take action to resolve and to describe the consequences of taking action and of not taking action. After the mindsets had been induced, the participants completed a questionnaire about affect and self-esteem.

The action-oriented mindset condition produced more attitude change than in the other conditions, which supports the tested prediction. The attitude change was significant in the neutral and action-oriented mindset condition, but not in the deliberative mindset condition. Negative affect was not a significant predictor of the degree of attitude change and neither was any other affect or degrees of self-esteem. This second experiment replicated the results from the first, but with a different decision and it also ruled out the possible effects of affect and self-esteem. This experiment thus gives further support to the action-based model of dissonance (Harmon-Jones & Harmon-Jones, 2002).

Plausibility of the Action-Based Model of Dissonance

The action-based model of dissonance gives an account of the adaptive function of dissonance, which other theories about dissonance do not. It also makes concrete and specific predictions. The prediction that an action-oriented mindset will increase discrepancy reduction was tested and confirmed in the two experiments presented in the previous section – this gives credibility to the theory. However, even if all predictions were confirmed, they could be explained by some other possible truth – especially the prediction of the adaptive function of dissonance is not a very obvious consequence of the confirmation of the predictions, even if it is plausible. This theory will be discussed further after the neuroscientific studies have been presented and in relation to the new look model of dissonance, which is presented in the next section.

The New Look Model of Dissonance

The new look model of dissonance was first introduced by Cooper and Fazio (1984). They argue that what cause the dissonance are the aversive consequences one feels personally responsible for – and not inconsistency, as the original theory of dissonance claimed. It is not desirable to cause an aversive consequence, and the dissonance reduction makes the

consequence seem more positive so that you no longer feel that you are responsible for a negative consequence.

In the study by Festinger and Carlsmith (1959), the dissonance was not, according to this theory, due to the inconsistency between the cognition that lying is wrong and the cognition that the person just told a lie – the dissonance arose because the person felt personally responsible for the aversive consequence that the “next participant” were going to have false expectations about the tasks and be disappointed when she discovers that the tasks were boring. By changing the attitude toward the tasks and so finding them less boring, the person no longer feels responsible for an aversive consequence, since there no longer is any.

The new look model of dissonance developed as a result of some anomalies which had been found in studies on dissonance. Some anomalies are compatible with the original theory, but some are not. One modifying condition was found already in Brehm’s 1956 study – the participants only changed their attitudes when they had chosen the alternative their selves. A study by Linder, Cooper and Jones (1967) showed that the higher the decision freedom, the more attitude change was shown (Linder, Cooper, & Jones, 1967). Another modifying condition is that the degree of commitment correlates with attitude change. A higher degree of commitment can be to be publicly identified with the inconsistent cognition or that there is not any opportunity to retract your behaviour. This was indicated in a study by Carlsmith, Collins and Helmreich (1966) and in another study by Davis and Jones (1960). Carlsmith, Collins and Helmreich (1966) used the same design as Festinger and Carlsmith (1959), but added a condition in which the participants wrote an anonymous essay which argued that the task was interesting and fun. The results showed that dissonance did not occur for participants in the added condition. Instead, the participants who got *larger* incentives had the more positive attitudes toward the task, as the learning theory would predict. When the participants got to be anonymous, dissonance did not occur (Carlsmith, Collins, & Helmreich, 1966). In Davis and

Jones (1960), the participants were asked or required to read a negative evaluation of a person. They could not see each other, but the participants were told that the other person would hear the evaluation. Some participants were told that they would meet the other participants after the experiment and could then retract their evaluation while others were told that they would not meet the other participants afterwards and the participant would continue to believe that the evaluation was honest. Before and after the participants read the evaluation, they filled in a questionnaire about what they really thought about the person. The participants who could not retract their behaviour, showed more attitude change (rated the person more negatively on the second questionnaire) (Davis & Jones, 1960).

Predictions Derived from the New Look Model of Dissonance

The new look model of dissonance predicts that dissonance arousal and attitude change follows certain steps. The process always starts with behaviour, then the person assesses whether the consequences are positive, neutral or negative. If the consequences are positive or neutral, which they most often are, the process does not continue. However, if they are negative the person assesses whether the consequences are unacceptable and irrevocable. If this is the case, the person concludes that the behaviour has brought about aversive consequences. The person then begins to search for who is responsible for the aversive consequences. If the person feels that he or she was forced to perform the action which brought about the consequences or if the consequences were not possible to foresee, the person concludes that he or she was not responsible for them. If, on the other hand, this is not the case the person accepts that he was responsible for the consequences and experiences dissonance arousal.

