

How Creative Groups Structure Tasks Through Negotiating Resources

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Abstract Creative collaborations are a complex, yet common phenomenon. In this paper we introduce a model that describes the development of a creative outcome by a group, based on its efforts to structure the task through the exploration and adoption of concepts and artefacts. We use our model as a basis to analyse a collaborative filmmaking study. Through this, we show how the model is an effective tool for describing the actions of the group as its members work towards producing an outcome. We conclude that the model could be utilised as a tool for recognising patterns in creative collaborations, for understanding support needs, and for comparing instances of these tasks.

Introduction

This paper describes a model of the development towards an outcome in creative collaborations, through the exploration and adoption of artefacts that add structure, bounding the space of possible actions. This can be utilized as a method for understanding and comparing the nature of instances of a creative task. In this paper we define the model, and apply it to the analysis of instances of creative collaboration, in which two separate groups devised and produced short films.

The model focuses on the introduction, adoption and dismissal of resources by creative groups, which structures the path towards producing a creative outcome. In the development of this structure, a spectrum of types of resources exists: From tangible artefacts such as physical objects or software tools, that enforce processes, structure and direction on the group, to adopted concepts such as goals that lack definition or shared understanding. The model presented here reflects the effects of

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the characteristics of these resources on a group's creative process. This includes the need to explore the possibilities inherent in tangible artefacts, to develop shared understanding of novel concepts, and to connect the two together to produce creative outcomes that are both feasible and in line with goals.

In this paper we use the model to analyse examples of interaction with these artefacts in the instances of the filmmaking study, and how this affects the progression of the groups towards an outcome (in this case a short film). Through these examples we discuss how the model provides a useful means to consider how artefacts relate to the effectiveness and efficiency of the group, and how the model can be useful in understanding support needs for group creativity, both in terms of the structuring effects of providing specific artefacts, and the structuring processes that occur within creative groups.

Background

Researchers including Boden [2] and Schön [15] have described creative tasks as inherently ill structured, with no single, clear path to producing an outcome, as they aim at a combination of novelty and value [4]. Sawyer [14] argues that collaboration in creative tasks is common, as complex creative outcomes often require, or are improved by, the knowledge, skills and labour of more than one person. Creative collaborations therefore represent a complex but important phenomena, for which an ability to model and understand the processes involved would be valuable across a range of disciplines and purposes.

Rittel and Webber [12] describe these unique and ill-structured tasks as *wicked problems*. According to Ritchey [11], two of the criteria for wicked problems are that they have no definite formulation and that they have no stopping rules. The absence of a definite formulation of the task and its solution means that the perceived steps for the task at any given stage are tied to the current understanding of the solution; in order to fully formulate the problem, all possible solutions for it would need to be known at the outset.

The absence of stopping rules does not imply that projects involving wicked problems never reach a conclusion. What it does mean is that the best or most complete solution for a problem can never be said to have been met. With creative tasks this is particularly true, as any solution will have an element of novelty that cannot be compared directly with possible alternatives.

Central to the completion of ill-structured tasks is the adoption or development of a structure that affords and constrains the space of possible actions. Stokes [17] describes creativity as requiring strategies for the adoption of constraints that provide a structure through which a goal can be defined and creative outcomes can be progressed towards.

Progression towards an outcome in a creative task is rarely linear: Perez y Perez and Sharples [10] find that distinct phases could be identified in creative writing processes of engagement in the production of ideas, and reflection on the structures that constrain

engagement. Similarly, Baer [1] and Gabora [5] explore how creativity involves periods of both divergent and convergent thinking, related to explorative and analytical modes of thought. The exploration of concepts and artefacts that may lead to novel ideas is balanced by the evaluation of concepts and artefacts that are considered for adoption. Whilst these processes have been identified and studied with respect to individuals, they are poorly understood with respect to creative groups. Whilst collaboration brings added complexity, it is essential to many creative tasks [14].

The characteristics of the various forms of structure affect the progress of the creative collaboration in different ways. The structures we consider range from tangible tools and artefacts that enforce behaviour, affording and bounding the space of possible actions, or novel, ill-defined concepts that the group develop as a basis for producing novel solutions. Norman [9] argues that the *perceived affordances* of objects are essential to how they are used. These artefacts, when adopted by a creative group, add a tangible structure, supporting a set of actions that can be performed. In contrast, Sarmiento and Stahl [13] develop Sawyer's argument that *indexicals* play a central role in creative groups – that is the shared development of symbols representative of novel concepts. These concepts form a structure of abstract goals, constraints and methods through which concrete ideas can be discussed, produced and evaluated.

Central to the understanding presented in this paper is the logic that creative collaborations negotiate the adoption and development of these various forms of structure, in response to the ill-structured nature of the tasks they undertake. Our previous work has considered both how the adoption of artefacts is negotiated [8] and how collaborators develop individual and shared structures in a software environment [3]. We have found evidence that supporting the shared end-user development of interfaces can aid co-ordination and negotiation by creative groups. In this paper we relate these pieces of work together, building a theoretical model that could inform both systems development, and the evaluation of instances of group tasks, by highlighting differences in group performance and process.

