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Does Involuntary Mental Time Travel Make Sense in Prospective Teachers' Feelings and Behaviours During Lessons?

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Abstract: This study examined the effects of involuntary mental time travel into the past and into the future on prospective teachers' feelings and behaviors during the period of a class hour. A total of 110 prospective teachers participated voluntarily in the study. The results of the present study showed that (a) the involuntary mental time travel into the past and into the future occurred in the classrooms even during the period of a class hour; (b) both involuntary memories/future images were significantly discernible in terms of their characteristics; (c) the characteristics of the participants' feelings and behavior following the involuntary memories/future images were evident; and (d) the characteristics of the involuntary memories/future images had a significant effect on the prospective teachers' feelings and learning related behaviors. Implications for teacher education and directions for future studies were also discussed.

As a crucial function of episodic memory (Conway, 2005, 2009; Tulving, 1985, 2002, 2005; Viard et al., 2011), Mental Time Travel (MTT) refers to "the faculty that allows humans to mentally project themselves backwards in time to re-live, or forwards to pre-live, events" (Suddendorf & Corballis, 2007, p. 299; see also Suddendorf & Corballis, 1997). A growing body of research suggests that MTT into the past and into the future occurs unconsciously (Ball & Little, 2006; Berntsen, 1996, 1998, 2010; Berntsen & Jacobsen, 2008; Finnbogadottir & Berntsen, 2011; Mace, 2004; Mace, Atkinson, Moeckel, & Torres, 2011; Schlagman & Kvavilashvili, 2008).

Moreover, recent research argues that involuntary MTT (IMTT) is an important individual difference variable that can potentially affect an individual's motivation (Berntsen, 2009, 2010; Rasmussen & Berntsen, 2009). Despite this, the motivational role of IMTT has largely been neglected in educational settings such as teacher education. Moreover, to the best of the researchers' knowledge, the effects of IMTT on prospective teachers' (hereafter, PTs) behaviours and feelings during a lesson have not yet been investigated.

This issue is important in teacher education for at least three crucial reasons. First, PTs' behaviours and feelings are important factors that affect the quality and quantity of their learning and motivation (Hargreaves, 1998), which, in turn, may significantly affect their professional development (Avalos, 2011; Rodgers & Scott, 2008). Likewise, enhancing the quality of teacher education programs to increase their effect on PTs' professional development is an international concern that occupies policy makers and teacher educators from diverse countries such as the United States, United Kingdom, Netherlands, and Turkey (Grossman, Onkol, & Sands, 2007; Grossman & Sands, 2008; Korthagen, 2010; UNESCO, 2008; Zeichner & Conklin, 2008).

Second, the major aim of the teacher education programs is to prepare PTs as effective and committed teachers, which is also an international concern that occupies teacher educators and policy makers from a diverse range of countries (OECD, 2011; World Bank, 2011). Indeed, such an aim requires PTs to engage in the lessons which constitute the building blocks of fundamental knowledge categories such as pedagogical knowledge and domain knowledge in any university-based teacher education program (Zeichner & Conklin, 2008). Given the crucial roles of memory, emotion, and cognition during learning (Damasio, 1999; Dolan, 2002), it is both important and reasonable to examine the effects of IMTT into the past and into the future on prospective teachers' feelings and behaviours during the lessons in order to uncover the factors affecting the quality of learning during teacher education.

Third, as Balli (2011) stated, "teacher educators have long recognized that pre-service teachers' beliefs about teaching stem, in part, from the memories they collect as they progress through 12 or more years of observing and interacting with their own elementary, middle, and high school teachers" (p. 245). Given that teachers' beliefs about teaching significantly relate to their teaching-related behaviours and emotions (Hargreaves, 1998; Pajares, 1992), it is crucially relevant for teacher educators to focus on their students' IMTT during lessons in order to "understand their beliefs about teaching and to determine potential gaps in pre-service teachers' prior knowledge" more comprehensively and accurately (Balli, 2011, p. 245). Thus, the present study has focused on a potentially relevant factor together with PTs' feelings and behaviours during lessons: IMTT into the past and into the future.