When dissonance arousal is present, the person attempts to label the valence of the arousal. It could be categorised as positive arousal and be attributed to some other source than dissonance and it could also be categorised as negative but nevertheless be attributed to

another source. However, the process only continues if the arousal is categorised as negative and is attributed to the acceptance of responsibility for the aversive consequence. Then the person becomes motivated to reduce the dissonance and does this by changing his or her attitudes in a way that the consequences do not seem aversive. According to the new look model of dissonance, the reason for attitude change is thus not the attempt to create consistency. Inconsistency is not important in producing dissonance; the reason it has been correlated with dissonance in studies is that it often coincides with aversive consequences (Cooper, 2007). The self and the self-esteem have no role in this theory and are not predicted to affect the result in dissonance studies, as opposed to some other theories about dissonance (Stone & Cooper, 2001). In his book from 2007, Cooper states that there is not yet any way of telling if dissonance is innate or learnt, even if it is clear that what are perceived as aversive consequences can differ with regard to individual or cultural differences (Cooper, 2007).

Behavioural Studies Testing the New Look Model of Dissonance

Most of the behavioural studies relevant to the predictions of the new look model of dissonance were conducted before the theory was first presented and the studies can thus not be said to have tested the predictions, but rather these studies might have been the foundation for the theory.

According to Cooper (2007), the need to take aversive consequences into account was first shown in a study by Nel, Helmreich and Aronson (1969). In their study, participants who were against the use of marijuana for adult people were paid either 0.50 dollars or 5 dollars to record a speech promoting the use of marijuana for adult people for an audience they were told consisted of (1) people who were definitively against the position of the speech, (2) people who were definitively for or (3) people who had not decided what they believed yet. The participants' attitudes were assessed some weeks before the speech and immediately after

the speech. Only the participants who held the speech for the third group showed significant attitude change (Nel, Helmreich, & Aronson, 1969).

Cooper (1971) investigated if foreseeability of the consequences was a necessary condition for dissonance to occur. The participants did problem-solving tasks together with a partner where they had the chance to win money. When they (separately) had an answer to the task, they had to guess if they had the correct answer or not. To win money, both the participant and their partner had to either (1) guess that they were right and be right or (2) guess that they were wrong and be wrong. Before the tasks, a participant was assigned a partner but was told that there was reason to expect that the partner either underestimated his performance (for some participants) or overestimated his performance (for the other participants). Some participants were given the choice to change partner while others had to keep their assigned partner. The participants who had a choice could have foreseen that their partner made them lose their money, because the partner underestimated or overestimated their performance and would make wrong guesses. The results showed that the aversive consequence must have been possible to foresee – if nothing indicates that an aversive consequence would follow from the person's action, he or she will not experience dissonance. But this does not mean that the consequence must have been foreseen (Cooper, 1971).

Cooper and Worchel (1970) wanted to examine if Festinger and Carlsmith's (1959) experiment, which was presented in the introduction, would give other results if there were not any aversive consequences. In the original experiment, the 'next participant' (who was a confederate) acted like she was convinced and looked forward to the experiment. This was an aversive consequence and to remove it, Cooper and Worchel had a confederate who was not convinced by the participant in some cases. Since they were not asked to rate the experiment before the conversation with the confederate, the only way to detect dissonance was to look at the differences in rating between the incentives. Only the participants who convinced the

confederate differed significantly in rating between the incentives (Cooper & Worchel, 1970). A similar study by Cooper, Zanna and Goethals (1974), in which the participant got to see a video of the confederate prior to the experiment and rate their liking of him, showed that dissonance only occurred when the confederate was liked by the participant. This supports the new look model of dissonance (Cooper, Zanna, & Goethals, 1974).

Goethals and Cooper (1975) let participants write a counterattitudinal essay about a disliked rule in the university which had a risk of being used to influence a committee which was going to make a decision concerning this rule. The experiment also measured attitudes after the essay was written. Some participants (1) were told that they were going to get information about whether their essay was going to be read by the committee in the end of the experiment, some (2) were told that they would not get any information about whether their essay was going to be read and some (3) were told that their essay was definitively going to be read. Every one of these groups were divided into two or three conditions: some participants from every group were told after writing the essay that not all essays were going to be read, but their essay would be read (or not read, for some participants), some participants from the first two groups filled in a questionnaire measuring their attitudes immediately after writing the essay and thus without knowledge about whether their essay would be read. A control group, which never wrote an essay but only filled in the questionnaire, was also included.