Issues with Creative Task Completion

Creative group tasks require a number of people to collaborate in a way that leads to a satisfactory outcome. Because creative tasks do not begin with a clear structure, the outcome of the task is unlikely to be obvious to the group members at the start of the task. They are likely to have some general conception of what this outcome may be – some of which is held only by individuals, some of which may be shared – but a collaborative process needs to be pursued so that the gaps in this conception can be filled.

Two types of structure that are routinely introduced by group members in order to make progress in collaborative tasks are concepts and tangible artefacts. In this paper we use the term *concept* to represent mental constructs and ungrounded ideas that group members introduce in the building of their conception of the outcome,

and the term *tangible artefact* to represent things that have defined affordances, such as physical objects and software.

The introduction of new concepts into a group enables them to make steps that could lead towards a better understanding of and/or solution to the task. By contrast, the introduction of tangible artefacts could lead towards the implementation of those steps, also enabling progress towards the task solution. In this paper we suggest that the balance between these two approaches is important in maintaining effective task progress. This balance can be lost in two ways: Firstly, the generation of too many ungrounded concepts can leave the group with too much malleability in their ideas. Secondly, the introduction of too many tangible artefacts, or inappropriate ones, can leave the group poorly constrained and unable to produce an effective outcome.

In the development or deployment of technological support for creative collaborations, tangible artefacts – or means through which to find or develop these – need to be provided in order that groups can produce an outcome. It is also likely that functionality for mediating the introduction and negotiation of concepts by the group will be needed, such as shared representations or communication channels. The rest of this section elaborates on concepts that can be used to understand these needs in instances of creative collaboration. Firstly, the notions of *efficiency* and *effectiveness* are considered as measures of the success of creative groups. The notion of a *conception of the outcome* is then discussed, followed by the introduction of two important phenomena that occur in the process of creative collaborations: *concept mismatches* and *artefact mismatches*.

Efficiency and Effectiveness

The notion of *success* in a creative group is complex and multi-faceted, but it is important to define some aspects of this as a basis for understanding what groups are attempting to achieve.

We define *efficient* group collaboration as all group members doing what is required by the group to complete the task in the most expedient way at any given time. In complex or unstructured problem-solving tasks, determining whether someone, or the group as a whole, is performing an activity that will ultimately be relevant to the production of the outcome is difficult. It may be that on reviewing a project after it is completed, a group would not do many of the activities that they undertook along the way, or perhaps they would do them differently, or in a different order. However, that does not necessarily mean that a group, or its members, was not being efficient at the time. In many cases, such activities are necessary to make the group decide how not to proceed, leading to structure that further defines a conception of the outcome.

It is necessary to make the distinction between achievable efficiency and optimal efficiency. An achievable efficiency for a person is if someone is making the maximum use of their knowledge and capabilities, even if they are less optimal than they could be with practice, or even if they are less than somebody else's capabilities. An achievable efficiency within a group is slightly more complex, as it is also

affected by the differing capabilities of its members, i.e. the most capable person for an activity within a group must be the one attempting it for the group to be efficient (although it is important to note that capability to attempt an activity includes availability, so if the most able person for an activity is not available, then they do not have the capability to attempt it). By comparison, an optimal efficiency is a theoretical ‘best attempt’ at a task, in which the best-known people were attempting the task in the best-known way. With even the slightest complexity or novelty in a task, the optimal efficiency will not be understood until after the task has been completed, and perhaps not even then.

If the collaborative effort of a group has been *effective*, then to an outside observer the outcome of the task would be judged to be a success. Therefore, a measure of the effectiveness of group collaboration has to be a measure of the quality of the group’s output. González et al. [6] describe ‘group effectiveness’ as the aggregation to group level of the effect of the group’s members’ behavioural performances or actions; when these behavioural performances or actions all relate to a specific collaborative task, then this is a good definition for *effective group collaboration*.

As with efficiency, there has to be some distinction made between an achievable level of effectiveness within the group and an optimal level of effectiveness with respect to the task. A group would meet an achievable level of effectiveness if it were possible to answer in the affirmative *has this group achieved the best solution it was capable of for this task?* Whereas, the group would have reached the optimal level of effectiveness if it were possible to answer in the affirmative *is this the best possible solution for this task?* Sundstrom et al. [18] make the link between group development and effectiveness, suggesting that the group’s capability to be effective increases as it builds through the phases of development; also supported is the argument that this capability for effectiveness increases because during a group’s development they need to allocate less time to teamwork activities and can therefore spend more on taskwork activities.

Another way of looking at group effectiveness is to apply Simon’s [16] rule of *satisficing*. In this case, instead of looking for the best possible solution for a task, either with or without respect to the group’s members’ capabilities, a satisficing solution would answer *is this a good enough solution for the task set?* To answer this, the assessor would have to understand the requirements of any sponsors of the task, rather than those of the group members contributing to the solution.

