How can we write software that can communicate creatively?

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Abstract. Communication is often defined as the ability to transmit information. We can employ creativity in many ways and to various degrees when communicating information. From a computational creativity perspective, how can we model such communicative creativity, so that we can make software that can communicate creatively? To answer this question, we need to tackle a more specific question: how can we better understand what entails creativity, enhances creativity and/or contributes to creativity in the context of communication? Then we can use this information to inform our models and/or evaluate their creativity. This paper tackles this question by analysing how creativity is perceived to be manifested in communication by participants with experience in studying communication and information. It uses a recent characterisation of key components of creativity to identify aspects that are particularly important for making communication more creative. Overall, the components that relate to autonomous and informed involvement in the communicative process seem to be prioritised most for creativity, alongside the unsurprising requirement for originality and novelty in this process. Our findings can help us create better computational models of creative communication, and guide us to a more informed evaluation strategy for assessing creative systems that perform communication tasks.

INTRODUCTION

What entails creativity in communication? The central aim of this paper is to identify how creativity is manifested in communication scenarios, in a format that can be represented computationally as a model of creativity.

Communication is typically defined as the ability to exchange or transmit information.

> Definitions of *communication*:
> 'The imparting or exchanging of information by speaking, writing, or using some other medium' (Oxford English Dictionary)
> 'the act or an instance of communicating; the imparting or exchange of information, ideas, or feelings' (Collins English Dictionary)

We should be able to create expressions representing the information we wish to communicate in a clear, understandable way. Creativity can be useful when we detect and clarify misunderstandings, by re-expressing this information in different formats. We also use creativity when we target our communication to be relevant and coherent to our specific audience at any one time. We can adapt creatively to different communication scenarios and different media for communication. Within society,[1] then, the ability to communicate allows us to demonstrate creativity in multiple ways.

What makes a communicator creative? What can we check or track, to see if a communicator entity is particularly creative (or less creative?) Particularly in the context of computational creativity, what should we prioritise including in computational models or simulations of communication, to maximise their creativity?

This paper considers what it means to be a creative communicator, identifying key themes and aspects that should be included in computational creativity systems that are designed to perform communication tasks as creatively as possible.

For this paper, creativity is considered to comprise fourteen *components of creativity*, as derived in [14]. The characterisation of creativity as these collection of components was the result of an investigation of the meaning of the word 'creativity': analysing the language that is used in discussions of the nature of creativity. This work, originally conducted as part of a study understanding how to evaluate the creativity of computational software [12], forms the basis of the current study. As argued elsewhere [12, 13, 18], creativity often appears to manifest itself differently in different domains of creativity. The study reported in this paper develops these ideas further in the context of communication, analysing how a model based on the components of creativity should be adapted to best represent creativity in communication.

Background

Computers are used in many communication tasks. We use computers to communicate in various ways over the internet, or to pass data from one location to another via electrical pulses that communicate that data. We also use computers to communicate information by re-representing data using pattern detection, information search, data mining, or various other techniques. These are communication scenarios where the human user is driving communication. This paper, however, focuses on scenarios where a computational agent is able

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[1] The AISB'17 convention, which includes the Computational Creativity symposium that this paper is presented at, is co-ordinated under the general overarching theme of 'Society and AI'.

to communicate in creative ways, with some degree of autonomy as a creative system.

Creativity manifests itself within the context of communication in a huge variety of ways. We use language creatively to converse and exchange information, in everyday communication [4] and in specialised circumstances such as professional scenarios [3] or translation [17]. Examples occur in discourse [10], narrative construction [16], creative writing and in the use of linguistic devices such as metaphors to communicate concepts [15] - but our creative communication abilities are not limited to spoken language; we also use other communication methods creatively such as gestures, facial expressions, sounds, body language, and so on. We can even be creative in using silence to communicate [9]. The creative act of improvisation is often a major part of communication, as we exchange and react to exchange of information [20]. We also use creativity to communicate digitally [7] or via other media such as imagery or visual language.

Figure 1. TheRiddlerBot twitterbot ($https$: $//twitter.com/TheRiddlerBot$) creates and posts riddles, and responds to Twitter users who try to solve them. Incidentally, the answer to this riddle is Weird Al Yankovic.

