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Kamp, M.T. van de; Admiraal, W.F.; Coertjens, L.; Goossens, M.; Rijlaarsdam, G.

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MARIE- THÉRÈSE VAN DE KAMP
WILFRIED ADMIRAAL
LIESJE COERTJENS
MAARTEN GOOSSENS
GERT RIJLAARSDAM

The Relationship of Types of Exploration Activities with Originality of Visual Arts Designs

ABSTRACT

This study examines *specific* exploration activities in students' visual arts portfolios from secondary education. Creating original visual arts products requires exploration according to Getzels and Csiksentmihalyi (*The creative vision. A longitudinal study of problem finding in Art*. New York: John Wiley & Sons Inc., 1976). Obtaining insight about the contribution of *specific* exploration activities to the originality of arts products is important for designing and supporting learning in arts education. The aim of this study is to examine the contribution of activities within three types of exploration: *association*, *combination*, and *abstraction* to originality of visual arts designs. Data consist of 196 portfolio events showing exploration activities and art designs, from 11 Grade 11 visual arts students. Portfolio events were coded for three different types of exploration: *association*, *combination*, and *abstraction*, on a dimension of ascending *abstractness*. We coded activities within each of these types, on a scale of *remoteness*, to determine the metaphorical distance. Visual originality of each portfolio event was assessed using the comparative judgment method. Multilevel regression analyses showed all three types of exploration significantly contributed to originality of visual designs. In total, 31% of the variance in originality at portfolio events level was explained by these types of exploration. In general, the more *remote* exploration activities were, the more *original* the visual design. These findings are discussed related to the literature on creative processes.

Keywords: creativity, visual arts, secondary education, generation, exploration, originality.

In visual arts in secondary education, learning to become original is an important aim. This implies students and teachers have to know to a certain degree *what* is novel, relevant, and surprising in the field of art. Next to this, they also need to know *how* to arrive at novel, relevant, and surprising visual arts products. In other words, students and teachers need to have (domain-specific) knowledge about *originality* in the field of visual arts, about visual arts skills, and about *creative generation and exploration activities*.

In a previous study (Van de Kamp, 2017), we found that domain-specific (i.e., *visual)* generation and exploration explained differences in the originality of visual arts products in secondary education. These results found for students in secondary education confirmed earlier findings by Getzels and Csikszentmihalyi (1976) for college students in visual arts, since they demonstrated visual exploration contributes to originality of visual arts designs. However, knowing that visual generation and exploration matter, does not mean we know exactly how to support these through learning and instruction in secondary education in an optimal way. More detailed insight into the relationship of *specific* generation and exploration *activities* with the *originality* of visual arts products is a prerequisite for designing effective creative learning activities by teachers to enhance their students' creativity. In addition, to support students' learning, teachers not only need to assess and grade final creative products but they also need to give feedback on specific aspects of the creative process such as exploration or flexibility (Haanstra, Damen, Groenendijk, & van Boxtel, 2015, p. 416). From the perspectives of educational research and teaching and learning in visual arts in secondary education, there is a need to examine *specific* generation and exploration activities in the domain of visual arts and to what extent specific activities can contribute to the originality of visual art designs. To examine this, we analyzed students' creative generation and exploration activities in visual art portfolios from secondary education. In these portfolios, creative activities and (intermediate) design products are documented in great

detail during the first part of the creative process, the *problem-finding* process. In the present study, we examine to what extent three specific types of exploration, varying on a dimension of abstractness (i.e., *association*, *combination*, and *abstraction*) and *remoteness* of these activities within these three types of exploration, can explain differences in *originality* of intermediate visual arts designs.

THEORETICAL FRAMEWORK

Common practice in visual arts in secondary education focuses on enhancement of students' creativity through design assignments (Hetland, Winner, Veenema, & Sheridan, 2007). Such an assignment is often based on a theme or an issue related to the contemporary world or to the field of visual arts (this can be called "the stimulus"). Once students have received the assignment, they start exploring their own views on the theme, via association of ideas and by collage making or sketching. This first part of the creative process is called *problem finding* (Getzels & Csikszentmihalyi, 1976), that is, through creative activities students need to find their own subtheme and approach ("problem") to conceptualize and visualize in an original way. Getzels and Csikszentmihaly (1976) discovered that visual artists at college level, using a problem-finding approach including visual exploration, produced art works that were more original compared to artists using a different approach. Problem-finding processes are based on two subprocesses: generation and exploration (Finke, Ward, & Smith, 1992), each with a conceptual and a visual mode, although basic creative activities in these modes are the same.

Generation refers both to *conceptual generation* toward an original (i.e., novel or remote) concept to visualize and to *visual generation* toward an original (i.e., novel or remote) visualization of a concept. For conceptual generation (i.e., divergent thinking), Runco (2008, p. 95) states that this is thinking in many different directions toward an original idea. In the beginning of a visual art process, students often generate many different ideas on a theme through association. *Visual generation* can be split into two types. The first type is *envisioning*, which means mentally representing an idea or image to be visualized in an art product (Efland, 2004). The second type is *visual perception*, including sensorimotor activities such as perceiving and selecting existing images that may provide inspiration for an original image to be further explored (Ellamil, Dobson, Beeman, & Christoff, 2012). These two types of visual generation take place when students in their problem-finding process perceive and select (collect and cut-out) existing images from newspapers or magazines as a visual form of association. We also distinguish two modes in exploration: *conceptual* and *visual* exploration. *Conceptual* exploration is experimenting with existing concepts that were generated to construct novel concepts for an original visualization, for example, through combining or abstracting concepts for designs (Finke et al., 1992). *Visual* exploration is experimenting with images that were generated to construct novel visual designs through, for example, combining or abstracting in sketching (Verstijnen, van Leeuwen, Goldschmidt, Hamel, & Hennessey, 1998a).

Problem-finding processes in visual arts in secondary education are usually documented in detail (in sequences of "events") by students in their art portfolios. In these portfolios, *conceptual generation* can be seen in the form of written associations, noted first ideas and thoughts; *visual generation* can be seen in the form of selected images from magazines or collages; *conceptual exploration* takes place when students describe their views, their concepts to be expressed, and elaborated plans for art production; and *visual exploration* can be seen in sketches, designs, or paintings in which students explore and elaborate their designs for their final visual product. These portfolios, therefore, contain detailed, in-depth, and well-documented information about the subprocesses of generation and exploration and specific creative activities undertaken by students during their problem-finding processes.

Although we know different (combinations of) generation and exploration activities are used in problem-finding processes in visual arts education, we do not yet know what *specific creative activities* enhance originality of visual arts designs. In our study, we use data about students' problem-finding processes from the first 7 weeks (i.e., before they start executing their final products) to determine the relationship of different creative activities in generation and exploration with the originality of intermediate visual arts designs. Furthermore, we use a theoretical model to analyze specific creative activities used in students' problem-finding processes (as documented in portfolio events, i.e., sequences of events from the problem-finding process).

THEORETICAL MODEL OF REMOTENESS AND ABSTRACTNESS

We developed a theoretical model, a matrix, on the creative generation and exploration activities in the problem-finding process, for a previous study (Van de Kamp, Admiraal, & Rijlaarsdam, 2016). In this

matrix, creative activities in generation and exploration are organized along two dimensions (functioning as vectors): *abstractness* and *remoteness*. (See Figure 1).

First, we studied the dimension of *abstractness* in exploration. Different types of exploration—*association*, *combination*, and *abstraction*—can be organized along this dimension of abstractness. The rationale behind the dimension of abstractness is as follows: schematic knowledge reduces the essence from concrete reality experiences and this leads to an increased psychological distance, which makes it easier to transcend reality and create novel ideas and shapes (Hunter, Bedell-Avers, Hunsicker, Mumford, & Ligon, 2008; Soderberg, Callahan, Kochersberger, Amit, & Ledgerwood, 2015). This means, the more abstract the exploration of concepts and visual designs is, the higher the chance of an original outcome. So, for example, exploration through *combination* will lead to a higher originality in a visual design than exploration by means of *association*.