In creative group collaborations efficiency and effectiveness are important measures of the group’s success, so understanding the patterns of creative collaboration that occur when groups of people work towards a shared goal is important when looking for ways to better support the process.

Conception of the Outcome

A group collaborating on a creative task move from an initial conception of the outcome, to a more refined conception as they work towards their goal, to a realised outcome when the task is completed. Initial conceptions of the outcome are likely

to differ across the individuals in a group. A shared conception is developed through the actions that occur when the group works together. These actions, such as externalising and evaluating ideas or concepts, or exploring the use of tangible artefacts, can constitute progress towards the goal, or alternatively lead to a realisation that their previous conception of the outcome was inadequate or unachievable through adopted tangible artefacts.

The conceptual space in which the outcome could exist can therefore *shrink* in response to the actions performed, and the conception of the outcome held by group members also *shifts*, in response to negotiation and the improved understanding of the task built through the actions of group members.

Concept Mismatch

We use the term *concept mismatch* to describe a point where the group has too much malleability in its work to be effective. This occurs through a build-up of concepts that are not grounded in the tangible artefacts that can be applied to the task, or are incompatible with each other. Without grounding the group loses the focus that is necessary in order to make progress towards some sort of task outcome.

When a concept mismatch occurs in creative group work, there are two possible ways that this can be rectified. The first of these is for the group to choose some of their shared concepts and begin to apply them by negotiating the use of tangible artefacts that can apply or instantiate the concepts. Instantiation of a concept might involve selecting a technology that can be used to produce a concrete idea that reflects the concept, but equally it could be something as simple as one of the group members detailing this idea more explicitly with pen and paper.

The second way that a concept mismatch can be rectified is for the group to agree that their understanding of the final outcome has changed to something less constrained. In these situations, realigning the new understanding of the task outcome to the current level of malleability allows the group to proceed without grounding their concepts further. The result of this choice is that either they will go through another realignment process later to direct themselves towards a more structured outcome, or they will achieve a final outcome that is not well structured. The nature of an individual task will determine which of these is most appropriate for any given task.

Artefact Mismatch

We use the term *artefact mismatch* to describe a point where the group is too constrained by its chosen artefacts to be effective. This occurs when the artefacts that the group has chosen (or those that it has to use because of external direction) forces the group to work in a particular way that no longer allows it to achieve its current conception of the outcome.

In a similar way to the concept mismatch, there are two ways that an artefact mismatch can be rectified. The first of these is for the group to develop their use of their chosen artefacts. This may occur through exploration of tangible artefacts that leads to the discovery of further functionality, or by introducing new concepts that support the artefact’s use.

The second way that an artefact mismatch can be rectified is for the group to agree that their conception of the final outcome has changed to something more constrained. In these situations, the group members will come to the conclusion that what they can achieve with the artefacts that they have is an acceptable solution for the task and agree a new goal that is based upon these constraints.

Directing a Shared Creative Task

If we use compass points to describe the progress made through a task, then it is possible to say that the start point is in the west and some form of optimal solution for that task is a straight line to a completion point due east of the start. The movement from the start point to the outcome represents a notion of task progress, the rate of which could be considered as the groups’ efficiency. If all the movement is directly from the start to the outcome, then all of the group members’ work has a direct and positive influence on the completion of their task. This would therefore represent a very trivial task, where the outcome and the steps required to achieving that outcome are well defined. Figure 1 illustrates such a task, showing that when all activities performed in the pursuit of a task achieve movement towards the desired outcome, this can be represented as linear task progress.

Lacking a specified structure for their completion at the outset, non-trivial tasks are less deterministic, and require elements of trial-and-error, learning and failure to achieve an outcome. Progression is not linear, as some activities do not achieve movement towards the outcome. Therefore, extending the compass metaphor, we can assert that any movement east of the start point is *progression* towards the completed goal; any movement west towards the start point is *regression* away from the completed goal; and so, any movement north or south represents a *digression* from this west-east optimal line.

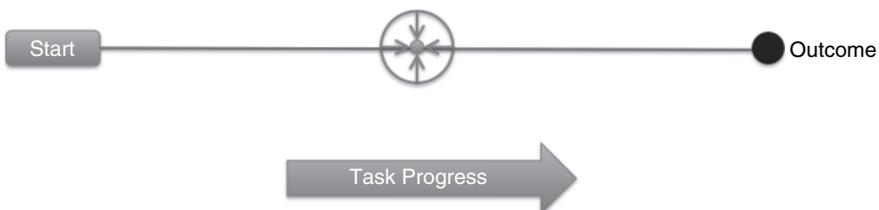


Fig. 1 Representation of a trivial task

As discussed in “Issues with Creative Task Completion”, one perspective on the development of structure is the need for the group to balance and relate their use of concepts with their use of tangible artefacts. The introduction of either concepts or tangible artefacts into the group can be seen as a digression from the work towards task completion; it is only when they are accepted by the group as purposeful to the task in some way that they begin to contribute towards task progress. Therefore we have two types of digression: *concept digression* and *artefact digression*, caused by the introduction of concepts and tangible artefacts respectively.