How could a computer program implement any of these tasks such that it is able to communicate in a creative way? We are all familiar with interactive software that are low in creativity, ranging from ELIZA [22] to modern-day voice-recognition-enabled telephone help systems, because of their reliance on 'canned' phrases and preprogrammed responses. Quite possibly, incorporation of computational creativity could help these systems be better communicators. Similarly, in other communication scenarios, the ability to adapt creatively to different communication scenarios has been already demonstrated in existing computational software. For example, on Twitter, as well as creating and tweeting riddles, *TheRiddlerBot* twitterbot [8] can also adapt its tweets in response to other tweets it has received, see for example Figure 1; the *MetaphorMagnet* twitterbot [21] is able to comment on current trends such as (perhaps provocative) tweets referring to the recent US presidential elections (see Figure 2). In the domain of one-way communication, rather than interactive/two-way communication, computational cre-

ativity has seen significant progress in the realm of story-telling and narrative [6, for a good summary]. There have also been achievements in other systems that perform communicative tasks such as the re-representation of news stories as images [5], or systems that can create and use their own communication language [19].
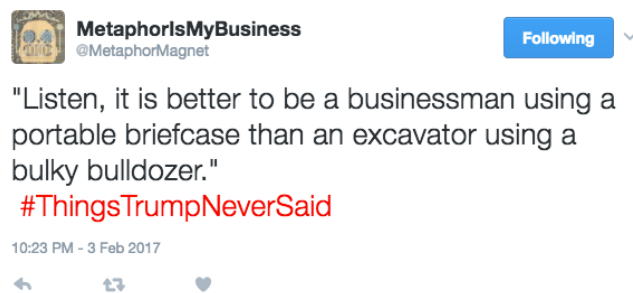

Figure 2. Metaphor Magnet twitterbot ($https$: $//twitter.com/MetaphorMagnet$) creates and posts metaphor-laden tweets referring to current news events, such as the recent US presidential election.

Computational creativity typically has two overarching motivators, which vary in their relative motivation for different computational creativity projects but which tend to both be present to at least some degree in computational creativity research. Firstly, such projects attempt to see if the creative tasks/behaviours under focus can be modelled, simulated or replicated using computational means, such that they can be done by computer. This affords various advantages such as possible automation to help generate creative outputs on a larger scale, or to help enhance our own creativity via co-creativity and interaction. Or, we can take advantage in a creative process of what computers can do better than humans, e.g. large-scale/long-term processing of data in a mechanical and accurate fashion, without becoming bored, tired, unduly biased or occasionally inaccurate due to lapses in attention. Secondly, the computational study of creativity allows us to study creativity in new ways afforded by the computational models, abstractions and algorithms we employ. Computational creativity gives us new tools with which to analyse, understand and simulate creativity. Particularly for this second motivation, we are able to test hypotheses of what makes us more creative in a particular task (or in general) via the computational means we employ.

When working with computational creativity and communication, how do we make our software more creative communicators? And how do we evaluate the degree to which our programs are indeed creative in their communication? To model, simulate or replicate creative communication using computational means, it is useful to have some prior understanding of - or hypotheses for - what entails creativity in communication. In an evaluation context, the Standardised Procedure for Evaluating Creative Systems (SPECS) evaluation methodology requires us to judge our creative systems in terms of what it means to be creative (both generally and in the domain(s) in which they perform their given creative task(s)) [11, 12]. So if we are approaching the task of creating software which can communicate creatively, what characterisation or definition of creativity should we use to guide and assess our success in this task?

Following [14], we have a characterisation of creativity, via 14 *components of creativity*: key themes and factors that collectively represent different aspects of creativity. These components were derived using statistical natural language processing to detect concepts