The participants in group (1) who filled in the questionnaire before being told whether their essay was going to be used did not show any attitude change (their rating was near the level of the control condition). The participants in group (1) who were told that their essay was going to be read before they filled in the questionnaire showed a significant attitude change. The participants in group (1) who were told that their essay was not going to be read and subsequently filled in the questionnaire did not show any attitude change. This indicates

that the attitude change does not occur until a person knows if an aversive consequence is going to happen, when the person knows that he or she will get that information eventually. However, all three conditions in group (2) showed attitude change – regardless if they did not know, if they were told that their essay was going to be read or if they were told it was not going to be read. This result suggests that knowing that an aversive consequence might occur is enough for dissonance to occur – but only if the person does not expect to find out eventually. That some participants in group (2) did find out that their essay was not being used for the committee did not change their attitude back. Both conditions in group (3) showed attitude change, which suggests that attitude change persists even if an assured aversive consequence did not occur (Goethals & Cooper, 1975).

Scher and Cooper (1989) investigated if dissonance could be aroused when behaviour led to aversive consequences in the absence of inconsistent cognitions – and if dissonance arouse when inconsistent cognitions were present but not aversive consequences. They let the participants – who were students – write an essay either arguing for something they agreed with or something they did not agree with. The issue was whether student fees should be increased, which students generally were against. They were told that their essays were going to be read by a committee and that the experimenters studied how essays influenced real committees' judgements. They were also told that they predicted that the first essays the committee read would affect them in the opposite direction and that the last would affect them in the direction the essay argued for. Some participants were told that their essay would be read 2nd by the committee and the other participants were told their essay would be read 14th by the committee. In total, the committee would read 15 essays, they were told. There were thus four conditions: (1) participants who wrote a proattitudinal essay and were told that it would affect the committee in the wished direction, (2) participants who wrote a proattitudinal essay but were told that it would affect the committee in an averse direction, (3) participants

who wrote a counterattitudinal essay and were told that it would affect the committee in an aversive direction and (4) participants who wrote a counterattitudinal essay but were told that it would affect the committee in the wished direction. The authors argue that if only conditions (1) and (2) would produce dissonance, the original theory by Festinger would be supported – but if only conditions (1) and (3) produced dissonance, the new look model of dissonance would gain support.

The results showed that only participants in conditions (1) and (3), which included aversive consequences, changed their attitudes positively toward increasing the fees. There was also a positive correlation between students' ratings about how much they expected to influence the committee toward increasing the fees and how much they changed their attitudes. The authors argue that this supports the proposition that responsibility for aversive consequences is necessary and sufficient for cognitive dissonance. They state that the study shows that inconsistency is not what drives dissonance. However, they recognise that there is a possibility that their manipulation merely was a form of inconsistency, even if they argue that this is not the most probable explanation and that this interpretation would limit the form of inconsistency which could produce dissonance to the one produced in this study (Scher & Cooper, 1989).

A study by Harmon-Jones, Brehm, Greenberg, Simon and Nelson (1996) tested if aversive consequences were sufficient to produce dissonance reduction. In the first of their three experiments, participants tasted a pleasant- or unpleasant-tasting beverage and wrote a sentence stating that the beverage tasted good, which they then threw in the trash so that no one would see it. Some participants were simply told to write that they liked the beverage (low-choice condition) and some were asked to, but told that it was their choice (high-choice condition). Then they filled in two questionnaires, one about what they really thought about the taste and the other about questions such as how much freedom they felt they had to write

the sentence and how interesting the study was. The participants in the high-choice condition liked the beverage more than the participants in the low-choice condition and according to the authors, this experiment shows dissonance reduction without an aversive consequence.

In the second experiment, participants read a boring text and were asked to write a sentence stating that the text was interesting (high-choice condition) or required to write that the text was interesting (low-choice condition). They then filled in two questionnaires. One about how interesting they thought that the text was and one about how much choice they felt they had to write the sentence. The results in this experiment were similar to the results from the first experiment. The high-choice participants rated the text as more interesting than the low-choice participants. The participants' rating of how much choice they had also correlated positively with their rating of the text.

The third experiment were similar to the second, with the exception that arousal was measured by measuring skin conductance before they read the text (baseline), after they had written the sentence and when they had completed the first questionnaire. In this experiment too, the high-choice participants thought the text was more interesting than the low-choice participants thought. Skin conductance did not differ between the conditions in the baseline measurement. However, both after the text was read and after the questionnaire was completed, high-choice participants had higher skin conductance than low-choice participants. This indicates that high-choice participants experienced arousal as a consequence of the dissonance (Harmon-Jones, Brehm, Greenberg, Simon, & Nelson, 1996).