Conceptual Framework

Involuntary Mental Time Travel

Involuntary autobiographical memory is defined as "a memory of a personal experience brought to consciousness with apparent spontaneity, that is, without preceding attempts at retrieving it" (Berntsen, 1996, p. 435). In contrast to consciously or voluntarily retrieved autobiographical memories, involuntary memories come to mind while performing routine activities and when one is distracted from the task at hand (Ball & Little, 2006; Berntsen, 2010; Kvavilashvili & Mandler, 2004). Additionally, involuntary autobiographical memories are more specific and distinctive (Berntsen & Hall, 2004; Schlagman & Kvavilashvili, 2008).

The involuntary form of autobiographical memories has only recently been examined through psychological (e.g. Berntsen, 1996) and neurobiological studies (e.g. Hall, Gjedde, & Kupers, 2008). These studies shed light on the conditions in which involuntary autobiographical memories are retrieved, the type of cues that triggers involuntary memory retrieval, and the contents of involuntary autobiographical memories (Ball & Little, 2006; Berntsen, 1998, 2009; Berntsen & Jacobsen, 2008; Mace, 2004, 2006; Schlagman & Kvavilashvili, 2008).

For example, based on a sample of Danish students using a structured diary method, Berntsen (1996) examined involuntary autobiographical memories in terms of their content, phenomenological properties, and the type of cues that triggered students' involuntary autobiographical memories in their everyday life over a period of 6 weeks. She found that the participants had more than two involuntary memories in a typical day. In addition, she found that these memories had identifiable cues such as people, objects, and feelings in the situation where involuntary memories sprang into the students' minds, indicating that both external (i.e. sensory/perceptual cues) and internal cues (i.e. thoughts, feelings) affected the emergence of involuntary memories (see also Berntsen, 1998).

Based on a sample of undergraduate students, Mace (2004) examined whether involuntary autobiographical memories were more likely to be elicited by sensory/perceptual cues or abstract cue types (i.e. thought and language-related cues), and found that abstract cue types were more effective in the emergence of involuntary autobiographical memories. These contrasting results suggested that the cue types should be investigated beyond the external-internal dichotomy. Thus, Ball and Little (2006) investigated cue types in terms of the characteristics of involuntary memories, and found that they can be classified under the heading of retrieval types: goal/sensory cued memories (i.e. an individual's current active goals and the sensory information associated with this goal-related activity), sensory cued memories (i.e. an involuntary memory that does not bear a relationship to the current goal directed activities of the individuals), and no-cue memories (i.e. an involuntary memory that does not appear to relate to either participants' current goals at retrieval or any sensory feature of the retrieval environment). Recently, Johannessen and Berntsen (2010) examined whether involuntary memories were perceived to a greater extent than voluntary memories to be related to self-defined current concerns, and found that involuntary memories did not differ from their voluntary counterparts regarding frequency and/or characteristics of concern-related contents. They also found that the concern-related memories (i.e. uncompleted personal-goal-related memories) were more central to personal identity and more often used as reference points for future goals than non-concern-related memories.

Although the studies summarized above illuminate the characteristics of involuntary autobiographical events, none of them focused on the concept of future. Thus, Berntsen and Jacobsen (2008) introduced the notion of IMTT in order to examine the IMTT into the future and into the past simultaneously. They defined IMTT into the future as "the MTT that takes place spontaneously – that is, with no preceding conscious attempt at mentally projecting oneself forward or backward in time" (Berntsen & Jacobsen, 2008, p. 1093). The results of this study revealed that (a) involuntary future episodic representations were as common as involuntary autobiographical memories; (b) both involuntary future representations and involuntary memories were evoked by external and internal cues; (c) the involuntary future and past event representations were activated when individuals were not concentrating on a particular task; (d) the involuntary future event representations were defined more positively than the involuntary past event representations; and (e) the temporal closeness was more evident for future than past event representations. These results indicated that IMTT should be considered in terms of both past and future aspects, which the present study has set out to do.