Secondly, we examined the dimension of *remoteness*: in line with Benedek, Könen, and Neubauer (2012) and Gabora (2018) we defined generation toward novel (or uncommon) ideas or images, as *thinking* that is more *remote* (from a certain stimulus). From this perspective, activities within each of the three types of exploration can be organized along the second dimension of *remoteness*, the more remote the generated ideas and images are, the higher the chance of an original outcome; more precisely: the more *remote*

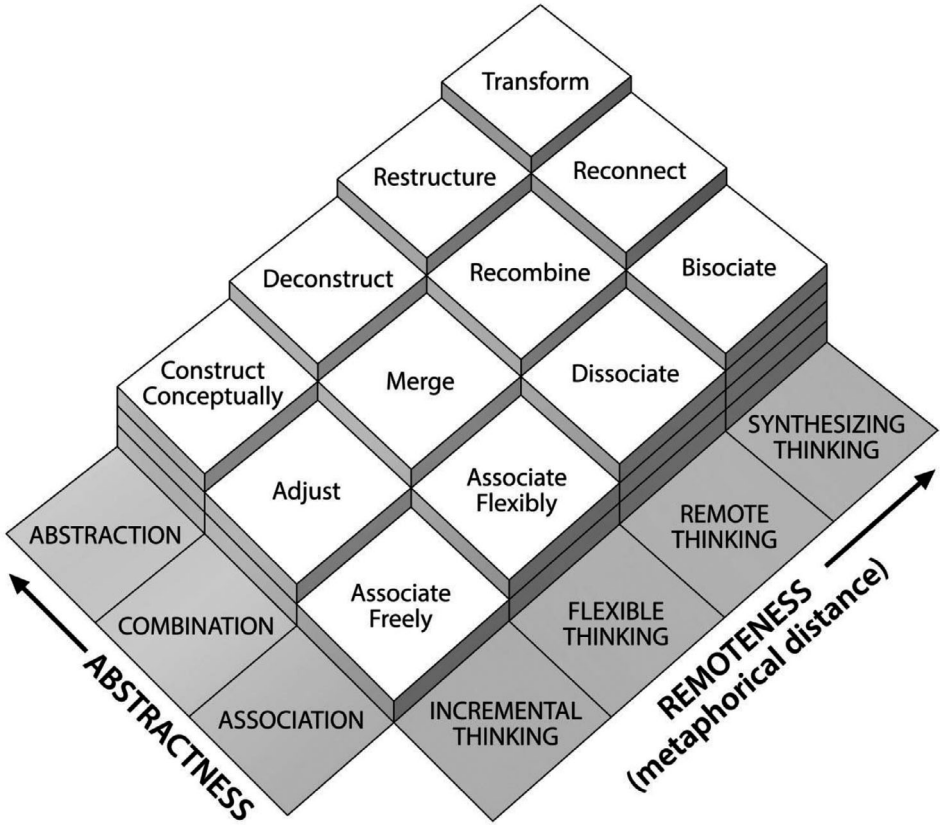


FIGURE 1. Matrix of three types of creative exploration organized along two dimensions: 1. *Abstractness*, running from concreteness (association) to abstractness (abstraction), and 2. *Remoteness (i.e., metaphorical distance)*, four levels of remoteness from a stimulus, running from closely related ideas (through incremental thinking) to remoteness of ideas (through synthesizing thinking). Visualization: R. Heer, Celt.

activities within each *type of exploration*, the higher the originality of the visual design. This means, activities using synthesizing thinking (i.e., that demonstrate *more remote* thinking from a stimulus) will lead to higher originality in visual designs than activities using step-by-step thinking (i.e., that are *more concrete* and demonstrate *less remote* thinking from a stimulus).

In this way, the model combines three types of exploration (*association*, *combination*, and *abstraction*) organized along a dimension of *abstractness* (based on Hunter et al., 2008; Soderberg et al., 2015) with—for each of these types of exploration—four levels of *remoteness*, resulting in 12 different *combinations* of generation and exploration activities. In this model of creative activities, *associate freely* is predominantly generation, *construct conceptually* is predominantly exploration, and *transform* is the ultimate combination of exploration and generation. (See Figure 1).

THE DIMENSION OF REMOTENESS

In the field of psychology, Mednicks' associative theory (1962) explained that generating many, different kinds of ideas was supposed to produce more *remote* associations, indicating more original outcomes. More recently, Benedek et al., (2012) showed specific generation activities, such as free association, flexible association, and associative combination, produce either less or more *remote* outcomes, related to the metaphorical distance from the stimulus. So within *association*, different activities can be organized on a dimension of *remoteness*.

Based on the literature about creative activities, we distinguish four types of activities arranged on a dimension of *remoteness* in thinking: (a) *incremental thinking*, (b) *flexible thinking*, (c) *remote thinking* and (d) *synthesizing thinking*. These levels, therefore, vary on the dimension of *remoteness*, running from low (not remote) to high (very remote).

First, *incremental thinking* is generating through step-by-step thinking, this mostly involves generation through knowledge retrieval. Incremental thinking is low on remoteness, as ideas or images generated are rather closely related to a certain stimulus, or in other words, they are very common (Ross, 2006). *Flexible thinking* indicates switching between different semantic or visual categories and this may lead to less common or more remote ideas and images (Nijstad, De Dreu, Rietzschel, & Baas, 2010). *Remote thinking* is generating from an entirely different, unexpected perspective. This way of generating is even more remote from a stimulus compared to incremental and flexible thinking since it involves mental leaps (Perkins, 1994; Ross, 2006). Finally, *synthesizing thinking* indicates generation of a combination of two or more very remote ideas or images through analogical thinking based on combining these more remote ideas or images through envisioning and mental blending (Benedek et al., 2012; Boden, 2004; See Table 1).

ABSTRACTNESS IN EXPLORATION ACTIVITIES

We distinguished three types of exploration: *association*, *combination*, and *abstraction*, based on empirical research on cognitive activities in creativity (Hunter et al., 2008; Soderberg et al., 2015). These types vary on the dimension of *abstractness*, running from low (concrete) to high (abstract).

Exploration usually starts with the first type, which is *association* (A). *Association* is based on re-imagining *concrete* images and ideas, this type of exploration does not move away (or "abstract") from concrete reality, from existing materials. Association can be organized on the dimension of remoteness, from almost zero to very remote. As explained, we distinguish four levels of association along the dimension of *remoteness*. In the first level of remoteness in *association* (*associate freely*, A1), this means concrete images and ideas are reimagined through envisioning or through perceiving and selecting existing images; for example, in collecting images from magazines as a source for inspiration. At the next level in association (*associate flexibly*, A2), different associations are flexibly connected and, due to this, remoteness from the given stimulus is further increased; an example of this is making a collage or mood board. In *association*, images and ideas are only reimagined not redesigned. Although mental leaps in association will lead to novel—and even more remote—associations, at the level of *dissociation* (A3) or *bisociation* (A4) (Benedek et al., 2012), they are not actually redesigned yet. In visual arts, examples of this are often seen in mind maps, collages, or mood boards.