Plausibility of the New Look Model of Dissonance

Cooper argues that the new look model of dissonance is supported by many studies and even if some studies, like Harmon-Jones et al. (1996), has shown dissonance without aversive consequences, the vast majority of studies supports the idea that inconsistency is not needed

and Scher and Cooper (1989) shows that aversive consequences are necessary to produce dissonance (Cooper, 2007).

However, Harmon-Jones et al. (1996) argue that there are alternative interpretations of the results Cooper thinks supports his theory. In his original presentation of the theory, Festinger (1957) states that cognitions have different levels of importance and that determine how much they will affect the magnitude of the dissonance. In the studies supporting the new look model of dissonance almost all participants complied, which may indicate that they were given too much justification (i.e. consonant cognitions, such as helping the experimenter, were more important than the dissonant cognitions) and consequently, not enough dissonance was aroused to produce attitude change. The participants who experienced dissonance in these experiments, on the other hand, did not have enough justification because they had a dissonant cognition with high importance – being responsible for an aversive consequence. The experiments by Harmon-Jones et al. (1996) support this interpretation, because they produced attitude change in the absence of aversive consequences, but with less justification in form of more choice. Their interpretation is that the studies claimed to support the new look model of dissonance merely show that feeling personally responsible for aversive consequences is an important cognition which increases the magnitude of dissonance (Harmon-Jones, Brehm, Greenberg, Simon, & Nelson, 1996).

Taking into account the results from the study by Harmon-Jones et al. (1996) and that there are alternative explanations for all these results, the plausibility of the new look model of dissonance is severely undermined. In order to make the interpretation supporting the new look model of dissonance plausible, the theory must address and be able to explain these results. The theory must also present studies and arguments supporting this interpretation.

The Self-Standards Model of Dissonance

Cooper, which is one of the authors to the new look model of dissonance, developed an expansion of the theory together with Stone, called the self-standards model (Stone & Cooper, 2001). I will present this theory briefly. This theory predicts – just like the new look model of dissonance – that dissonance is not produced by inconsistency, but rather by aversive consequences. However, this theory also predicts that self-esteem sometimes plays a role in dissonance. According to the self-standards model, a consequence can be regarded as aversive when compared to personal standards (idiographic dissonance) or consensual, normative standards (nomothetic dissonance). Whether a person compares a consequence with personal or normative standards depends on which standards are more accessible, i.e. comes quickly into mind. This can be controlled by priming.

Only idiographic dissonance can be affected by self-esteem. While nomothetic dissonance is reduced by attitude change, idiographic dissonance can sometimes take a different route. If positive self-attributes are made accessible to the person experiencing idiographic dissonance, they can reduce dissonance. However, the self-attributes must be irrelevant to the aversive consequence (i.e. about some other attribute). If they are relevant to the consequence, they will create even more dissonance which will be reduced by attitude change.

Stone and Cooper (2001) present studies which support this extension of the theory and Cooper (2007) present more recent supporting research. However, the self-standards model does not increase the plausibility of the theory, since it does not modify the parts of the theory that are undermined. The theory is undermined by the fact that the results of the studies said to support the new look model of dissonance can be explained by the high justification participants got and dissonance has been produced in the absence of aversive consequences by Harmon-Jones et al. (1996). Stone and Cooper (2001) revise the new look model of

dissonance to make it able to account for some findings indicating that the self can have a role in dissonance, while refraining from addressing the critique directed to the new look model of dissonance and the studies said to support it.

What are the Neural Correlates of Cognitive Dissonance and What Can They Tell Us about the Phenomenon?

There are mainly two regions which have been found to correlate with cognitive dissonance: anterior cingulate cortex (ACC) and prefrontal cortex. The following section presents information about what functions these regions previously have been associated with and then the studies which have investigated correlations with dissonance.

The General Functions of Regions Found to Correlate with Cognitive Dissonance

The ACC is one of the regions which have been found in many studies about the neural correlates of cognitive dissonance. Although the region is believed to have many functions, only the functions relating to conflict will be presented here, since dissonance tasks are conflict tasks. Three main conflict tasks have been found to show ACC activity – response override, undetermined responding and error commission. *Response override* are tasks in which a superior response should be overridden e.g. such as the Stroop task (Botvinick, Cohen, & Carter, 2004) in which the participants are required to name the ink colour of a word which in some cases is another colour than its ink (for instance, the word “green” written in red). There is a response conflict between participants’ impulse (to say the written colour) and the correct answer according to the task (to say the ink colour) (Miller & Cohen, 2001). In *undetermined responding* tasks, the participant chooses among equally likely alternatives e.g. there are several allowed answers but no right answer. A conflict appears when participants are to choose one. In *error commission*, the participant makes errors. When the incorrect answer is executed, the correct answer is processed. This makes the two

responses activate at the same time which in turn creates a conflict (Botvinick, Cohen, & Carter, 2004).