The Possible Functions of Involuntary Episodic Memories

Based on neurobiological and psychological evidence, Rasmussen and Berntsen (2009) described two major functions of involuntary memories. The first is to "serve the overarching function of providing a sense of continuity, enlarging our subjective temporal horizon, and updating our personal existence in an automatic and cognitively undemanding fashion" (Rasmussen & Berntsen, 2009, p. 1138). They also argued that one of the important aspects of this function is to allow individuals to rehearse their past and prepare for their future when their attention is not focused on current activities. The second is the directive function that guides thinking and planning in terms of both present and personal future (Rasmussen & Berntsen, 2009). According to Rasmussen and Berntsen (2009) memories with directive functions not only assist in problem solving and planning, but they also inform, inspire and motivate.

Likewise, there is evidence that both voluntary and involuntary MTT into the past and into the future are significantly related to PTs' self-efficacy beliefs and situational intrinsic motivations (Eren, 2009, 2010). Based on a sample of Turkish PTs, Eren (2009) demonstrated that the PTs' self-efficacy beliefs were significantly related to their teaching-related possible future events (i.e. how they will teach in the future). This effect persisted even when the PTs' teaching-related past events were controlled for (i.e. the episodic memories regarding how PTs were taught when they were students).

Recently, with a sample of Turkish PTs, Eren (2010) examined the effects of IMTT into the past and into the future on situational intrinsic motivations in the classrooms during the period of a class hour, and found that IMTT into the past and into the future occurred in the classrooms during this period. He also found that the contents of involuntary memories and future images can be classified as teaching-related memories/future images (i.e. teacher and teaching-related memories/future images), learning-related memories/future images (i.e. learning, studying, and class-related memories/future images), and unrelated memories/future images (i.e. memories/future images including neither teaching nor learning-related memories/future images). The results of the Eren (2010) study revealed that, regardless of the effects of their current situational intrinsic motivations regarding their classes, teaching-related positive future images significantly and positively affected the PTs' situational intrinsic motivations.

Finally, relevant research showed that involuntary memories impacted individuals' mood more negatively than voluntary memories, and caused physical reactions (e.g. smiling, crying, hitting things) more than their voluntary counterparts (Berntsen & Jacobsen, 2008; Johannessen & Berntsen, 2010); for example, Johannessen and Berntsen (2010) found that involuntary memories had more negative mood impact, and had more induced physical reactions than voluntary memories (see, for similar results, Berntsen & Jacobsen, 2008).

To summarize, the abovementioned studies reveal that (a) humans travel mentally into the past and into the future both voluntarily and involuntarily; (b) involuntary memories/future images are sudden and unexpected by nature which makes them more open to the effects of both internal and external cues than their voluntary counterparts; (c) involuntary memories/future images have discernible characteristics in terms of their contents, valence, and temporal distances; (e) involuntary memories may significantly affect individuals' current moods and behaviours; and (f) involuntary memories/future images may play a significant motivational role in educational settings such as teacher education.

Thus, it can be said that it is not only important, but also reasonable to examine the possible effects of PTs' involuntary memories/future images on their feelings and behaviours during the period of a class hour, as the characteristics of PTs' involuntary memories/future images have a strong potential to affect their feelings and behaviours in educational settings such as classrooms.

Aims and Research Questions

The aim of this study is to explore the effects of these characteristics on PTs' feelings and behaviours in the classrooms during the period of a class hour. In line with this aim, two research questions are formulated as follows:

- (a) How did PTs' feel and react after they remembered/imagined involuntary memories/future images?
- (b) Do characteristics of the involuntary memories/future images significantly affect the PTs' feelings and behaviours?

No specific hypotheses are suggested due to the exploratory nature of the present study. Nevertheless, given the motivational role of involuntary memories/future images (Rasmussen & Berntsen, 2009; Eren, 2010), and also given that the characteristics of the involuntary memories/future images significantly affect individuals' current moods and physical reactions (Berntsen & Jacobsen, 2008; Johannessen & Berntsen, 2010), it is reasonable to hypothesise that the PTs' feelings and behaviours may significantly be affected by the characteristics of their involuntary memories/future images during the period of a class hour.