that we typically talk about when we discuss what creativity is. This works on the cognitive linguistics assumption that if a word is often mentioned when we talk about a concept, then that word is connected to the meaning of that concept. Figure 3 reproduces these components of creativity from [14].
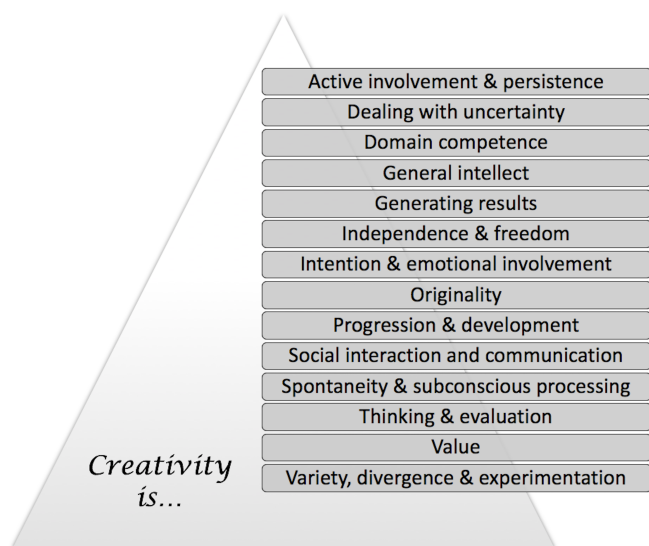

Figure 3. Fourteen components of creativity [14]

With the Figure 3 components as a model or characterisation of creativity in general, we can ask: are there any particular priorities (or conversely, less important components) for creativity in communication? Different types of creativity can manifest themselves in different ways; although some elements of creativity transcend all types of creativity, other elements are more - or less - important for different types of creativity [2, 18, 1]. For example, in the domain of mathematical creativity, it is crucial to generate correct results at the end of the creative process. On the other hand, in musical improvisation, we have found that the music produced as the end result of improvisation is actually not so important a contributor to the creative process of improvisation, compared to other factors such as the ability to show intention and emotional involvement during improvisation, or to interact and communicate in the social context within which improvisation is taking place [13]. So what components are particularly important for creativity in communication? What should we prioritise when we build and evaluate computationally creative communication systems?

Aims of this research

In [13] we consulted various people with an expertise/interest in music, to get their opinions on what it means to be creative in the context of musical improvisation. We analysed data from questionnaires about creativity in musical improvisation, to customise the 14 components of creativity from [14] and understand which components are most important for this type of creativity. In this present work, the aim is similar: *to understand better what entails, enhances and/or contributes to creativity in the context of communication*. This aim can be achieved by consulting the opinion of people who are experienced in the use and analysis of communication, and using the data generated from this consultation to weight and order the 14 components of creativity for this particular type of creativity.

METHODOLOGY

Attendees of the 11th International Colloquium for Computational Creativity colloquium acted as participants for the exercise of gathering data. This Colloquium was held at Universidad Autonoma Metropolitana (UAM)'s Cuajimalpa campus in Mexico City, Mexico. The Colloquium attendees largely came from the interdisciplinary Masters programme in Design, Information and Communication (MADIC). Based in UAM's Division of Communication and Design, MADIC students specialise in how to integrate Design, Information and Communication together in interdisciplinary ways, studying each of these three levels in detail individually and in combination.

Although levels of expertise in communication vary according to students' individual background, all these students spend their time thinking about how to approach communication of information in an interdisciplinary way, as well as having some training in how to design technologically based solutions. This is why their opinions were considered to be a useful source of information for the research question: *when you are a creative communicator, what makes your communication more creative?*

The workshop where data was gathered for this study occurred in the middle of the colloquium, after a series of talks relating to creativity and computational approaches. Participants were given a brief introduction to the 14 components of creativity from [14] during one of the lectures on the first day of the colloquium. This introduction to the components was then repeated as part of a workshop the following day. Participants were also given brief written definitions of the components as appear in [14, 12] and as has been reproduced in the Appendix to this paper.

We should acknowledge the potential impact of language issues on this research, as well as the steps taken to deal with these issues. This set of participants was selected because of 1. their masters-level interdisciplinary study of communication with design and information, and 2. their exposure to creativity and computational creativity during the colloquium. Participants were mainly Mexican, with Spanish as their native tongue and English as a second language. The colloquium lecture and workshops were conducted in English[2] with live Spanish translation for those who felt their English was not sufficient to understand. Then they were given paper surveys to complete (as part of the tasks for the aforementioned workshop); their responses form the data for this paper. Again, these surveys were in English, however people who felt their English was not sufficient for the task could work in pairs with another participant with stronger English language skills. In practice, it was pleasing[3] to note that most of the participants were able to work capably in English.