Combination (B) is the next and more abstract type of exploration in the theoretical model and is about redesigning two or more concepts or images. In *combination*, concepts or images are abstracted from reality to some extent: either by *adapting* forms or materials, or by *reconnecting* different functions or contexts (Ludden, Schifferstein, & Hekkert, 2008). In exploration through *combination*, envisioned or concrete concepts and/or images are combined and constructed—for example, redesigned—from parts of existing concepts and/or images. For *combination*, we can also distinguish four levels along the dimension of

TABLE 1. Matrix of Three Types of Creative Exploration, Running from Concreteness (A. Association) to Abstractness (C. Abstraction), and within Each Type of Exploration, Four Levels of Remoteness from a Stimulus, Running from Closely Related Ideas (ABC 1) to Remoteness of Ideas (ABC 4)

EXPLORATION TOWARD (REMOTENESS IN) ABSTRACTNESS

Three basic types of exploration from association to abstraction

A: ASSOCIATION *By combining remote concepts and generation of non-obvious or surprising ideas through retrieval from long-term memory and/or through analogical thinking. Increasing complexity in association: A1 to A4, types of thinking to generate ideas from more closely related ideas to more remote ideas (from a stimulus).*

A1: **ASSOCIATE FREELY**	A2: **ASSOCIATE FLEXIBLY**	A3: **DISSOCIATE**	A4: **BISOCIATE**
Free generation of as many associations as possible from a stimulus.	Generation of as many *diverse* associations as possible (chains of associations).	Generation of unrelated concepts from a stimulus, that is, generation of as many remote associations as possible.	Generation of associative combinations of two (bisociation) or more remote concepts.

B: COMBINATION *Combining different features and functions for broad uses through imagination and/or through semantic combinations. Increasing complexity in combination → B1 to B4, types of thinking to generate ideas from more closely related ideas to more remote ideas (from a stimulus).*

B1: **ADJUST**	B2: **MERGE**	B3: **RECOMBINE**	B4: **RECONNECT**
Adding or changing one of the features or properties of a specific object or function (features like color, shape, size, and texture) through association.	Flexibly combining all features or properties of two or more objects, subjects, or functions.	1) Splitting the object or function into parts or functions. 2) Combining remote properties and functional parts for non-obvious, novel purposes or functions.	Using functions in remote, non-obvious contexts or for novel, broad use purposes (shoe as "weapon").

C: ABSTRACTION *Apparently remote and incompatible concepts, functions, or contexts are analyzed, deconstructed, restructured, and ultimately transformed on a structural level through defocused and focused attention. Increasing complexity in abstraction → C1 to C4, types of thinking to generate ideas from more closely related ideas to more remote ideas (from a stimulus).*

C1: **CONSTRUCT CONCEPTUALLY**	C2: **DECONSTRUCT**	C3: **RESTRUCTURE**	C4: **TRANSFORM**
Analyzing remote categories and contexts on a deep structural level and constructing novel concepts through complex and systematic combinations.	Deconstructing concepts, functions and contexts on a deep structural level can be used to analyze specific structures of various and apparently incompatible concepts, functions, or contexts for restructuring, through focusing on possible novel use of these structures in remote contexts (*disassembly use*).	Mapping the complex structure of one concept, function, or context to restructure another remote concept, function, or structure in a non-obvious way (*dissociation*). Problem analysis and problem definition: 1. Break frame/conceptual change. 2. Relating existing structures to remote, non-obvious structures.	Blending two apparently incompatible structures (far transfer) into a radically new concept, function, or category through *bisociation*. This requires: 1. Abstraction: a systematic comparison of two concepts on a structural level (types of objects or categories). 2. Complex combination: mapping similarities on a structural level that can be used to create a novel structure (analogical or metaphorical thinking).

	3. Combining knowledge of existing structures for the creation of new structures through analogical thinking.	3. The blending of structures into a novel structure; a structure is radically transformed.

Within each type of exploration, we also distinguish the level of remoteness, that is, four types of thinking to generate ideas from more closely related ideas to more remote ideas (from a stimulus). A1, B1, and C1: incremental thinking, that is, to retrieve knowledge from memory and step-by-step thinking; A2, B2, and C2: flexible thinking, that is, to switch flexibly between different categories; A3, B3, and C3: remote thinking, that is, to think from an entirely different perspective and to make mental leaps; and A4, B4, and C4: synthesizing thinking, that is, far analogical thinking, envisioning and mental blending.

remoteness. This means redesigning in *combination* can be performed through progressive step-by-step construction, that is, *adapting* (B1) just one visual element as color, shape, or material, which is a less remote combination activity. In *merging* (B2), different images are combined into one, which is a more remote combination activity compared to adapting. *Recombining* (B3) more remote aspects or functions indicates combining through even more remote thinking (making mental leaps in combination). Combining through synthesizing thinking means *reconnecting* (B4), this is using different functions in non-obvious contexts or for novel broad use purposes, which is the most remote activity in *combination*.

Along the dimension of abstractness, we then move from combining concepts/images toward *abstraction* of concepts/images. Exploration at the level of *abstraction* (C) indicates materials are *transformed* (i.e., moved further away from reality and more abstracted). In abstraction, the concepts and images explored did not exist before as repertoire from the designer or in the field of art and design. Activities in this type of exploration are the most abstract ones because a creator has to think at a deep, structural level in a radical novel way (Boden, 2004). In exploration through *abstraction*, we can also distinguish four levels of remoteness. In *constructing conceptually* (C1), concepts or images are analyzed and constructed in an incremental, although deep structural way. *Deconstructing* (C2) concepts and images occurs through analyzing how specific and apparently incompatible concepts, functions, or contexts may be re-used. *Restructuring* (C3) concepts and images in non-obvious ways can be performed through mapping the structure of one concept, function, or context to restructure another—remote—one. In a visual design, the balance of a composition can be restructured in order to express concepts or emotions in original ways.

Ultimately, concepts and images with apparently incompatible structures can be blended or *transformed* (C4). *Transformation* may lead to the highest chance of originality in visual arts because it is the most *remote* activity from the stimulus, and is also the most complex and *abstracted* activity. In line with Boden (2004), we understand transformations as radically novel, original concepts and visual designs, which could not have been thought of before or envisioned before by a visual designer. To transform ideas and images into *original* visual arts designs, Verstijnen, van Leeuwen, Goldschmidt, Hamel, and Hennessey (1998b) demonstrated the importance of externalization (e.g., through sketching) in visual design processes. Visual designers will explore *visual elements* such as composition, form, light, space, or *visual principles*, such as balance, unity, repetition, proximity, contrast, emphasis, or alignment, and also specific *visual materials* and *techniques* in order to *transform* (C4) a specific concept or emotion in an original way. A visual designer should not only *think* in a radical novel way but should also develop novel *strategies* to explore specific features of a design (Suwa, 2003). (See Table 1). In the next paragraph, we outline the relation between creative exploration activities and originality in the field of (professional) visual arts because this field serves as the frame of reference for aims and learning activities for visual arts in secondary education and also for the assessment of originality of visual arts designs.

EXPLORATION AND ORIGINALITY IN THE FIELD OF VISUAL ARTS

To become creative in visual arts, teachers and students in secondary education need to know more about the relationship of exploration with originality in the field of visual art. Learning objectives in visual arts in secondary education are derived from and related to *professional practices* in visual arts. In the field of visual arts, creative exploration is essential for professional artists to imagine, to investigate, and to play

with ideas, images, materials, and techniques. Art, as Armstrong (1998) argued, can be perceived as a space of imagination, reflective enquiry, purposeful play, and invention. Artists will *associate*, *combine*, and *abstract* to explore their concepts for artworks. Furthermore, originality is important, it can even be considered as a driving force for artists, since artists will continuously try to transcend boundaries and transform categories to create and present their artworks in new ways (Hammershøj, 2014; Smith & Mathur, 2014). Also, artists always aim to elicit new aesthetic experiences and to generate new meanings through their artworks, according to Van de Vall (2008). Originality, as a driving force, leads to continuous changes in art. The reason for this continuous change is explained by South African painter Marlene Dumas (2012): "Art is there to remind us, that all laws about what is beautiful and valuable were made by humans and can be changed by them." This refers to the constant changing of the "rules" of the game in art and to the fluidity of the boundaries of visual arts. In the field of visual arts, artists will use *exploration* activities that combine, restructure, and transcend conventional ways of thinking, perceiving, and visualizing (Suwa, 2003; Verstijnen et al., 1998a). These exploration activities aim to *produce* an *original* visual artwork that will attempt to add something to what has already been made in art and/or design history. To achieve this, visual artists ultimately need to perform exploration activities that *transform*, these require abstract thinking, designing, and visualizing in "radical innovative ways" (Boden, 2004). This supports a dimension of *abstractness* in exploration. Originality as a driving force in art also means art practices will focus on *remoteness* in thinking to arrive at original artworks. Relations between the field of professional art and visual art in secondary education are, firstly, both focused on problem-finding processes and creative exploration activities in *association*, *combination*, and *abstraction* and, secondly, they are both focused on creating *original* designs.