A study by van Veen, Cohen, Botvinick, Stenger and Carter (2001) indicated that the ACC is selectively responsible to response conflict (when there are conflicting responses to a task) and not stimulus conflict (when there is a conflict at the stimulus identification level), which is consistent with the interconnectivity between ACC and motor areas (Veen, Cohen, Botvinick, Stenger, & Carter, 2001). However, response conflict may not be the only conflict eliciting ACC activity – other conflicts have been found to produce ACC activity (Veen & Carter, 2002). Dorsolateral prefrontal cortex (DLPFC) is another region which has been found to correlate with dissonance and this region is also activated in conflict tasks. A study by MacDonald, Cohen, Stenger and Carter (2000) indicated that the role of ACC in control is to monitor performance and signal to other regions when control needs to be adjusted and the role of DLPFC is to implement the control (MacDonald, Cohen, Stenger, & Carter, 2000).

According to Miller and Cohen, prefrontal cortex (PFC) is involved when behaviour needs to be guided by internal intentions, which is often the case in novel tasks such as the Stroop task. In such cases, the mappings between the different regions involved in carrying out an action are not enough strong established and needs top-down processing from PFC. Many agree that PFC enables coordinated voluntary behaviour (Miller & Cohen, 2001).

Studies Investigating the Neural Correlates of Cognitive Dissonance

Westen, Blagov, Harenski, Kilts and Hamann (2006) investigated the neural correlates of cognitive dissonance in a study where the participants, who were all partisans of either Democrats or Republicans, got to read inconsistent statements about their party's leader, the other party's leader or a neutral person, while their brain activity was measured with fMRI. The participants first read a statement about the target person, then a statement that was

inconsistent with the first statement. They then got to rate how inconsistent they thought the statements were and thereafter followed an explanation which made the statements seem consistent. Finally, they got to rate how inconsistent the statements seemed after this explanation.

When comparing the same-party inconsistency with the neutral inconsistency, Westen et al. found activation in medial prefrontal cortex (PFC), ventral anterior cingulate cortex (ACC) and posterior ACC. The large activation of ACC and medial PFC only appeared when the inconsistency was undesired and consequently, unbiased reasoning would lead to unwanted conclusions and negative emotions. When contrasting the same-party inconsistency-phase with same-party explanation-phase, activation was found in left lateral inferior frontal cortex, left insula (both associated with processing of negative affect), bilateral inferior orbitofrontal cortex (associated with emotional processing) and precuneus (associated with evaluative judgements). The large activation in orbitofrontal cortex was not found in the neutral target condition. Activation in parahippocampal gyrus was also found, which may have been due to efforts to find rationalising solutions in memory. This was the first study examining the neural bases of cognitive dissonance and it had several limitations. They did not have any regions of interest, since there were no previous studies examining this. All participants were men and the results can thus not be generalised to women. With this study design, it was not possible to know exactly when the dissonance started. Furthermore, the participants were all committed partisans and no control group was included (Westen, Blagov, Harenski, Kilts, & Hamann, 2006).

Harmon-Jones, Harmon-Jones, Fearn, Sigelman and Johnson (2008) tested if manipulation of relative left frontal cortical activation affected the attitude change following a free choice paradigm test. They used neurofeedback with EEG to either increase or decrease the activity. Neurofeedback is done by giving the participant feedback, in this case in form of

a tone, when the EEG shows activation or decrease in activation in a particular part of the participant's brain. The participant is only told to try to make the tone stay on and receives no information about how that is done, other than that it is his or her brain activity that causes the tone. Only the manipulation of the decrease-condition was expected to be successful, since previous studies have shown that increasing activity needs more than three days. The increase-condition was chosen as a control group instead of a no-feedback-condition. In this study, 33 participants received neurofeedback training for 8 minutes two times the first day and four times day two and day three. They got a false explanation of the purpose of the study and did not get information about the real purpose until the experiment was over. On day three, the participants got to fill in questionnaires about their preferences for different types of psychological research, then rate their desire to participate in each of nine different research projects and thereafter order the nine projects in desirability. They then got to choose to participate in one of two similarly and highly rated research projects, before the last four sessions of neurofeedback were done. They were then asked to repeatedly read descriptions of the nine formerly rated projects and then to rate them once more.