Figure 2 shows how progression, regression and digression are forces that move the current state of a task around this plane. Progression is a force that moves the task towards an outcome; regression is a force that moves the task away from an outcome; and digressions over artefacts or concepts alter what the potential outcome might be.

As group members collaborate on a creative task, they generate forces that push the task in different directions, causing different combinations of progression, regression and digression to occur. Individual group members introduce all the concepts or artefacts used by the group, so these individuals generate the forces that cause digression. By comparison, the overall group reaction to the introduction of these concepts or artefacts determines whether they are adopted and lead to task progress, are rejected without them having any effect on the task, or whether they lead to a rethink over work completed so far, which can be seen as a regression from previous progress towards an outcome.

An individual who introduces a concept or artefact becomes its *sponsor* and they negotiate with the other group members to determine its purpose within the context of the task. This process of negotiation then determines the degree – if any – of task progress. Initially in a complex or ill-structured task there is a high degree of freedom over what is an acceptable final outcome, which means that the chance of concept or artefact mismatches occurring is lower in the initial stages of a task; as the understanding of the task’s requirements becomes clearer to the group this freedom is reduced, meaning that the introduction of further concepts or artefacts is more likely to lead to a situation where these resources are mismatched to the perceived outcome.

In contrast to Fig. 1, Fig. 3 represents an example path between starting a task and its final outcome in a creative task. The start point and final outcome are not on a direct east-west line, such as that illustrated in Fig. 1, representing that the

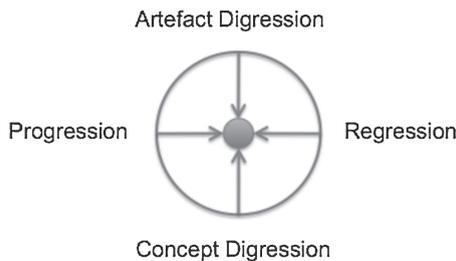


Fig. 2 Forces acting on the task

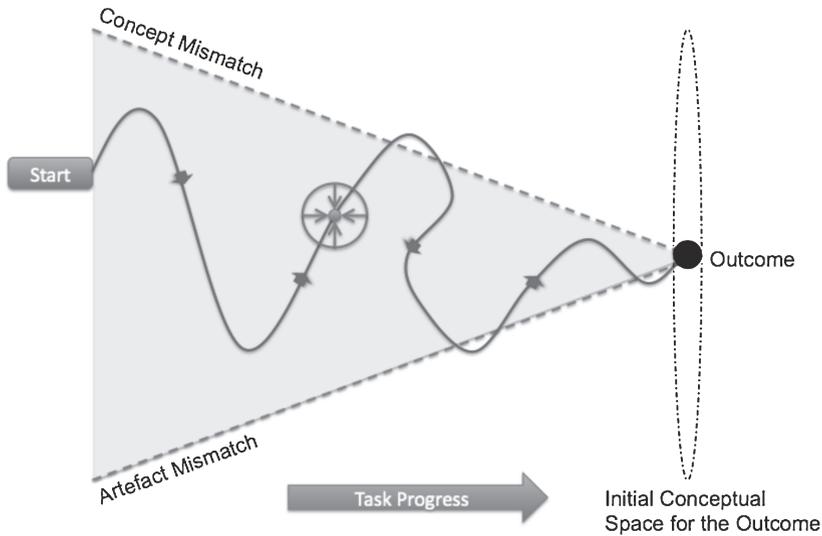


Fig. 3 Representation of a collaborative creative task

original conceptions of the outcome held by individuals at the start of the task have been modified and defined by the activities that have led to its completion by the group. Figure 3 also illustrates how the valid space for avoiding mismatches narrows as progress is made towards task completion.

A Study of Group Creativity

In the following sections we describe the filmmaking study, and then analyse vignettes that exemplify the progress of each group, using the model presented above. Three excerpts are taken from each group’s process of completing the task, showing their chronological work towards the outcome and the characteristics of this at each stage through diagrams representing their path, and descriptions using the concepts presented.

Method

Two groups of four people took part in a creative task to produce one or more promotional videos to improve environmental awareness around a university campus. The groups were independent of each other and did not work concurrently. They were encouraged to have as many co-located meetings as necessary in order to complete this task within a 3-week timeframe.

The groups were provided with technologies that were expected to aid them in completing the task. This included a large touch screen display attached to a PC in the meeting room, and HP iPaq Smartphones for each individual. Video recording equipment was made available to the groups, but in the first instance the group used one of the member's own video camera, and in the second case combined clips recorded using the Smartphones. The groups were given assistance to transfer materials from the Smartphones on to the PC in the meeting room at the start of each meeting, but were told that they could use any other tools or artefacts they wished in completing the tasks.