PURPOSE OF THIS STUDY

In the present study, we examine students' *types of exploration activities*—and the level of *remoteness* of activities in each of these types of exploration—in creative visual arts processes in secondary education. In this study, we focus on (simultaneous) occurrence of three types of exploration, and to what extent activities in exploration are *remote* from the stimulus. We expect that the more *remote* ideas and images are within each of the three types of exploration, the more these will explain differences in originality of students' intermediate visual art designs. Our research question was as follows: *"To what extent does the level of remoteness in students' exploration activities in association, combination and abstraction, explain differences in the originality of intermediate visual art designs?"*. As explained, more insight into specific creative activities that contribute to originality of visual art designs is important to support learning and instruction in visual arts.

METHOD

PARTICIPANTS

All 11 students (Grade 11, aged 16–17, 10 females) from one secondary school class of visual arts education participated. These students all attended visual arts lessons in studio art/art production as an (optional) exam subject at pre-university level. In the Netherlands, in secondary education, arts education is part of a profile called "Culture and Society." This profile leads to university studies and professions in the field of culture and society and shows a gender imbalance (more female students opt for this profile). This gender imbalance is also seen in the students who opt for visual arts education. Students and their parents provided their passive consent to participate.[1] These participants attended a one semester long project (21 weeks) in the pre-final school year with one 100-minute lesson of studio art production a week. The first author was their teacher.[2]

[1] Students and their parents were informed about the study and the lessons, and were asked to participate. Also they were explicitly invited to contact the team-manager or teacher, if they had any questions or doubts about their participation or in case they did want to withdraw from participation. They were also briefed about what data would be used and how, and they were briefed about the research afterwards. No questions or doubts were expressed by students or their parents.

[2] Since the participants were from 11-grade, they already were familiar with a common problem finding process. Usually - and also in this case - a teacher provides space and time for a student to generate ideas and explore them. No formal feedback was given to students during these first seven weeks. Also no evaluation took place: this in order to provide students with enough space and time to explore and find their own problem. Since students document their process in their art portfolios, teachers can observe the process of a student. The teacher only provided the theme and observed students' processes. In the final week (week 7) students wrote down questions they had about their work and their process for the teacher. Then the guidance of students' processes took place - not during the collection of data. This approach from the teacher - to stand back and observe students' is often used in the first weeks while students are generating ideas and exploring.

PROCEDURES

Procedure data collection

The focus of our study is on *the first phase of the creative process* (i.e., the problem-finding process) and students document this part of the creative process in great detail in their art portfolios during the first 7 weeks, without formal or informal guidance by the teacher. After these first weeks, students are evaluated and receive grades and they continue working on their visual art works and present and discuss these, and the creative process is not documented in as much detail or in a chronological order. We decided for our study to focus on this first part of the process since we were especially interested in creative exploration activities and the level of remoteness of these activities during problem finding.

In the first 7 weeks of a regular arts curriculum project of a semester, students worked individually on their problem-finding process to create an original visualization of a theme using art portfolios. Events are sequenced using a single or double page of the portfolio. A portfolio event documents students' creative generation and exploration activities and (intermediate) visual designs. From the first 7 weeks of the project —during the problem-finding process—students' portfolios with intermediate art designs were collected using photographs and prints of the events and using video recordings of reflections by each of the students and descriptions by their teacher.

Lessons and assignments

Students used art portfolios already from Grade 7 and were, therefore, familiar with the use of portfolios to document their creative processes, that is, their ideas and images and written reflections on the theme of technology and the senses ("Tech*no*bodies & Sensorium"). This theme involved the issue of the relationship between (digital) technology and the human senses in contemporary art, focusing on students' reflections on the role and meaning of embodied experiences in a digitalized society. Students were invited to create original ideas for visualizing this theme and they were familiar with exploring their own individual problem-finding process using their portfolios. No formal or informal teacher feedback or teacher evaluation took place during these first 7 weeks as we wanted to observe and describe students' actual problem-finding processes without any interference by the teacher or influence of grading. Students themselves talked about their ideas to other students during classes.

Student reflections

Students were familiar with providing intermediate reflections on their own process. At weeks 3 and 7 of the problem-finding process, all students delivered individually, without a teacher present, a thinking aloud reflection on the first part of their problem-finding process, browsing through their portfolio as stimulus. These sessions were videotaped and transcribed. Transcripts of students' reflections were used as supportive materials for coding students' exploration activities. To provide background information for teachers involved in the coding procedure, in addition to the transcription of students' reflections, in week 7, the teacher orally described each problem-finding process of every student based on their portfolio. These reflections were only used by the teachers involved in coding, in case there was doubt about the remoteness/distance from the stimulus of a specific event.

Portfolio events

We collected data from students' portfolio events on specific creative activities in the first 7 weeks of the problem-finding process and on originality of (intermediate) visual designs such as collages, sketches and designs for the art product to be made. Each week during the lesson, students document their problem-finding processes in portfolios. These portfolios were A4-format dummies with written and visualized pages with a mixture of students' brainstorm ideas and images such as collages (*associations*), visual experiments and sketches (*combinations*), and/or conceptual and visual designs (*abstractions*), and furthermore written evaluations and reflections on their processes and products. After 7 weeks, the teacher photographed and printed all portfolio pages ($N = 283$). Students then reported which portfolio pages formed one particular "event" (indicating a separate activity or design sequence on a single page or double page), which resulted in 196 portfolio events (147 events with images and texts and 49 events with texts only). The teacher checked if these separate portfolio events that were indicated by the students could indeed be identified as a

separate activity or sequence. The 196 portfolio events were used as the units of analysis. Portfolio events were anonymized prior to coding and analysis.[3]

Measures

Exploration activities

Each event was coded for presence of each of the three types of exploration: *association*, *combination*, and *abstraction*, since we wanted to include simultaneous occurrence of these three types of exploration. Absence of any particular type of exploration was coded as 0. In addition, for each type of exploration, the level of remoteness in generation was coded: 0= *absence of generation*, 1 = *incremental*, 2 = *flexible*, 3 = *remote*, and 4 = *synthesizing*.

Coding procedure

Three visual art teachers, including the first author, coded each portfolio event for the presence of each of the three types of exploration in three rounds; starting in the first round with *association*, then in the second round with *combination*, and in the final round with *abstraction*. Coding one of these types of exploration meant also the level of remoteness within this particular type of exploration was indicated by each rater separately. Figure 1 shows the matrix of creative activities that was developed for a previous study (Van de Kamp et al., 2016). The three teacher raters received all subsets of portfolio events, arranged per student (anonymized) and within students in chronological order. Each rater had a different order of students to prevent rating effects. The raters also received supportive material, transcribed reflections from the students (from weeks 3 and 7), and transcribed descriptions of the portfolio events by the teacher (from week 7).

During two rounds of pilot coding, the first author/investigator first explained the matrix as presented in Table 1. A discussion was set up about how this matrix could be applied to assess existing artwork (an advertisement design). In this way, the various creative activities mentioned in the matrix were explained and visualized. Then, the raters themselves generated ideas about the theme of "Tech*no*bodies & Sensorium" in order to know what ideas would be rather usual and what ideas would be more remote. Then, three portfolio events were used to code by each rater separately for the level of remoteness of each of the three types of exploration: first for the level of remoteness in association, then for the level of remoteness in combination, and then for the level of remoteness in abstraction. Afterwards, the coding was compared and discussed, and rules for coding were adapted. For example, we decided to consider the theme of Tech*no*bodies and Sensorium as the *given stimulus* from which students started their associations and used this to code the levels of remoteness in association. Also, we decided to code the remote level when coders were hesitating between two levels of remoteness. The three pilot coding events were included in the final analysis, since they were part of the process of this sample of 11 students. In five sessions of approximately 3 hours, all 196 events were coded by the three coders, independently, without any further discussion or comparison.