The participants in the decrease-condition showed less attitude change than the ones in the increase-condition – the changes in the decrease-condition were not significant, which means that the well-established spreading of alternatives effect were eliminated by this manipulation. However, the participants in the increase-condition showed a significant attitude change. The results also showed a correlation between attitude change and relative left frontal cortical activation. These findings supports the idea that left frontal cortical activation has a role in dissonance and they are consistent with the action-based model of dissonance, which predicts that approach-oriented processes (which left frontal cortex have been shown to activate) should occur after a commitment to a course of action (Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008).

In 2009 Sharot, Martino and Dolan investigated if the attitude change seen in free choice paradigm studies reflects change in the physiological representation of the hedonic value of the alternative and the emotional response it produces. The participants got to imagine 80 different vacation destinations and rate them while they were being scanned with an MRI. They then got to choose between similarly rated or differently rated destinations. When the scanning was over, the participants rated the destinations once more.

The results showed that ratings correlated with activity in bilateral caudate nucleus, which is a region previously related to reward processing and anticipation. The left amygdala and left pregenual anterior cingulate cortex also showed correlations with ratings, however, these correlations became insignificant when controlling for ratings of arousal, vividness, familiarity and previous visits to the vacation destinations. The activity in the caudate nucleus in the imagination task was greater when the participant imagined the later chosen than when he or she imagined the later rejected alternative, which shows that the choice is not arbitrary. The results indicate that the neural representation of a hedonic value can change after a choice between two similarly attractive alternatives and that this change is reflected in caudate nucleus activity (Sharot, Martino, & Dolan, 2009).

Van Veen, Krug, Schooler and Carter did a study in 2009 which investigated the neural basis of dissonance, using the induced compliance paradigm. The participants were first divided into one of two groups – the dissonance group or the control group, but all participants began by lying in an uncomfortable MRI scanner and performing a 45-minute long boring task. The control group then got to answer some questions and were told to answer that they enjoyed the scanner and the task, when such questions were asked. They would receive an extra dollar for every such answer. The dissonance group got the same questions, but they were told that the next participant was waiting outside and was nervous about the scanning. The next participant could see what the participant answered, they were

told, and they were asked to answer that they were enjoying the scanner and the task, when such questions were asked, in order to put the next participant's mind at ease. When the scanning was over, all participants answered a set of forms about how they really felt about these issues. The researchers then correlated the brain activation for each region, during the questions about the scanner, with the final attitude score.

The results showed that attitude change significantly correlated with bilateral dorsal anterior cingulate cortex (dACC) and bilateral anterior insula. Since anterior insula, dACC and cognitive dissonance all have been associated with negative affect and autonomic arousal; these regions might be producing the negative emotion and arousal associated with dissonance. The results support the idea that dissonance is conflicts between cognitions. They also specifically support the action-based model of dissonance, which has predicted that dACC is involved in dissonance. The new look model of dissonance is not supported by the results from this study. The theory predicts anticipation of aversive consequences, which would show activation in the orbitofrontal cortex, rather than the dACC. However, research has not ruled out the possibility that the anticipation of aversive consequences one feels responsible for is in another region. The results from this study are inconsistent with the self-perception theory, which argues that dissonance reduction occurs because one infer ones attitudes from ones behaviour – and not because of inconsistent cognitions (Veen, Krug, Schooler, & Carter, 2009).

Izuma, Matsumoto, Murayama, Samejima, Sadato and Matsumoto made a study in 2010 to investigate a methodological problem with dissonance studies and to explore the neural correlates of dissonance. They used the free choice paradigm and measured the participants' brain activity with fMRI while they rated 160 food items, made choices between pairs of food items, watched when a computer made choices between food items and then rated the 160 items one more (with information about if they or if the computer rejected or chose the items).

Some choices were difficult (two similarly rated items) and some easy (two differently rated items). This study revealed that almost the whole cingulate cortex was activated during the first rating task. It also showed, as van Veen et al. (2009), that the level of dissonance reduction correlated with dACC. This was only the case in the second rating task, after choices were made. The activation was not different between the chosen and rejected items, which indicate that the dACC activation is not a consequence of the past behaviour, but rather the discrepancy as such. They also found activation in the bilateral dorsolateral prefrontal cortex (DLPFC). Activity in anterior insula was also found, although not as significantly as the other regions.