The students were asked, in the paper survey, to rank the 14 components in order of importance for being a creative communicator. The header of the survey sheet asked "How important do you think each of these things are, for being a creative communicator?" This was followed by the list of components, by which they were asked to fill in the sentence 'This is the ____ most important out of all the 14 things in this list." The students were given as much time as they needed to complete the survey.

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[2] I have promised to work on my Spanish(!) but unfortunately it is not at a level where I could conduct research in Spanish.
[3] And slightly humbling, to the author.

Table 1. Mean and standard deviation for the 51 responses to the survey. A ranking of 1 for a component indicates it is considered 'most important' by a participant, and 14 is 'least important'. Results are sorted first by lowest mean ranking (to 1dp) and then by lowest standard deviation (to 1 dp).

Mean	S.D.	Component
5.6	4.5	Originality
6.3	4.1	Intention & emotional involvement
6.6	3.5	Independence & freedom
6.7	4.2	Social interaction & communication
6.8	4.2	Active involvement & persistence
7.4	3.9	General intellect
7.7	3.9	Thinking & evaluation
7.8	3.5	Variety, divergence & experimentation
7.8	3.7	Generating results
7.8	3.6	Progression & development
8.2	3.9	Spontaneity & subconscious processing
8.3	4.5	Domain competence
8.6	4.2	Dealing with uncertainty
9.6	3.3	Value

RESULTS

In total, 51 participants returned the survey with complete data. Occasionally participants had made mistakes (or deliberately not ranked the components in strict order) by ranking, say, two components as 6th most important and no components as 7th most important. Such scenarios were rare (6 participants in total out of 51). In these cases, data was recorded as it was supplied, with no normalisation or forcing into a strict 1-to-14 ordering.

The results in Table 1 and Figure 4 show that overall, participants considered *Originality* to be the most important component for creativity in communication with a mean ranking of 5.6, followed by *Intention & Emotional Involvement* (mean ranking of 6.3) then by *Independence & Freedom* (mean 6.6), *Social Interaction & Communication* (6.7) and *Active Involvement & Persistence* (6.8) respectively.
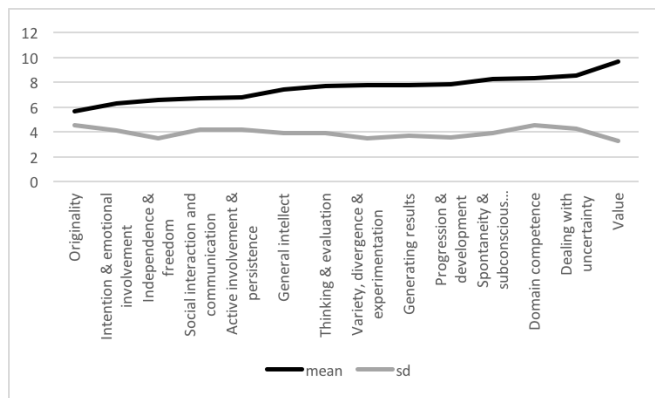

Figure 4. Graphical representation of the data in Table 1.

The standard deviation showed no particular variance in opinions to take note of. Typically participants varied in their responses by around 3.9 standard deviations; responses varied in standard deviation from 3.3 (*Value*, with the highest agreement at a ranking of around 9.6 out of 14) through to 4.5 (*Originality* and *Domain Competence*, with the highest disagreement over rankings of 5.6 and 8.3 respectively).

The mean values for the raw response data do, however, in fact rank all components between 5.6th and 9.6th most important for cre-