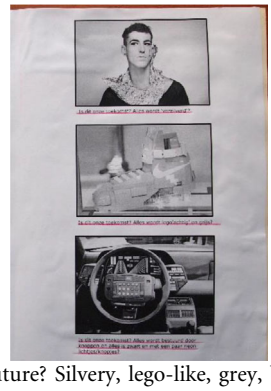
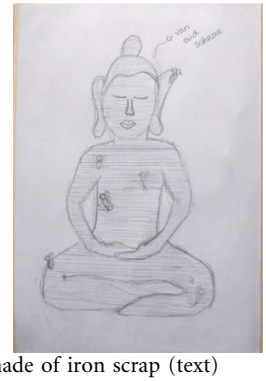
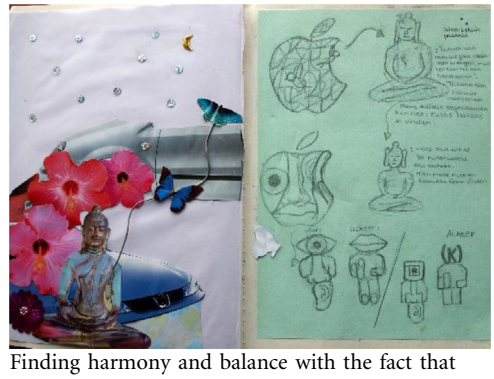
The final scores that were used in the analyses were the scores of coder 1, the principal investigator who originally developed the coding scheme, except if both other coders differed from coder 1 (15% of all cases). The association between the raters' scores and the final scores used in the analyses was satisfying: for *association* with a Spearman's ρ of 0.76 (rater 1), 0.60 (rater 2), and 0.61 (rater 3); for *combination* Spearman's ρ of 0.87 (rater 1), 0.68 (rater 2), and 0.77 (rater 3); and for *abstraction* Spearman's ρ of 0.88 (rater 1), 0.60 (rater 2), and 0.54 (rater 3). This means for all exploration activity categories, the association of raters 2 and 3 codings with the final codings was at least moderate. In Table 2, we show examples of the lower range and higher range of association, combination, and abstraction. See Table 2.

Rating originality of visual arts designs

For the assessment of the originality of each of the visual arts designs, we selected only the portfolio events with images and images and texts ($N = 147$), since these could be used for this purpose. Originality of visual arts designs of the portfolio events was established by the results from a comparative judgment exercise in the Digital Platform for the Assessment of Competences (comproved.com). Although the Consensual Assessment Technique (CAT, Amabile, 1982) is often used for assessment of originality in creativity

[3] Distribution of portfolio events per student: student 1($N = 21$); student 2($N = 14$); student 3($N = 19$); student 4($N = 13$); student 5($N = 29$); student 6($N = 16$); student 7($N = 9$); student 8($N = 20$); student 9($N = 18$); student 10($N = 14$); student 11 ($N = 23$).

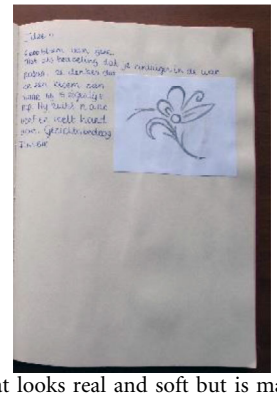
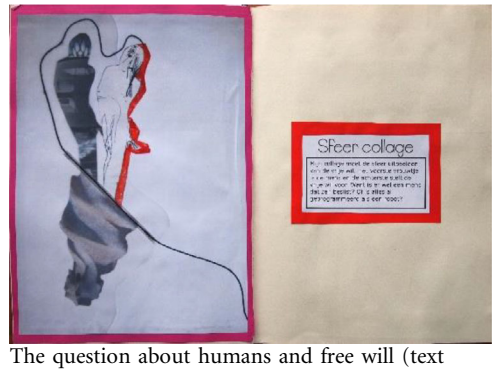
TABLE 2. Examples of the Lower Range and Higher Range in Remoteness within Three Types of Exploration: Association, Combination, and Abstraction—Theme Tech*no*bodies & Sensorium. Texts Depicted were Summarized and Translated for this Table 2. For Association (Higher Range), a Text from the Reflection Document by the Student was Used and Translated

Lower range in remoteness	**Higher range in remoteness**
Association	Association
	
Is this the future? Silvery, lego-like, grey, black materials and buttons (text summarized).	About the paradox of technology and feelings (text from reflection document by the student).
Combination	Combination
	
A Buddha made of iron scrap (text)	Finding harmony and balance with the fact that nature is overruled by technology (text summarized).

research, alternative assessment of creativity is available, and in relation to the context of education, we wanted to study the benefits of an alternative method. Comparative Judgment (CJ) also is a valid and reliable method for assessing (Van Daal, Lesterhuis, Coertjens, Donche, & De Maeyer, 2019). This method has several benefits: raters can work very fast without a training using their intuition and expertise; originality of products is rated many times without this resulting in choice overload and cognitive load for raters (Cseh & Jeffries, 2019), since they compare only two works at the same time. Different ratings are compared and a check of the quality of the rating is part of the procedure. The digital tool was easy to use for raters.

Thirteen expert raters (visual arts teachers) were provided with distributed randomly drawn pairs of portfolio events and were asked to decide which one evidenced a higher originality of visual arts design. In total, 2193 comparisons were made. Subsequently, data (wins–losses) were analyzed using joint maximum likelihood analysis (Linacre, 1998; Wright & Panchapakesan, 1969), resulting in a rank order of portfolio events and a logit score for each portfolio event. This logit score indicates the chance (more precisely, the

TABLE 2. (Continued)

Lower range in remoteness	Higher range in remoteness
Abstraction  A flower that looks real and soft but is made of metal. (text summarized).	Abstraction  The question about humans and free will (text summarized).

logistic transformation of the chance) that a portfolio event will win a comparison with a portfolio event of average quality (having a logit score of 0). The reliability of the rank order was calculated using the Scale Separation Reliability (SSR; Bramley, 2015), which indicates to what degree the score distribution is not due to measurement error (Verhavert, De Maeyer, Donche, & Coertjens, 2018): A minimal measurement error implies that the relative position of the items on the scale is quite fixed. The SSR for the rank order resulting from 2193 comparisons was 0.85, indicating an acceptably high internal consistency of the rank order (Jones, Swan, & Pollitt, 2015), especially taking into account that a non-adaptive algorithm is used (Bramley, 2015).

We subsequently inspected judge infit measures (Lesterhuis, Verhavert, Coertjens, Donche, & De Maeyer, 2016; Pollitt, 2012) to determine whether any assessor deviates from the group consensus by making judgments which are at odds with the eventual rank order. Results indicate that one judge had an infit score that was much higher than that of the colleagues. Consequently, for this judge, the written remarks were examined. These indicated that this judge had not focused on *visual* originality. Hence, the comparisons from this judge were omitted. For the remaining 2024 comparisons from 12 expert raters, the rank order was calculated anew. The reliability level was not impacted: the SSR remained .85. The re-estimated logit scores for the portfolio events, reflecting the originality of visual arts design, were used in the analyses as dependent variable.

DATA ANALYSIS

We performed multi-level regression analyses to examine the relationship between the three types of exploration (*association*, *combination*, and *abstraction*) and originality of visual arts design of the same event. In these analyses, only the 147 portfolio events with images and images and texts were included. For each type of exploration (*association*, *combination*, and *abstraction*), four categories were included in the analyses referring to the level of remoteness with 0 (absence) as reference category.