The results are consistent with Festinger's original theory and they also support the action-based model of dissonance, as it predicted activity in dACC. This study also extends the study by van Veen et al. (2009) by showing that the activation in dACC occurs in the free choice paradigm as well. Since this study measured the correlation trial-by-trial, it offers more concrete evidence that dACC is a neural correlate of dissonance. The DLPFC has been found to be involved in the implementation of control and behavioural adjustment that happens after a conflict has been detected, and its left side have been found to be involved in dissonance reduction. This may be the reason why van Veen et al. (2009) did not find such activation. The authors propose that the study by van Veen et al. (2009) identified the passive emotional reaction to the dissonance, while this study identified the active process of dissonance reduction (Izuma, Matsumoto, Murayama, Samejima, Sadato, & Matsumoto, 2010).

In 2011, an fMRI study by Jarcho, Berkman and Lieberman investigated the neural basis of cognitive dissonance in the free choice paradigm. Their main aim was to investigate if attitude change occurs immediately after a choice has been made. The participants got to rate 140 names and 140 paintings before they were put in a MRI scanner and chose between 80 pairs of names and paintings that were similarly rated. They were told to choose the name

they would rather choose for their future child and they were told that they would receive two posters of the paintings based on their choices, in order to make the decisions more meaningful. When the scanning was over, the participants rated the 140 names and 140 paintings once more.

Jarcho et al. (2011) investigated if the brain activity during decision making (the choices in the scanner) correlated with attitude change (between the first rating and the second). The regions found to correlate positively with attitude change was right inferior frontal gyrus (IFG), medial prefrontal cortex, precuneus, ventral striatum and parahippocampal gyrus. Bilateral anterior insula and lateral parietal cortex were negatively correlated with attitude change.

The results indicate that attitude change occur rapidly after a choice has been made. One plausible possibility is that IFG decreases the distress and arousal in the anterior insula, by changing perceived desirability of the alternatives to fit better with the choices. That activity in IFG correlated more with decrease in anterior insula when there was more attitude change, supports this possibility. This function could have a big advantage – it could make it possible for cognition and attention to be directed to more important emotional stimuli such as implementation of the decision, as the action-based model of dissonance proposes. The study by van Veen et al. (2009) also found a correlation between attitude change and anterior insula. However, they did not find any correlations with regions associated with resolution of distress. This indicates that the attitude change in the induced compliance paradigm may not happen immediately.

The correlation with medial prefrontal cortex can be interpreted in several ways. This region has been associated with self-reflection and self-relevance and the results can thus support theories claiming that self-relevance has an important role in dissonance. However,

the region has also been associated with evaluative processes of positive stimuli and also with generating goals to produce a positive effect. Jarcho et al. interprets this as an indication that the activation in medial prefrontal cortex reflects evaluation of self-relevant, positively valenced stimuli and encouragement of actions toward goals with positive outcomes.

The activity in ventral striatum may reflect the role of striatum in processing of hedonic information related to rewards and tracking of the perceived values of these outcomes. In this context, this means that the preferences for the names and paintings would be assessed and updated in the process of making the decisions (Jarcho, Berkman, & Lieberman, 2011).

Discussion about What the Neural Correlates Tell Us about Cognitive Dissonance

The exploration of neural correlates of dissonance is very new. There are very few studies and consequently, not much can be said. Parts of PFC and ACC were found to correlate with dissonance in many of the presented studies. Izuma et al. (2010) hypothesises that the insula and ACC are involved in dissonance arousal while ACC and DLPFC are involved in dissonance reduction. Decrease in left frontal cortical activation eliminated the dissonance reduction in the free choice paradigm, which indicates that left frontal cortex is involved in dissonance. Jarcho et al. (2011) found activation in IFG and hypothesises that IFG changes the desirability of the choices and thereby decrease distress and arousal produced by the insula.

Jarcho et al. (2011) also indicates that dissonance reduction occurs rapidly in the free choice paradigm. The action-based model of dissonance is supported by several of these studies. I will discuss this more in the conclusions.