Analysis of Group 1

Group 1 met four times over the 3-week period, including the opening meeting when the task was explained to them and a final meeting when they created their video to promote environmental consideration on campus. They envisaged a single 90-s video clip to be shown around campus and targeted making a production-quality version of this video, using a mixture of their own film and publicly available clips.

In Vignette 1, Group 1 are at an early stage in completing the task. They are involved in concept digression, leading to an artefact mismatch. This begins with A introducing ideas for the video that are supported by C. However, B reminds them that they have adopted the Movie Maker editing software, and the constraints

Vignette 1: Taken from Meeting 2 of Group 1

Group members discuss conceptual ideas, how they could be implemented, and the affordances of editing software in relation to these ideas. A has produced several concepts, including speeding up the film, that will require suitable technologies to perform. C is supportive of these ideas until B highlights that the software he was expecting to adopt is unlikely to be able to perform these functions.

A: So for reuse (*one of the adopted thematic concepts*) ... the movie takes someone through the process of making paper, but funny, maybe Benny Hill-esq... We could intersperse ourselves with footage we can get... and so it could maybe be kind of speeded up as well."

C: "Yeah definitely"

A: "Cos it need to be short, and that would make it entertaining if it was sped up"...

B: "Windows Movie Maker, I've not found a way that it can speed up, or slow down, or reverse or anything like that... My theory would be that if we can come up with something without needing any gimmicky kind of effects, other than some editing, it would probably be better..."

C: Yeah I mean, that's an idea, if it's easy we do it, if not... whatever.

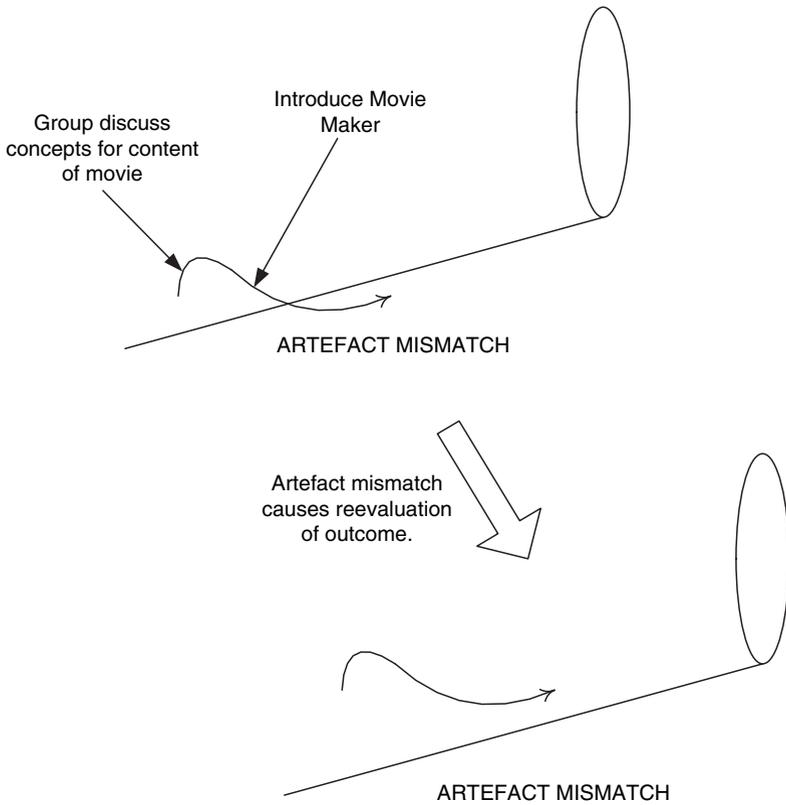


Fig. 4 Model representation of vignette 1

on this artefact means that they have a mismatch between their artefacts and their conception of the outcome at this stage of the task. The group members have a choice between changing their adopted artefacts to match their conception of outcome, or shifting their conception of the outcome to match the chosen artefacts. In this case, they choose the latter option and so Movie Maker remains within the group as before, but with the new understanding that whatever it does will be twisted to satisfy the task outcome.

Figure 4 represents this activity by showing an overall curve towards an outcome, shaped by digressions as group members introduce concepts and artefacts. The artefact mismatch boundary is crossed when we observe that the group has to re-evaluate its perceived outcome. In terms of providing technological support to creative groups, identification of points of transgression, such as this artefact mismatch, and instances where concept mismatches occur, could show where intervention is necessary in similar tasks so that the overall task work is either more efficient, more effective, or both. In this case, it would have been possible to improve the *efficiency*

Vignette 2: Taken from Meeting 2 of Group 1

The use of sound in the film is discussed, as C is interested in presenting some facts and advice to viewers. B and A are interested in how this may be done, and suggest the possibility of reading the facts out audibly. C then suggests that sound may not always be audible, and the group adopt the concept that the sound used in the film will only be complementary. C is explaining some of the advice he feels the film should get across.

B: How do you want to do that? I mean do you just want someone reading out these facts or some pictures...

C: No I have to admit I haven't worked on that.

A: I would think it could be pictures and then you reading the facts, which relate to the pictures...