Three types of models will be presented. First, in a variance components model (Model 0), the variance components were examined of portfolio events (level 1) and student (level 2). The result of this analysis will show the variance in originality at the level of portfolio events (level 1) and student (level 2). Secondly, in one model per type of exploration activity (*association*, *combination*, and *abstraction*), the relationship of that particular type of exploration and originality of the portfolio events was estimated (Models 1a, 1b, and 1c). The results of these analyses will show for each exploration activity which category (coded as 0 = not applicable and 1 = applicable) significantly explains variance in originality in the portfolio events. Separate models provide insight into the distinct importance of each exploration activity for explaining differences in

TABLE 3. Multilevel Regression Analysis with Association, Combination, and Abstraction as Independent Variables and Originality Scores on Portfolio Event Level as Dependent Variable (N = 147): Estimates of B-Weights with Standard Error Between Brackets

	Model 0 Variance components *B* (*SE*)	**Model 1a Association** *B* (*SE*)	**Model 1b Combination** *B* (*SE*)	**Model 1c Abstraction** *B* (*SE*)	**Model 2 Final** *B* (*SE*)
Constant		−1.903 (0.722)*	−1.366 (0.249)*	−0.514 (0.140)*	−1.889 (0.621)*
Fixed effects					
Association (reference category=0; n = 3)					
Associate freely (A1, n = 14)		1.220 (0.789)			0.223 (0.700)
Associate flexibly (A2, n = 34)		1.443 (0.748)			0.479 (0.677)
Dissociate (A3, n = 63)		1.682 (0.735)*			0.730 (0.658)
Bisociate (A4, n = 33)		2.053 (0.756)*			0.226 (0.730)
Combination (reference category=0; n = 26)					
Adjust (B1, n = 34)			1.167 (0.309)*		1.247 (0.293)*
Merge (B2, n = 43)			1.228 (0.295)*		1.296 (0.292)*
Recombine (B3; n = 31)			1.499 (0.326)*		1.039 (0.363)*
Reconnect (B4, n = 13)			1.580 (0.424)*		0.505 (0.529)
Abstraction (reference category=0; n = 74)					
Construct conceptually (C1, n = 25)				−0332 (0.276)	−0.626 (0.268)*
Deconstruct (C2; n = 22)				0.621 (0.276)*	0.342 (0.280)
Restructure (C3; n = 17)				0.876 (0.321)*	0.947 (0.421)*
Transform (C4; n = 9)				1.745 (0.421)*	2.245 (0.549)*
Random effects					
Level 2 (student) $\sigma^2 u_{0j}$	0.127 (0.107)	0.069 (0.079)	0.063 (0.072)	0.003 (0.046	0.094 (0.076)
Level 1 (portfolio event) $\sigma^2 e_{0ij}$	1.593 (0.193)	1.512 (0.183)	1.374 (0.166)	1.417 (0.171)	1.094 (0.133)
2*log likelihood (IGLS Deviance)	493.440	483.123	469.085	468.641	438.595
Explained variance in originality scores	89%	2%	5%	5%	31%

N = number of students included in the model; "*SE*" = standard error. Significant fixed effects (with $\alpha = 0.05$) are printed with an asterisk.

originality. Thirdly, in Model 2, the three types of exploration were included in one regression analysis to provide an overall view on the relationship between types of exploration activities and remoteness of these activities, and originality of the portfolio events.

RESULTS

Variance has been examined at two levels: portfolio events (within students) and student. The results of the variance components model (Model 0 in Table 3) indicate significant differences between portfolio events ($\sigma^2 e_{0ij}$) but not between students ($\sigma^2 u_{0j}$). This means that the originality in our sample seems to vary on the level of portfolio events only. The variance partition coefficient (Goldstein, 2003) equals 0.89, which means that 89% of the variance in the originality of visual arts design of portfolio events is due to differences between events. This means that the variety in originality between portfolio events within students is much larger than differences between students. This means that in our sample, students do not differ from each other in terms of originality of their work, but the portfolio events they created did.

Models 1a, 1b, and 1c show significant relationships between each type of exploration and the originality of visual designs of the portfolio events. Model 1a shows that for *association*, the two most remote activities, *dissociate* (A3) and *bisociate* (A4), significantly relate to originality of visual designs, explaining 2% of the variance at the event level. Model 1b shows that all categories of *combination*, *adjust* (B1), *merge* (B2), *recombine* (B3), and *reconnect* (B4) significantly relate to the originality, explaining 5% of the variance in originality at the event level. Finally, Model 1c indicates that the three most remote categories of *abstraction* (C2, C3, and C4) significantly relate to the originality of visual designs with 5% explained variance in originality at the event level.

The final model (Model 2) with all three types of exploration shows that two types of exploration activities, *abstraction* and *combination*, are significantly related with originality of visual design of portfolio events. For *combination*, in general, the more remote activities—*adjust* (B1), *merge* (B2), and *recombine* (B4)—are, the more original an event is. For *abstraction*, the more remote the activities—*restructure* (C3) and *transform* (C4)—are, the more original an event is. All relationships are positive, except for *construct conceptually* (C1), which is a low remote activity: the less students construct conceptually, the more original an event is. In total, 31% of the variance in originality at the portfolio events level is explained by these types of exploration showing the importance of *combination* and *abstraction* for the originality of visual art design. None of the four categories of *association* was significantly related with originality in visual design of portfolio events.

DISCUSSION AND CONCLUSIONS

DISCUSSION

In this study, we examined the relationship among three types of exploration with the originality of students' visual designs in portfolio events. We studied which exploration activities could explain variance in the originality of visual art designs as documented in portfolio events. To examine this, we coded for all events for three types of exploration—*association (A)*, *combination (B)*, and *abstraction (C)*—the *level of remoteness* ranging from 1 to 4. We found that three categories in *combination*, *adjust* (B1), *merge* (B2), and *recombine* (B4), and two categories in *abstraction*, *restructure* (C3), and *transform* (C4) explained 31% of variance in originality of visual designs of portfolio events, which is rather high and much higher than the proportion explained variance in the models with only one of the three types of exploration. Although we can only speculate about the explanation for this difference, it seems that the extent of remoteness of combination and abstraction reinforce each other with respect to the assessed level of originality.

The models with *association*, *combination*, or *abstraction* activities (Models 1a, 1b, and 1c) generally indicated that the more *remote* exploration activities were, the more the visual designs of the portfolio events were rated as *original*. These effects can be related to the findings from other studies with respect to the particular (visual) exploration activities (Finke et al., 1992; Getzels & Csikszentmihalyi, 1976; Jaarsveld & van Leeuwen, 2005; Suwa, 2003; Verstijnen et al., 1998a, 1998b). With respect to *association*, in the study of Benedek et al., (2012), higher levels of *remoteness* in association, that is, *dissociate* (A3) and *bisociate* (A4), were found to be related to higher originality of *ideas* generated. The findings from our study add similar conclusions for *visual* art designs. With respect to *combination*, Finke et al., (1992) and Gilhooly, Fioratou, Antony, and Wynn (2007) demonstrated the importance of *remoteness* in *combination* to arrive at original ideas and images. However, in our findings, all categories of *remoteness* in *combination* seem to be important. For example, combining through *adjusting* (B1) visual features is less remote, but was also found to be related

to originality of visual designs, as were the other categories of combination. This is in line with findings on visual design strategies used by product designers, such as combining existing objects (a lamp or a chair), with the use of new materials; thus, adding new material possibilities that may lead to original and surprising designs, for example, in creating "visual-tactual incongruities" (Ludden et al., 2008). With respect to *abstraction*, the importance of externalized (visual) explorative activities for creating original visual designs is in line with other studies (Suwa, 2003; Verstijnen et al., 1998a, 1998b). These studies also showed that creative discoveries in *visual design*—that is, rich, colorful, complex, and effective imagery (Schlegel et al., 2015)—benefit from externalizations and visual explorations at a deep and structural level.

According to our finding, the originality of the students did not differ, but the originality of their work (portfolio events) did. This finding seems to hint that originality is not a trait that students have or not have, but it more strongly points that it is something that can be learned by, for example, the use of specific creative activities as described in our study (See Table 1 and Figure 1).