Method

This study was conducted using a mixed method approach. It is a pragmatic approach to research design in which elements of qualitative and quantitative approaches are combined in a single study for the purpose of breadth and depth of understanding (Creswell, 2009; Johnson & Onwuegbuzie, 2004). In the present study, both qualitative data through the open ended questions and quantitative data through the closed ended questions were collected simultaneously (see research instruments and procedure sections, for details). In addition, the qualitative data were converted into numerical codes and analysed accordingly by conducting a series of Multiway Frequency Analysis (MFA) (see results section, for details). By doing so, it was aimed to answer the research questions appropriately and comprehensively.

Participants

A typical case sampling, which is one of the purposive sampling methods (Maxwell, 1997), was used to generate a sample consisting of those prospective teachers who experienced IMTT into the past and into future during lectures. Specifically, a total of 110 PTs (75 females) from a large university located in the Western Black Sea region of Turkey majoring in Mathematics Teaching ($n = 43$), English Language Teaching ($n = 41$) and Computer and Educational Technologies Teaching ($n = 26$) participated voluntarily in the study. The sample consisted of 31 first-year, 37 second-year, 38 third-year, and 4 final-year PTs. The participants' ages ranged from 17 to 26 years ($M = 20.36$, $SD = 1.60$).

Research Instruments

The Mental Time Travel Scale

The Mental Time Travel Scale (MTTS), which was developed by the Eren (2009) based on previous research (D'Argembeau & Van der Linden, 2004, 2006; Rubin, Schrauf & Greenberg, 2003), was used to assess the degree to which PTs' experienced involuntary memories/future images. The MTTS consists of 5 past-related items (i.e. while remembering the event, I feel as though I am reliving it; while remembering the event, I feel that I travel back to the time when it happened; I can see it in my mind; I can hear it in my mind; I can feel now the emotions that I felt then) and 5 future-related items (i.e. while imagining the event, I feel as though I am experiencing it; while imagining the event, I feel that I travel forward to the time when it would happen; I can see it in my mind; I can hear it in my mind; I can feel now the emotions that I will feel then). The PTs rated their responses on a 7-point scale ranging from 1 (*not at all*) to 7 (*completely*). The wide range of response options allowed PTs to respond to the items of the MTTS in a detailed manner so that the higher the score the higher the degree to which PTs experienced MTT.

Additionally, in order to obtain the qualitative data required to answer the research questions appropriately, the participants were asked to complete a number of short-response open-ended questions immediately following the MTTTS in one of two frames depending on the temporal direction of the events (i.e. Frame 1 for memories and Frame 2 for future images). Based on previous research (Berntsen & Jacobsen, 2008), these questions were as follows: 'What caused you to remember/imagine this event?' (cue type); 'Was the remembered/imagined past/future event positive, negative or neutral?' (valence); 'What was the event?' (event type); 'How did you feel after you remembered/imagined this event?' (feeling); 'What did you do after you remembered/imagined this event?' (behaviour).

Participants were also asked to rate the time of the event based on the provided categories ranging from today to 10 years ago/later. Specifically, a total of 13 temporal categories were determined (i.e. today, yesterday/tomorrow, one week ago/later, one month ago/later, one year ago/later, five years ago/later, and ten years ago/later) on the basis of previous studies (D'Argembeau & Van der Linden, 2004, 2006). These questions were included in the MTTTS.

Procedure

The data were collected by the researchers during the spring semester of the 2010/2011 academic year. The data collection procedure consisted of two stages: the preparation stage and the application stage. During the preparation stage, the domains (e.g. English Language Teaching) and the field-specific courses (e.g. Language Acquisition) and pedagogic courses (e.g. Instructional Technologies and Materials Design) in the curriculum of these domains were selected. In the application stage, the researchers asked for permission from the course lecturers to enter the classroom in order to collect the data immediately before the end of the approximately 50-minute class period. The lecturers were not initially informed of the research topic in order to avoid priming the participants. After the lecturers left the classroom, the researchers explained the aim of the study and the nature of involuntary memories/future images to the participants. Following these explanations, the participants were asked to raise their hands if they had had such memories/future images during the past lesson and were willing to share them. This approach enabled the researchers to select the sample purposively.

The scales were presented to those PTs who raised their hands ($n = 110$), and these PTs constituted the sample of the present study. They were instructed to choose the single most evident and important memory/future image they had experienced during the period and to complete either Frame 1 or Frame 2 accordingly. During the process, any questions from the participants were answered. Administration lasted approximately 25 minutes.