ativity in communication. We can analyse the data further by grouping responses. If we categorise rankings using the bins of 1-5, 6-9, and 10-14, this gives us an idea of what people considered top 5 (most important) components for creative communication, middling in importance, and bottom 5 (least important) components. These grouping data are shown in Figure 5.
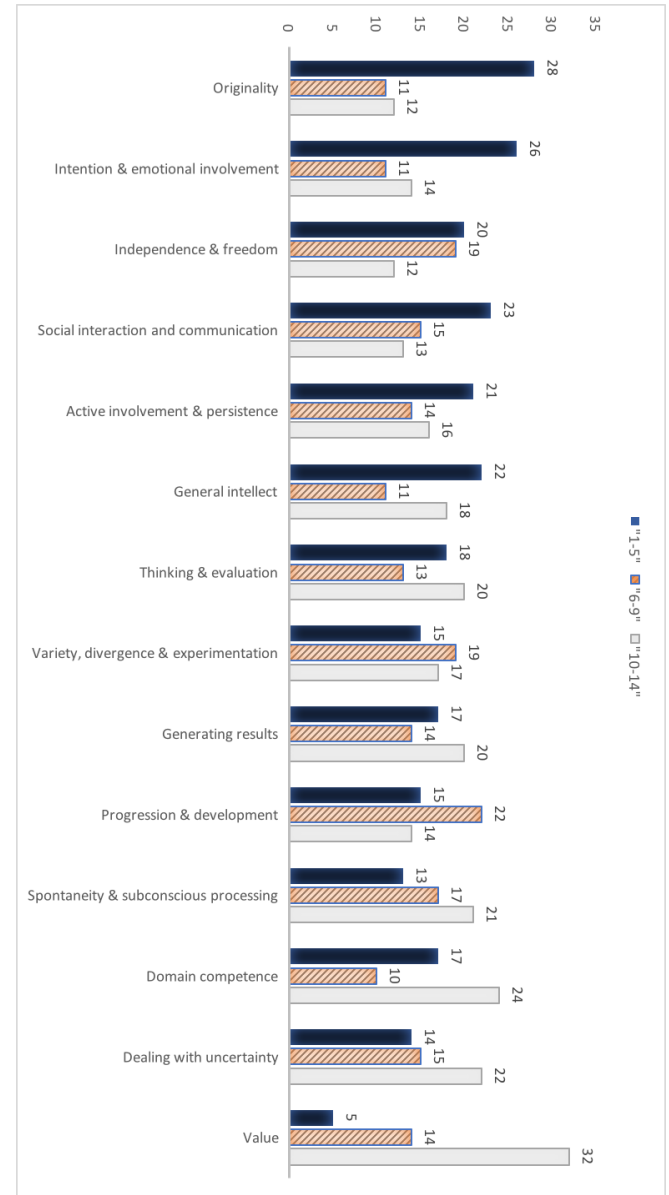

Figure 5. Rankings data categorised using the bins of 1-5, 6-9, and 10-14 (top 5 (most important) components for creative communication, middling in importance, and bottom 5 (least important) components, respectively). Components are ordered in the same order as for Figure 4.

Inspecting Figure 5, more differentiation can be identified in responses. We see that 27 people considered *Originality* to be in the top 5 most important components for creativity in communication - this is over half the respondents). 26 people considered *Intention & Emotional Involvement* to be top 5 most important, the second highest response (and again just over 50% of respondents). *Active Involvement & Persistence* and *General Intellect* were each chosen

by 21 participants in their top 5 most important components, and 20 people selected *Independence & Freedom* in their top 5 most important components.

Looking at the components people ranked in the bottom 5 for importance for creativity in communication, 31 respondents out of 50 felt *Value* was in the bottom 5 (with only 5 people ranking it in their top 5). 24 people felt *Domain Competence* was in the bottom 5 in terms of importance, followed by *Dealing With Uncertainty* (22 participants), *Spontaneity & Subconscious Processing* (21 participants). Next came *Thinking & Evaluation* and *Generating Results*, tied at 19 respondents each who ranked these components in their bottom 5 in terms of importance.

DISCUSSION

The following components have emerged as particularly important for creativity in communication. They are marked with an asterisk * if they are identified as important via the raw rankings data, and by a plus sign + if they are identified as important via the treatment of the data as ordinal:

- Originality *+
- Intention & Emotional Involvement *+
- Active Involvement & Persistence *+
- General Intellect +
- Independence & Freedom *+
- Social interaction & communication *

Overall, the components that relate to autonomous and informed involvement in the communicative process seem to be prioritised most for creativity, alongside the unsurprising requirement for originality and novelty as part of creativity.

One surprise in this data was that the component *Social Interaction and Communication* did not feature much more highly in importance, being ranked a mean of 6.7th most important component out of the 14, with just under half of participants placing it as one of the top 5 most important components for creativity in communication. This could be because this component was interpreted in this context as focusing on the social and interactive parts of communication, and that the participants did not feel that communication necessarily needed to be social/interactive in order to be *creative*. In the rankings data it was still seen as relatively important compared to other components, but in the ordinal treatment of the data just over half the participants tended to pass over this component in their choice of the top 5 components for communicative creativity.