C: Umm, I'm thinking if that is to be played in the Parade (*a bar*) or in the public streets, maybe sound is not an option.

A: That's true.

C: Or maybe we should have sound only as a complementary channel, and we should have the facts bring it out. So we have a quote displayed. You can have voice on top, but not dependent on it.

A: Yeah true.

C: We can have sketches that are without dialogue, and have some nice music on top, if its not being played its not necessary.

of the collaboration by constraining them to using Movie Maker from the outset of the task, as it would have restricted their discussions on content to only those things that are supported by Movie Maker. How the group's *effectiveness* would be affected by this intervention is less certain; the same artefact would ultimately shape the outcome, but the creative freedom that would be lost in the early phases of the task, although inefficient, may be necessary to help develop a 'better' solution. By not enforcing a choice of editing software during this study, the groups could consider a much wider space of initial possibilities and constrain themselves.

By the time this second meeting occurs, the group members have all completed some individual work on the task, based on activities identified in their first meeting. Vignette 2 represents a common pattern for this type of meeting, where ideas that have been formed by an individual prior to the meeting are introduced as concepts to the group, which are then discussed, modified and ultimately either accepted or rejected as the group members collaborate on these aspects of the task.

Figure 5 shows a representation of this vignette using the model. This particular vignette represents concept digression leading to progression, as the concept of making something that does not need to rely on sound is introduced by an individual and adopted by the group. Some narrowing and shifting of the space in which the outcome can fit also occurs, as the group have agreed to communicate their message visually. If the group members had been unable to agree on how to proceed, then the

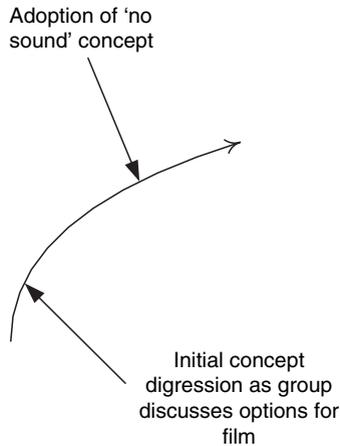


Fig. 5 Model representation of vignette 2

Vignette 3: Taken from Meeting 3 of Group 1

One of the group members – C – copies a video clip that he has prepared onto the desktop computer. It is suggested that he starts the meeting by showing this to the group. As the group members watch the video clip, they ask questions and offer suggestions on how C could develop this idea further.

A – Maybe C should start, cos you're doing the first bit

C – Yeah. *He takes the desktop mouse and starts the clip.*

They all watch the video for a few seconds, then B asks:

B – Do you have sound on this one?

C – No

B – Ok

They watch the remainder of the clip in silence; at the end, the discussion of it begins again.

D – That's good/A- Yes, very nice

B – I think we need a bit longer for the messages

A – I think the messages are ok, if it's playing on a loop

B – Some of them I didn't have time to read

A – I think we should ... well (*he looks at C*) have you got any music to go with it?

C – No, I haven't

group could be described as regressing away from an outcome to their task, and this would be represented by the curve turning back away from the outcome.

In Vignette 3, the introduction of the video clip is an artefact digression that has arisen as a result of the introduction of concepts in a previous meeting. As he plays the video to other members of the group, this begins a negotiation process that will

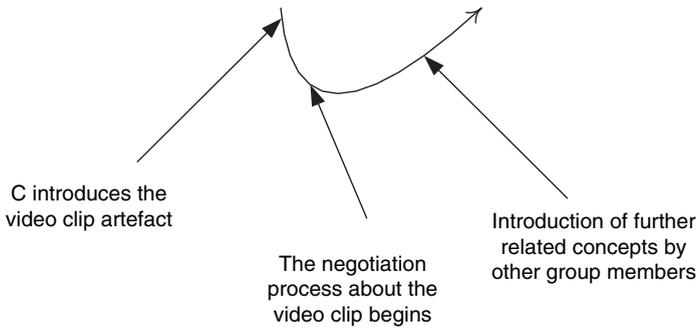


Fig. 6 Model representation of vignette 3

ultimately determine whether the artefact is adopted or rejected; whichever of these outcomes occurs, the group's shared understanding of the artefact will necessarily change as a result of the negotiation.

The negotiation process also adds a force to the group work that joins the artefact to some element of task progress. Depending upon how the negotiation develops, this may result in some form of progression or regression, towards or away from the solution, as well as digression. In this case, the video clip is received positively by the group, although there are some queries about whether there should be sound with the clip and whether some inserted messages were too quick to be read.

This process is represented in Fig. 6 as a strong digression initially as the concept is presented to the other group members. The curve then softens towards greater progress as the other group members become involved, before moving back towards concept digression as other group members begin to introduce related concepts. This illustrates what could be argued as one potential template for representing a useful level of achievable efficiency, whereby the negotiation process between the group members links the benefits of conceptual understanding with tangible artefacts to achieve overall task progress.