Conclusions

The action-based model of dissonance attempts to answer why dissonance occurs. The theory argues that inconsistent cognitions can interfere with effective and unconflicted action and that it is therefore advantageous to make cognitions consistent (Harmon-Jones, Amodio, & Harmon-Jones, 2009). The new look model of dissonance does not explain why dissonance occurs. Cooper (2007) argues that it is not possible yet to know if dissonance is an innate or a learnt process. The action-based model of dissonance focuses on the actions cognitions can lead up to while the new look model of dissonance focuses on the consequences cognitions in the form of actions lead to. The new look model of dissonance sees no reason for inconsistency to be a problem that motivates people to seek consistency and the theory wants to shift the problem to consequences. The action-based model of dissonance gives a reason for inconsistency to be a problem – it hampers effective and unconflicted action. While the new look model of dissonance modifies Festinger's original dissonance theory, the action-based model of dissonance simply adds explanation and predictions.

The predictions derived from the action-based model of dissonance have been tested and supported. The action-based model of dissonance is thus a much stronger theory than the new look model of dissonance, which includes one prediction that has been disconfirmed and whose other support is better explained by alternative explanations. Even though the new look model of dissonance has been extended by Stone and Cooper (2001), the self-standards model does not address any of this critique and can thus not make the theory any more plausible.

The studies about neural correlates do not rescue the new look model of dissonance by giving it neural support. Rather, the theory is undermined by the study of van Veen et al. (2009), who mentions that anticipation of aversive consequences would show activation in orbitofrontal cortex, rather than dorsal ACC, which was the region activated in this study.

However, the new look model of dissonance could argue that feeling *personally responsible* for aversive consequences could show activation in some other region.

The action-based model of dissonance predicts that ACC is a neural correlate of dissonance – specifically the process of dissonance arousal. Many studies (Westen, Blagov, Harenski, Kilts, & Hamann, 2006; Veen, Krug, Schooler, & Carter, 2009; Izuma, Matsumoto, Murayama, Samejima, Sadato, & Matsumoto, 2010) found activation in ACC during dissonance arousal or some other part of the dissonance process. This prediction is thus supported by recent neuroscientific research.

Another prediction supported by neuroscientific studies is that activity in prefrontal cortex should follow after the ACC activity. Jarcho et al. (2011) found a correlation between medial prefrontal cortex activation and attitude change, although they do not report any ACC activity preceding this activation. Izuma et al. (2010) found activation in DLPFC, which they interpret as an indication that they identified the active process of dissonance reduction – whereas van Veen et al. (2009), who used another experimental paradigm and did not find this activation, identified dissonance arousal. This interpretation is supported by Jarcho et al. (2011), who suggest that dissonance reduction occurs rapidly in the free choice paradigm (which Izuma et al. (2010) used), but might occur at a later point in the induced compliance paradigm (which van Veen et al. (2009) used). Westen et al. (2006) did not separate dissonance arousal from dissonance reduction, but they did find activation in medial prefrontal cortex. Harmon-Jones et al. (2008) showed that dissonance reduction can be prevented by manipulating left frontal cortical activation, which supports the prediction that left frontal cortex is involved in dissonance. However, more support is needed to confirm the prediction that prefrontal cortical activation *follows after* ACC activity.

To determine if ACC activity precedes prefrontal activity, a study similar to Harmon-Jones et al. (2008) should be conducted. The decrease condition participants should be scanned with fMRI during the decision task, to see if ACC activity is present even though dissonance reduction does not occur.

The action-based model of dissonance presumes that dissonance is an innate process. However, even though studies such as Egan et al. (2007) have investigated dissonance in children and monkeys, alternative interpretations exist – for instance, that the children were old enough to have learnt the behaviour and that other primates can learn this behaviour as well – and it has thus not been conclusively shown if dissonance is innate or learnt. Studies investigating dissonance in infants could answer this question.

The core of the action-based model of dissonance is that inconsistent cognitions could interfere with effective and unconflicted action. This could be tested by inducing inconsistent cognitions in participants and make sure dissonance reduction does not occur – by neurofeedback or some other manipulation – and test if it is more problematic for these participants to act on these cognitions than for a control group.

No study testing the action-based model of dissonance, the new look model of dissonance or investigating the neural correlates of dissonance has used the effort justification paradigm. To determine if the results apply to this paradigm as well, studies in these areas should be conducted in the effort justification paradigm.

The new look model of dissonance needs to show that the alternative interpretations are inadequate, in order to gain plausibility. This could be done by modifying Scher and Cooper (1989) or Cooper and Worchel (1970) in a way that gives the participants less justification. The theory must also be able to explain the results from Harmon-Jones et al. (1996).

The studies investigating the neural correlates of cognitive dissonance have in some cases received very different results. While different parts of ACC, insula and prefrontal cortex are recurring results, caudate nucleus and striatum were each only found in one study. Further studies should determine the roles of these structures in the dissonance process.

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