It is interesting to see the lack of consensus of opinion on a clear outlier(s) for the most or least important components of creativity in communication; no individual components were universally (or near-universally) agreed upon as most important for creative communication, or least important. Perhaps this is due to the diversity of different means and modes of communication (as highlighted earlier in this paper). Alternatively, perhaps we need much larger numbers of informed participants in order to arrive at a consensus - if there is a consensus to be arrived at?

On the whole, though, we now have some useful data about factors of communication that make it more creative.

CONCLUSIONS AND FUTURE WORK

This paper aimed to uncover data helping us to understand what makes communication more creative. In a computational creativity context, we want to understand creativity more by using computational means. In this current paper, we wish to identify what is important to include in computationally creative models and simulations of communication. Our specific aim was *to understand better what entails, enhances and/or contributes to creativity in the context of communication.*

To address this research aim, this paper analyses of data provided by participants with a particular interdisciplinary focus on studying, analysing and applying communication in the context of design and information. We found that all of the components were considered important to some degree for communicative creativity, perhaps more uniformly than in other creative domains such as music improvisation. Some components, though, did emerge as particularly contributory to creative communication. We found that, as is common for most types of creativity (if not all), originality is considered very important for creativity in communication. Also important is the ability to demonstrate the intent to communicate and emotional involvement in that process, on a level which is active and persistent. General intellect is important for assisting creativity in communication, as are the abilities to operate independently and without constraint, as well as the abilities to interact socially during communication.

It should be noted that the data reported in this paper was obtained via studies conducted in English with participants who were mostly native Spanish speakers. While participants' competence in English was mostly found to be very high, it would be useful to replicate this study with a group mostly consisting of native English speakers, to verify whether the same findings are to be found.

Nonetheless, we do now have some useful data on what constitutes creativity in communication. We can use this in computational models of communication in two ways.

Firstly, we can use the data to better understand/evaluate how creative these computational models are, and how to increase their creativity; for example, working on making creative systems more capable of being original and demonstrating intent would be more fruitful than working on the quality of communicative output and grasp of domain skills such as language, if we are intending to maximise the creativity of the system. (Note that maximising the creativity of the system is not the same aim as maximising the performance of the system, where quality of output might be more important.) Secondly, we can use this data as evidence that creativity in different domains has been shown to differ.[4] [13] found a different distribution of importance for the components, in the context of their importance for creativity in musical improvisation: *Domain Competence* and *Social Interaction & Communication* were considered two of the most important components for musical improvisation creativity. The two different types of creativity considered here (music improvisation and communication) do both show an emphasis on *Intention & Emotional Involvement*, which is interesting to note given that this would be considered more tricky to achieve in computational systems than some of the other components. The data for this current study and that in [13] shows the value of efforts to make our creative systems show intent and emotional involvement in their creative tasks, at least in the context of creativity in communication (this study) and in musical improvisation [13].

In communicative creativity, this data shows a more even distribution of the components' relative importance for this type of creativity. This study is not conclusive, as it comes from the perspective of one group of participants, mostly of a similar demographic and possibly

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[4] As noted by a reviewer of this paper, there is potential for exciting future work to use comparative analysis to investigate in depth how individual components are manifested in different creative domains.

with biases introduced from their study of the MADIC Design, Information and Communication masters degree in UAM, Mexico. The study, however, gives a good indication of what entails creativity in communication, from the perspective of people who study communication and related concepts as masters level.

Now that we have this data on what to include in creative communication systems, we can use it to inform the building of software that emphasises the aspects which were found to be particularly important for creativity (while not overlooking other aspects of creativity). One fascinating potential application of this work is in the annual Loebner Prize competition based around the Turing Test, which AISB hosts and organises.[5] Could computational creativity assist Turing Test software entrants, using creativity in communication towards a better performance at the Turing test? It would be very interesting to pursue this angle. There are many other potential applications; in fact, during the workshop where data was collected, the students were also asked to consider a piece of software that could do a communication task that requires creativity. Their suggestions were extremely broad in range, from chatbot software through to applications that use creativity in communication with mentally ill patients. In short, the potential array of possibilities for creative communication software is vast, and we now have more information on how to make such systems more creative.