Analysis of Group 2

Group 2 met five times over an equivalent 3-week period, which were used for similar purposes to Group 1, but had two distinctions: first, in the third and fifth meetings, only two of the four group members were present – in both instances the two absentees were the same people; second, Group 2 needed two meetings (their fourth and fifth) to create their output for the task. Their interpretation of the task was slightly different to group 1: They envisaged a much grander set of 20 short videos to be played around campus, spoofing famous film roles, such as James Bond and Indiana Jones. However, they only aimed to use these meetings to create a few prototype videos to illustrate the environmental messages that they had scripted. This shows how the ill-structured nature of the same creative task leads to the adoption of different structures in each instance.

This shows early conceptual digression in a wide space of possibilities, which at the end of the vignette is found to be proceeding away from a suitable conception of what the outcome should be (it shouldn't irritate people). It is similar to Vignette 2 where Group 1 discusses the use of sound, although the outcome is different (showing that the problem space of the task is open to various solutions).

As the animal and noise concept is ultimately rejected, the progress that seemed to have been made is reversed, however the actions of the group are not without value – they have aided definition of the group's conception of the outcome, which has now been reduced in scope to disregard ideas that might irritate people through inappropriate use of sounds in a public space. Their conception now does include (and focuses on) possibilities for reminders that grab the attention of passers by, encouraging them to recycle.

Vignette 4: Taken from Meeting 1 of Group 2

The group are generating and discussing ideas for their film. The concept that the film is to be a reminder to people to recycle is suggested by A, and elaborated by A and B. A further concept of using animals is suggested, then – due to questioning from C – is elaborated to be animal noises that grab attention by A and B. D then interjects, noting that these noises may be irritating when in a public place.

A: Perhaps the film is just a reminder, I just forget to do it (*recycling*)

B: So you are talking about someone passing by?

A: Talking about someone passing by, I quite like this idea of reminders as you pass by.

B: OK you pass by and you see something, a message, just saying LOOK! This is the recycle bin...

A: Well I think the silly animal trick is quite funny sometimes...

C: How does that go?

B: Noise?

A: Well you just have an animal

B: Oh I see, you just have an animal... it grabs attention

A: you have that... people like animals it grabs attention.

C: So a cow?

A: Ducks... 'What's that duck doing there?'

B: OK that's interesting, you hear the sound of an animal, but it has nothing to do with animals. You hear the animal then you look at the screen and...

A: Its just a thought, it's a trick, you see it a lot in adverts on the tele(*vision*).

D: Yeah, it's a good idea but if we're putting it somewhere where a lot of people are walking past...

A: It this going to make them fed up.

D: Its going to make them crazy...

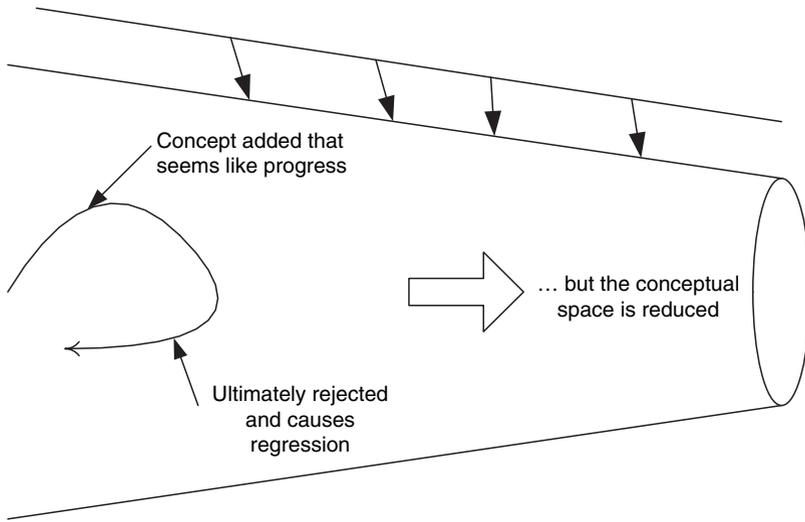


Fig. 7 Model representation of vignette 4

Later the group adopts a modified version of this idea, using film characters rather than animals, which would be less likely to “make them (*passers by*) fed up”. This fitted better with their conception of the outcome – reminding people to recycle in a public space – but still contained much of the essence of the ideas presented here.

Figure 7 illustrates how this can be represented by the progress trail turning back on itself, showing that task progress has turned to regression and therefore the group ultimately are no nearer an outcome for their task. At the same time, it illustrates how the conceptual space for acceptable outcomes has been reduced through the negotiation process.

This instance demonstrates how support for creative collaborative tasks must take into consideration the tension between support for *effective* collaborations and support for *efficient* collaborations. In this case, an intervention could have been made to reduce the conceptual space earlier. If this were to be done, then the group’s activity would be more efficient as their activities would be slightly more deterministic; however, reducing this space reduces the range of potential solutions, meaning that unless care is taken to understand the space in which effective outcomes exist, the group could be prevented from devising and producing the most effective outcome to their task.