Results

Preliminary Analyses

Using the Maximum Likelihood method of estimation from AMOS 16 (Arbuckle, 2007), a Confirmatory Factor Analysis (CFA) was conducted to see whether the MTTTS was confirmed in the present sample. Standardized Root Mean Square Residual ($SRMR \leq .08$), Incremental Fit Index ($IFI \geq .90$), and the Comparative Fit Index ($CFI \geq .90$) were used to assess the data fit, because they are less sensitive to sample size and violations of distributional assumption (Fan, Thompson, & Wang, 1999; Kline, 2005).

The results of the CFAs demonstrated that the one-factor model with five indicators (i.e. MTTTS) had good fit to data in terms of past-related events ($\chi^2(5) = 8.33, p = .139$; $CFI =$

.94; IFI = .95; SRMR = .061), future-related events ($\chi^2(5) = 11.60, p = .041$; CFI = .90; IFI = .91; SRMR = .077), and in terms of both past and future-related events ($\chi^2(5) = 7.28, p = .201$; CFI = .98; IFI = .98; SRMR = .038). For the past-related events, standardized parameter estimations ranged from .55 to .68, while, for the future-related events, they ranged from .51 to .92. For the whole scale data, standardized parameter estimations ranged from .53 to .73. Cronbach's coefficient alphas were computed as .74, .80, and .76 for the past-related events, future-related events, and the whole sample data, respectively. These results indicate that both the factor structure and the internal consistency of the MTTs were confirmed in the present sample.

An Analysis of Covariance (ANCOVA) was also conducted to check the possible effects of gender, temporal directions and age (as a covariate), year of study, course type (i.e. field-specific courses and pedagogic courses), and fields of study on the MTTs (i.e. dependent variable). The results of the ANCOVA revealed that the effects of gender ($F(1, 93) = .322, p = .572, \eta^2_p = .003$), fields of study ($F(1, 93) = .190, p = .664, \eta^2_p = .002$), year of study ($F(2, 93) = .059, p = .942, \eta^2_p = .001$), course type ($F(1, 93) = .917, p = .341, \eta^2_p = .010$), age ($F(1, 93) = .605, p = .439, \eta^2_p = .006$), and temporal directions ($F(1, 93) = 3.384, p = .070, \eta^2_p = .035$) on the MTTs were non-significant. Thus, the demographic variables were not considered any further in the present study.

Involuntary MTT in the Classrooms

It was found that 67 (60.8%) PTs specified that they experienced IMTT into the past (e.g. "When I was at primary school, our teacher divided us into 3 groups: lazy, middle and hard-working. I was in the hard-working group. One day, my teacher moved me to the middle group and I was very upset"; whereas 43 (39.2%) specified that they experienced IMTT into the future (e.g. "I imagined myself going into class with related teaching materials. I was dividing the students into groups and telling them about the topic. After giving them short details, I handed out the materials and the lesson went on.")

The Characteristics of the Involuntary Episodic Memories and Images

A series of content analyses was conducted to see whether the involuntary memories/future images could be classified in terms of their types (i.e. teaching-related events, learning-related events, and unrelated events), cues (i.e. external, internal, and no-cue), and amount of details (i.e. with details and without details).

The results of the first content analysis, which examined the memories/future images in terms of their contents, revealed that the contents of the memories/future images could well be classified under the headings of teaching-related events, learning-related events, and unrelated events. Specifically, teaching-related events refer to the teacher and teaching-related memories/future images, and/or the memories/future images about how PTs were taught/will teach when they were students/will become teachers; for example, one PT asked "How would I introduce myself to the students before I teach in the future?" On the other hand, learning-related events refer to the learning and studying-related memories/future images and/or the class-related memories/future images (e.g. "Now I have taken the Special Teaching Methods course I can take Practicum. I imagined myself taking Practicum"). Unrelated events, however, refer to those memories/future images containing neither teaching nor learning-related episodes (e.g. "My mother's being angry with me for going out to see my friends without wearing a vest"). The inter-rater agreement on the event types was satisfactory in terms of both memories (Cohen's Kappa- $k = .73$) and future images ($k = .79$),

suggesting that the memories/future images can well be represented with teaching-related events, learning-related events, and unrelated events in the present sample