To summarise this paper's contribution, in conclusion we return to the question in the title of this paper: *how can we write software that can communicate creatively?* From our findings above, we can conclude that we should focus on equipping our software with the abilities to be original and independent, to demonstrate intent and emotional involvement, to actively persist in that involvement in the communication process, to interact socially and with intelligence. Perhaps with such information, we may produce software that creatively tackles the Turing test, in a prize winning capacity? Or, and with more every-day intentions in mind, we can at least have a more robust understanding of how to make creative software that communicates.

ACKNOWLEDGEMENTS

REFERENCES

[1] John Baer, 'The case for domain specificity of creativity', *Creativity research journal*, **11**(2), 173–177, (1998).
[2] John Baer, 'Is Creativity Domain-Specific?', in *The Cambridge Handbook of Creativity*, eds., James C Kaufman and Robert J Sternberg, chapter 17, 321–341, Cambridge University Press, New York, NY, (2010).
[3] Vijay K Bhatia, 'Creativity and interdiscursive performance in professional communication', in *Routledge Handbook of Language and Creativity*, ed., Rodney H. Jones, chapter 9, Routledge, Abingdon, UK, (2016).
[4] R. Carter, 'Common language: Corpus, creativity and cognition', *Language and Literature*, **8**(3), 195–216, (1999).
[5] Michael Cook and Simon Colton, 'Automated Collage Generation - With More Intent', in *Proceedings of the 2nd International Conference on Computational Creativity*, pp. 1–3, Mexico City, Mexico, (2011).
[6] Pablo Gervas, 'Computational Approaches to Storytelling and Creativity', *AI Magazine*, **30**(3), 49–62, (2009).
[7] A. Goddard, '"is there anybody out there?" creative language play and literariness in internet relay chat (IRC)', in *Communication Research and Media Science in Europe*, eds., A. Schorr, B. Campbell, and M. Schenk, pp. 323–43, Berlin, (2003). Mouton De Gruyter.
[8] Ivan Guerrero, Ben Verhoeven, Francesco Barbieri, Pedro Martins, and Péréz, 'TheRiddlerBot: A next step on the ladder towards creative Twitter bots', in *Proceedings of the Sixth International Conference on Computational Creativity (ICCC 2015)*, eds., Hannu Toivonen, Simon Colton, Michael Cook, and Dan Ventura, pp. 315–322, Park City, Utah, (June 2015). Brigham Young University.
[9] Adam Jaworski, 'Silence and creativity: re-mediation, transduction, and performance', in *Routledge Handbook of Language and Creativity*, ed., Rodney H. Jones, chapter 20, Routledge, Abingdon, UK, (2016).
[10] Rodney H. Jones, *Discourse and Creativity*, Pearson, Harlow, Essex, 2012.
[11] Anna Jordanous, 'A Standardised Procedure for Evaluating Creative Systems: Computational Creativity Evaluation Based on What it is to be Creative', *Cognitive Computation*, **4**(3), 246–279, (2012).
[12] Anna Jordanous, *Evaluating Computational Creativity: A Standardised Procedure for Evaluating Creative Systems and its Application*, Ph.D. dissertation, University of Sussex, Brighton, UK, sep 2012.
[13] Anna Jordanous and Bill Keller, 'What makes musical improvisation creative?', *Journal of Interdisciplinary Music Studies*, **6**(2), 151–175, (2012).
[14] Anna Jordanous and Bill Keller, 'Modelling creativity: Identifying key components through a corpus-based approach', *PLOS ONE*, **11**(10), e0162959, (2016).
[15] George Lakoff and M Johnson, *Metaphors we live by*, University of Chicago Press, Chicago, IL, 1980.
[16] Andrea Macrae, 'Literary narrative', in *Routledge Handbook of Language and Creativity*, ed., Rodney H. Jones, chapter 15, Routledge, Abingdon, UK, (2016).
[17] *Translation and Creativity: Perspectives on Creative Writing and Translation Studies*, eds., M. Perteghella and E. Loffredo, Continuum, New York, 2006.
[18] Jonathan A Plucker and Ronald A Beghetto, 'Why Creativity is Domain General, Why it Looks Domain Specific, and why the Distinction Doesn't Matter', in *Creativity: From Potential to Realization*, eds., Robert J Sternberg, Elena L Grigorenko, and Jerome L Singer, chapter 9, 153–167, American Psychological Association, Washington, DC, (2004).
[19] Rob Saunders, Petra Gemeinboeck, Adrian Lombard, Dan Bourke, and Baki Kocaballi, 'Curious Whispers: An Embodied Artificial Creative System', in *Proceedings of the International Conference on Computational Creativity*, pp. 100–109, Lisbon, Portugal, (2010).
[20] R. K. Sawyer, *Improvised Dialogues: Emergence and Creativity in Conversation*, Ablex, Westport, CT, 2003.
[21] Tony Veale and G Li, 'Specifying viewpoint and information need with affective metaphors: A system demonstration of Metaphor Magnet', in *Proceedings of ACL'2012, the 50th Annual Conference of the Association for Computational Linguistics*, Jeju, South Korea, (2012).
[22] Joseph Weizenbaum, 'ELIZA - a computer program for the study of natural language', *Communications of the ACM*, **9**(1), 36–45, (1966).