Vignette 5 represents an artefact mismatch – the lack of a camera to film with, which is resolved by C suggesting the adoption of a new artefact to perform the filming. D agrees with C’s adoption. The simplicity of the identification and rectification of this problem is due to the structure the group have adopted through their previous actions. The group had intended to film, and knew that they needed a camera to do this. Although A thought that the group would not film in the rain, C wants to follow this existing concept rather than change direction. As they have

Vignette 5: Taken from Meeting 4 of Group 2

The group have met with the intention of filming footage based on their ideas. A was expected to bring a camera but due to bad weather assumed it would not be needed. C suggests that filming is still possible and that a Smartphone (referred to as PDA by the group) can be used to record, the adoption of which is supported by D.

A – I’ve brought a bottle

A – ‘My camera’s in the car. I thought with this rain we wouldn’t be bothering with much.’

C – ‘we can film in the rain.’

B – ‘Well, er, T just said...’

A – ‘The camera’s in the car’

C – ‘We can film with the PDA’

D – ‘Yeah, we can film with the PDA’

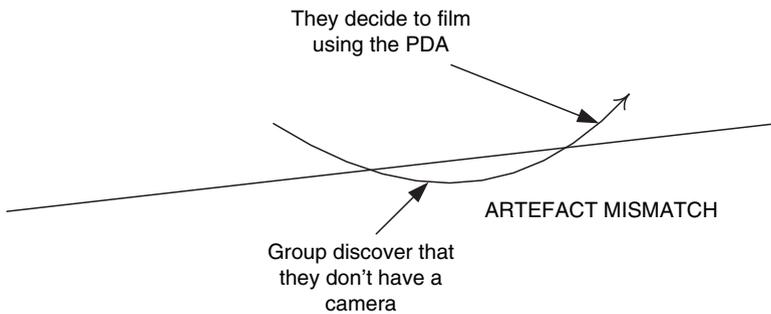


Fig. 8 Model representation of vignette 5

previously identified that the Smartphone could produce film, the rectification of the artefact mismatch is simple.

Figure 8 illustrates that in this instance the mismatch boundary remains the same. This means that the group has chosen to stay on track with their previously envisaged conception of the outcome, which at this stage remains broad, and modify how they will achieve it by introducing new concepts that are suitable to this outcome.

This shows how much more structured the activity has become by the time the group actually decide to produce the film. Concepts (shared understanding of the film idea, and that they are going to film footage now using the Smartphone) and artefacts (script, Smartphone as a camera) are in place, allowing A and B to define and share a detailed understanding of what will occur in filming.

Figure 9 illustrates that once the task (or part of it that is currently being undertaken) is well understood by the group, then it becomes trivial and can be represented in the same way as the abstract case shown in Fig. 1.

Vignette 6: Taken from Meeting 4 of Group 2

The group are getting ready to film a scene. B and A are looking at the produced script and checking that they share the same understanding of what will occur. A is to act the part of James Bond in the scene, so practises some of the required actions with B watching.

B – *(checking script with A)* So, is that ok?

A – Err.... *(he pauses)*

B – So what are you doing? Camera's there *(he gestures to an imaginary location)*

You come in ... I mean, you have the bottle there. You come in. You recycle it.

A – Look at the camera...

B – and then, you turn to the camera *(he starts making gestures of adjusting an imaginary bow tie)*

A – ...and walk off

B – Bow tie, hair and you go out.

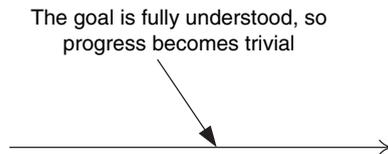


Fig. 9 Model representation of vignette 6

Conclusions

This paper has presented a theoretical model that describes the structuring of creative tasks undertaken by collaborative groups. In its current form, this can be valuable to the deployment of technologies to support collaborative creativity, by providing a basis with which to consider how providing tangible structures such as software environments will impact on the groups' efficiency and effectiveness. Perhaps more importantly, the model can aid in the development of technologies by describing the processes through which groups' members themselves need to develop structure in a task. This could be applied in the design of novel systems that support collaborative types of end-user development [7], or that support the shared development of novel concepts [13]. The model shows how both of these types of system could aid creative collaboration processes.

The model presented in this paper can be used to describe and analyse complex task progression in two ways. First, it provides a means of describing individual events in a collaborative activity and illustrating the effect of those events on the overall task progress. Second, it provides a means of joining these events to describe the collaborative task over its duration, thereby identifying more long-term patterns of task progress.

In future work, we expect to be able to identify particular recurring patterns that have consistent effects on the progress made in complex collaborative tasks. From descriptions of these patterns and their effects on the process of creative collaboration, design heuristics could be developed which would extend this model towards a useful prescriptive design tool for creative groupware. Of further interest would be the introduction of this model to participants involved in retrospection on tasks, to explore how they would describe their structuring behaviours and subjective experiences. The model could also be used for the comparative analysis of instances of collaborative creativity, providing scope to analyse the effects of interventions or variations between these instances.

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