This study may, therefore, provide new insights for teachers in secondary education, on ways to support students' creative learning, for example, by designing *specific* creative learning activities and/or pedagogical activities for *combination*, *adjust* (B1), *merge* (B2), and *recombine* (B4), and for *abstraction*, *restructure* (C3), and *transform* (C4), although possible uses of the matrix may vary for different contexts or samples. Teachers may also use the matrix as a learning resource to provide feedback to their students, on the development of their students' creative problem-finding process, indicating what different activities from the matrix (in close proximity to the activities used by students) may lead to more abstract and/or remote ideas and images that may result in more original visual arts designs.

LIMITATIONS

This study focused on the relationship between three types of exploration and the level of remoteness in each of these types and the originality of visual art designs in a problem-finding process. An issue might be that we have coded the level of remoteness within each of the three types of exploration. Alternative methods could have been to provide two scores—one for the level of remoteness in generation and one for the level of abstractness in exploration—or to provide one score which refers to one category from the matrix about generation and exploration. However, in both cases, this would mean we would not have information about the three exploration activities (*association*, *combination*, and *abstraction*) *separately*. This more detailed analysis of exploration activities—although probably at the expense of a more detailed analysis of separate generation activities—is in alignment with the findings of our earlier study (Van de Kamp, 2017) in which the importance of exploration activities for the originality of visual art designs was established for secondary education students. Moreover, comparing these different levels of exploration seemed to be important, since findings by Finke et al., (1992), Getzels and Csikszentmihalyi, (1976), Jaarsveld and van Leeuwen (2005), Suwa (2003), and Verstijnen et al., (1998a, 1998b) all indicated (visual) exploration activities in both combination and abstraction were related to the originality of a visual design. We now may consider this is not only the case for professional artists and designers but also for students in secondary education. Another potential limitation could be that the resulting codes may vary to some extent based on, for example, rater, context, population, culture, and type of assignment. This provides some ideas for future investigations. Finally, the number of portfolio events and students was rather low, which limits the power of our analyses. Although we already found quite some significant relationships with originality, these could be more and more stronger when the number of participants (and consequently the number of portfolio events) increases substantially.

FUTURE RESEARCH

To produce originality in visual designs, a designer needs self-awareness to control his or her own creative visual arts process, that is, find ways on when and how to persist in focused attention, while preventing fixedness on conventional ways of representing. Also, on when and how to be flexible and open minded to detect seemingly "irrelevant" external visual-sensory information that may lead to original ideas or images (i.e., using the remoteness dimension). Next, to visual and conceptual generation and exploration activities, additional processes may play a role, such as *self-awareness* (in constructive perception, according to Suwa, 2003), or *cognitive control* or *cognitive flexibility* (i.e., using the abstractness dimension and/or using both the abstractness and the remoteness dimensions simultaneously). We expect there may be differences in the way different cognitive processes are related to the three types of exploration activities and the four levels of remoteness of these activities. For example, Zabelina Colzato, Beeman, and Hommel (2016) showed that the

process of *cognitive control* (i.e., focusing and goal-directed behavior—we expect to be related to a higher degree in *abstractness* and a lower degree in *remoteness*) is important to deliberately go beyond the usual through inhibition of dominant uses. These authors also showed the importance of *cognitive flexibility* as an alternative route to arrive at original ideas or images (we expect this to be related to a higher degree in both *abstractness* and *remoteness*). *Cognitive flexibility* means flexible switching between either opting for a goal-directed strategy or opting for automatic processes and accepting internal self-generated thought or external visual sensory information. Insight from further (empirical) studies into the relations between these cognitive processes and the way these may support generation and exploration activities in specific ways may be important for improvement of learning and instruction in creativity. These types of studies may provide new ways in which to differentiate learning activities and pedagogical activities—along the dimensions of *abstractness* and *remoteness*—to optimize learning in visual arts education for every individual student. Based on the type of strategy a student often uses, he or she could be stimulated—for example, through explicit metacognitive strategy instruction (Van de Kamp, Admiraal, van Drie, & Rijlaarsdam, 2015)—to use a different creative learning strategy. In this way, students who are often using a goal-directed strategy in exploration using activities that are *less remote* may be stimulated to conduct exploration activities that are *more remote* (i.e., either try to *dissociate* or *bisociate*). These association activities might subsequently lead to explorative activities in more remote categories in *combination*, in casu, to *recombining* or *reconnecting* in order to arrive at more original ideas.

In future research, effects of different types of instruction on students' generation and exploration activities could also be examined. Enhancement of students' skills in generation and exploration has been demonstrated before, for example, through observational learning (Groenendijk, Janssen, Rijlaarsdam, & Van den Bergh, 2013) or through explicit strategy instruction (Van de Kamp et al., 2016). Both types of instruction seem to support students' metacognition, through observational learning of modeling of creative activities in generation and exploration, reflection of these observations, and explicit instruction on metacognition about strategies in divergent thinking. But these studies did not examine effects on both conceptual and visual generation and exploration strategies. Yet these types of instruction might have the potential to trigger both types of generation and exploration strategies and, consequently, the originality of visual designs.

CONCLUDING REMARKS

Originality—one of the major driving forces in visual arts—aims at the production of original conceptual or visual ideas for a design through generation and aims at the actual production of original visual designs through exploration. In this study, we examined to what extent exploration activities could explain differences in the originality of visual designs. Our conclusion is that the three levels of exploration activities seem to be of major importance in explaining differences in originality of visual arts products, with in general the more remote the exploration activities were, the more original the visual art design.

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DATA AVAILABILITY

Data not available due to ethical restrictions. Due to the educational setting of this study, participants of this study did not agree for their data—other than the data used in this study—to be shared publicly, so supporting data are not applicable.

REFERENCES

Amabile, T.M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology*, *43*, 997–1013. https://doi.org/10.1037/0022-3514.43.5.997.

Armstrong, I. (1998). Writing from the broken middle: The post-aesthetic. *Women: A Cultural Review*, *9*, 62–96. https://doi.org/10.1080/09574049808578335.

Benedek, M., Könen, T., & Neubauer, A. (2012). Associative abilities underlying creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *6*, 273–281. https://doi.org/10.1037/a0027059.

Boden, M.A. (2004). *The creative mind. Myths and mechanisms* (2nd edn) London: Routledge.

Bramley, T. (2015). *Investigating the reliability of Adaptive Comparative Judgment*. Cambridge Assessment Research Report Cambridge, UK: Cambridge Assessment.

Cseh, G.M., & Jeffries, K.K. (2019). A scattered CAT: A critical evaluation of the consensual assessment technique for creativity research. *Psychology of Aesthetics, Creativity, and the Arts*, *13*, 159. https://doi.org/10.1037/aca0000220.

Dumas, M. (2012). *Every price has its price*. Edited version of the speech given by Marlene Dumas during the award ceremony of the Johannes Vermeer Prize. Delft: Museum Het Prinsenhof http://www.marlenedumas.nl/11362-2/

Efland, A.D. (2004). Art education as imaginative cognition. In E.W. Eisner (Ed.), *Handbook of research and policy in art education* (pp. 751–774). London: Routledge.

Ellamil, M., Dobson, C., Beeman, M., & Christoff, K. (2012). Evaluative and generative modes of thought during the creative process. *NeuroImage*, *59*, 1783–1794. https://doi.org/10.1016/j.neuroimage.2011.08.008

Finke, R.A., Ward, T.B., & Smith, S.M. (1992). *Creative cognition. Theory, research and applications*. Cambridge, MA: MIT Press.

Gabora, L. (2018). The neural basis and evolution of divergent and convergent thought. *The Cambridge Handbook of the Neuroscience of Creativity*, 58–70.

Getzels, J.W., & Csikszentmihalyi, M. (1976). *The creative vision. A longitudinal study of problem finding in Art*. New York: John Wiley & Sons Inc.