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[5] The Loebner prize is an annual AI competition where software is tested in a Turing-style test, on how human-like its communicative abilities are. For more information see http://www.aisb.org.uk/events/loebner-prize.

Appendix: Definitions of components of creativity

Definitions are reproduced here for the fourteen components of creativity, as derived in [14]:

1. Active Involvement and Persistence
   - Being actively involved; reacting to and having a deliberate effect on a process.
   - The tenacity to persist with a process throughout, even at problematic points.

2. Generation of Results

- Working towards some end target, or goal, or result.
- Producing something (tangible or intangible) that previously did not exist.

3. Dealing with Uncertainty
   - Coping with incomplete, missing, inconsistent, uncertain and/or ambiguous information. Element of risk and chance, with no guarantee that problems can or will be resolved.
   - Not relying on every step of the process to be specified in detail; perhaps even avoiding routine or pre-existing methods and solutions.

4. Domain Competence
   - Domain-specific intelligence, knowledge, talent, skills, experience and expertise.
   - Knowing a domain well enough to be equipped to recognise gaps, needs or problems that need solving and to generate, validate, develop and promote new ideas in that domain.

5. General Intellect
   - General intelligence and intellectual ability.
   - Flexible and adaptable mental capacity.

6. Independence and Freedom
   - Working independently with autonomy over actions and decisions.
   - Freedom to work without being bound to pre-existing solutions, processes or biases; perhaps challenging cultural or domain norms.

7. Intention and Emotional Involvement
   - Personal and emotional investment, immersion, self-expression, involvement in a process.
   - Intention and desire to perform a task, a positive process giving fulfilment and enjoyment.

8. Originality
   - Novelty and originality - a new product, or doing something in a new way, or seeing new links and relations between previously unassociated concepts.
   - Results that are unpredictable, unexpected, surprising, unusual, out of the ordinary.

9. Progression and Development
   - Movement, advancement, evolution and development during a process.
   - Whilst progress may or may not be linear, and an actual end goal may be only loosely specified (if at all), the entire process should represent some developmental progression in a particular domain or task.

10. Social Interaction and Communication
    - Communicating and promoting work to others in a persuasive, positive manner.
    - Mutual influence, feedback, sharing and collaboration between society and individual.

11. Spontaneity / Subconscious Processing
    - No need to be in control of the whole process - thoughts and activities may inform a process subconsciously without being fully accessible for conscious analysis.
    - Being able to react quickly and spontaneously during a process when appropriate, without needing to spend time thinking about options too much.

12. Thinking and Evaluation
    - Consciously evaluating several options to recognise potential value in each and identify the best option, using reasoning and good judgment.
    - Proactively selecting a decided choice from possible options, without allowing the process to stagnate under indecision.

13. Value
    - Making a useful contribution that is valued by others and recognised as an influential achievement; perceived as special; 'not just something anybody would have done'.
    - End product is relevant and appropriate to the domain being worked in.

14. Variety, Divergence and Experimentation
    - Generating a variety of different ideas to compare and choose from, with the flexibility to be open to several perspectives and to experiment with different options without bias.
    - Multi-tasking during a process.