Gilhooly, K.J., Fioratou, E., Anthony, S.H., & Wynn, V. (2007). Divergent thinking: strategies and executive involvement in generating novel uses for familiar objects. *British Journal of Psychology*, *98*, 611–625. https://doi.org/10.1348/096317907X173421.

Goldstein, H. (2003). *Multilevel statistical models* (3rd edn). London: Arnold.

Groenendijk, T., Janssen, T., Rijlaarsdam, G., & van den Bergh, H. (2013). Learning to be creative. The effects of observational learning on students' design products and processes. *Learning and Instruction*, *28*, 35–47. https://doi.org/10.1016/j.learninstruc.2013.05.001

Haanstra, F., Damen, M., Groenendijk, T., & van Boxtel, C. (2015). A review of assessment instruments in arts education. *International Yearbook for Research in Arts Education*, *3*, 413–418.

Hammershøj, L.G. (2014). Creativity in education as a question of cultivating sensuous forces. *Thinking Skills and Creativity*, *13*, 168–182. https://doi.org/10.1016/j.tsc.2014.05.003.

Hetland, L., Winner, E., Veenema, S., & Sheridan, K.M. (2007). *Studio thinking. The real benefits of visual arts education*. New York: Teachers College Press.

Hunter, S.T., Bedell-Avers, K.E., Hunsicker, C.M., Mumford, M.D., & Ligon, G.S. (2008). Applying multiple knowledge structures in creative thought: Effects on idea generation and problem-solving. *Creativity Research Journal*, *20*, 137–154. https://doi.org/10.1080/10400410802088779.

Jaarsveld, S., & van Leeuwen, C. (2005). Sketches from a design process: Creative cognition inferred from intermediate products. *Cognitive Science*, *29*, 79–101. https://doi.org/10.1207/s15516709cog2901_4.

Jones, I., Swan, M., & Pollitt, A. (2015). Assessing mathematical problem solving using comparative judgement. *International Journal of Science and Mathematics Education*, *13*, 151–177. https://doi.org/10.1007/s10763-013-9497-6

Lesterhuis, M., Verhavert, S., Coertjens, L., Donche, V., & De Maeyer, S. (2016). Comparative judgement as a promising alternative to score competences. In G. Ion & E. Cano (Eds.), *Innovative practices for higher education assessment and measurement*. Hershey, PA: IGI Global.

Linacre, L.M. (1998). Estimating Rasch measures with known polytomous item difficulties. *Rasch Measurement Transactions*, *12*, 638.

Ludden, G.D., Schifferstein, H.N., & Hekkert, P. (2008). Surprise as a design strategy. *Design Issues*, *24*, 28–38. https://doi.org/10.1162/desi.2008.24.2.28

Mednick, S. (1962). The associative basis of the creative process. *Psychological Review*, *69*, 220–232.

Nijstad, B.A., De Dreu, C.K.W., Rietzschel, E.F., & Baas, M. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*, *21*, 34–77. https://doi.org/10.1080/10463281003765323.

Perkins, D.N. (1994). Creativity: Beyond the Darwinian paradigm. In M.A. Boden (Ed.), *Dimensions of creativity* (pp. 119–142). Cambridge, MA: MIT Press/Bradford Books.

Pollitt, A. (2012). The method of Adaptive Comparative Judgement. *Assessment in Education: Principles, Policy & Practice*, *19*, 281–300. https://doi.org/10.1080/0969594X.2012.665354

Ross, V.E. (2006). A model of inventive ideation. *Thinking Skills & Creativity*, *1*, 120–129. https://doi.org/10.1016/j.tsc.2006.06.003

Runco, M.A. (2008). Commentary: Divergent thinking is not synonymous with creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *2*, 93–96. https://doi.org/10.1037/1931-3896.2.2.93

Schlegel, A., Alexander, P., Fogelson, S.V., Li, X., Lu, Z., Kohler, P.J., ... Meng, M. (2015). The artist emerges: Visual art learning alters neural structure and function. *NeuroImage*, *105*, 440–451. https://doi.org/10.1016/j.neuroimage.2014.11.014

Smith, T., & Mathur, S. (2014). Contemporary art: World currents in transition beyond globalization. *Contemporaneity: Historical Presence in Visual Culture*, *3*, 163–173. https://doi.org/10.5195/contemp.2014.112

Soderberg, C.K., Callahan, S.P., Kochersberger, A.O., Amit, E., & Ledgerwood, A. (2015). The effects of psychological distance on abstraction: Two meta-analyses. *Psychological Bulletin*, *141*, 525–548. https://doi.org/10.1037/bul0000005

Suwa, M. (2003). Constructive perception: Coordinating perception and conception toward acts of problem-finding in a creative experience. *Japanese Psychological Research*, *45*, 221–234. https://doi.org/10.1111/1468-5884.00227

Van Daal, T., Lesterhuis, M., Coertjens, L., Donche, V., & De Maeyer, S. (2019). Validity of comparative judgement to assess academic writing: examining implications of its holistic character and building on a shared consensus. *Assessment in Education: Principles, Policy & Practice*, *26*, 59–74. https://doi.org/10.1080/0969594X.2016.1253542

Van de Kamp, M.T.A. (2017). *Reimagine, redesign and transform: Enhancing generation and exploration in creative problem finding processes in visual arts education*. [Doctoral Dissertation, University of Amsterdam.]

Van de Kamp, M.T., Admiraal, W., & Rijlaarsdam, G. (2016). Becoming original: Effects of strategy instruction. *Instructional Science*, *44*, 543–566. https://doi.org/10.1007/s11251-016-9384-y.

Van de Kamp, M.T., Admiraal, W., van Drie, J., & Rijlaarsdam, G. (2015). Enhancing divergent thinking in visual arts education: Effects of explicit instruction of meta-cognition. *British Journal of Educational Psychology*, *85*, 47–58. https://doi.org/10.1111/bjep.12061.

Van de Vall, R. (2008). *At the Edges of Vision. A Phenomenological Aesthetics of Contemporary Spectatorship*. Aldershot, Hampshire: Ashgate Publishing Ltd.

Verhavert, S., De Maeyer, S., Donche, V., & Coertjens, L. (2018). Scale Separation Reliability: What Does It Mean in the Context of Comparative Judgment? *Applied Psychological Measurement 42*: 428–445. https://doi.org/10.1177/0146621617748321

Verstijnen, I.M., van Leeuwen, C., Goldschmidt, G., Hamel, R., & Hennessey, J.M. (1998a). Creative discovery in imagery and perception: Combining is relatively easy, restructuring takes a sketch. *Acta Psychologica*, *99*, 177–200. https://doi.org/10.1016/S0001-6918(98)00010-9.

Verstijnen, I.M., van Leeuwen, C., Goldschmidt, G., Hamel, R., & Hennessey, J.M. (1998b). Sketching and creative discovery. *Design Studies*, *19*, 519–546. https://doi.org/10.1016/S0142-694X(98)00017-9

Wright, B.D., & Panchapakesan, N. (1969). A procedure for sample-free item analysis. *Educational and Psychological Measurement*, *29*, 23–48.

Zabelina, D.L., Colzato, L., Beeman, M., & Hommel, B. (2016). Dopamine and the creative mind: individual differences in creativity are predicted by interactions between dopamine genes DAT and COMT. *PLoS One*, *11*, e0146768. https://doi.org/10.1371/journal.pone.014676.

Marie-Thérèse van de Kamp, University of Amsterdam

Wilfried Admiraal, Leiden University

Liesje Coertjens, Université catholique de Louvain

Maarten Goossens, University of Antwerp

Gert Rijlaarsdam, University of Amsterdam

Correspondence concerning this article should be addressed to Marie-Thérèse van de Kamp, Research Institute of Child Development and Education, University of Amsterdam, PO box 15776, 1001 NG, Amsterdam, The Netherlands. E-mail: m.t.a.vandekamp@uva.nl