The second content analysis examined the involuntary memories/future images in terms of their amount of details. It was found that they could be classified as memories/future images with detail (i.e. those memories/future images containing environmental and/or personal details) and memories/future images without detail (i.e. those memories/future images containing no specific details). The inter-rater agreement was computed as .82 for the memories and 1.00 for the future images. An example of a detailed memory includes the following statement: "My Philosophy teacher at high school always taught using the question-answer method. My Philosophy teacher appeared in front of me". On the other hand, a memory without details can be exemplified by the following: "The sports event of the other day."

Finally, the results of the third content analysis revealed that the cues that triggered the memories/future images could be classified as external cues (e.g. "The style of the lecturer's beard"); internal cues (e.g. "Thinking about how children acquire language"; and no-cue (e.g. "It just came into my mind"). The inter-rater agreement was quite high in terms of both memories ($k = .94$) and future images ($k = .91$), indicating that the cue type can be reliably classified under the headings of external, internal, and no-cue. Additionally, an MFA was conducted to examine the relationships between the characteristics of the involuntary memories/future images and the temporal directions (Tabachnick & Fidell, 2007). The results of the MFA are presented in Table 1.

Characteristic	Memories		Future images ^a		z
	f	(%)	f	(%)	
Valence					
Positive	23	34.3	28	65.1	-2.11*
Negative	19	28.4	3	7.0	1.41
^a Neutral	25	37.3	12	27.9	
Distance in time					
Today	13	19.4	6	14.0	-.18
Yesterday/tomorrow	5	7.5	5	11.6	-.91
One week ago/after	6	9.0	5	11.6	-1.04
One month ago/after	11	16.4	2	4.7	1.24
One year ago/after	11	16.4	3	7.0	1.08
Five years ago/after	7	10.4	17	39.5	-1.92 [†]
^a Ten years ago/after	14	20.9	5	11.6	
Type of events					
Teaching-related	24	35.8	27	62.8	-2.29*
Learning-related	18	26.9	6	14.0	-.67
^a Unrelated	25	37.3	10	23.3	
Type of cues					
External	58	86.6	32	74.4	.80
Internal	6	9.0	9	20.9	-.23
^a No-cue	3	4.5	2	4.7	
Amount of details					
With details	31	46.3	23	53.5	.29
^a Without details	36	53.7	20	46.5	

* $p < .05$; [†] $p = .055$; ^athe outer category

Table 1: Characteristic of the Involuntary Memories and Future Images

As seen in Table 1, contents of the memories were both more negative (28.4%) and neutral (37.3%), albeit not significant ($z = 1.41, p = .158$), than the contents of the involuntary future images (7% and 27.9% respectively); whereas the contents of the involuntary future images (65.1%) were significantly more positive than those of the involuntary memories (34.3%) ($z = -2.11, p = .035$). In terms of the temporal distances, the only difference between the numbers of involuntary future images regarding the period of five years later (39.5%) and those regarding the period of five years ago (10.4%) approached significance ($z = -1.92, p = .055$), signifying that the numbers of involuntary future images regarding the period of five years later were significantly higher than those regarding the same period of time. The numbers of the involuntary memories/future images regarding the remaining periods of time were not comparable with each other in terms of the temporal directions, although the involuntary future images were closer in time than the involuntary memories (see Table 1).

The results also showed that the number of teaching-related involuntary future images (62.8%) were significantly higher than the number of teaching-related involuntary memories (35.8%) ($z = -2.29, p = .022$). The number of learning-related memories (26.9%) and learning-related future images (14%) were not comparable with one another in terms of the temporal directions. The cue type did not relate to the temporal directions, indicating that neither the external cues (past: 86.6%; future: 74.4%) nor the internal cues (past: 9%; future: 20.9%) were comparable in terms of the temporal directions. The same was also true for the amount details of the involuntary memories/future images because involuntary memories (46.3%) did not significantly differ from the involuntary future images (53.5%) in terms of their amount of details ($z = .29, p = .775$) (see Table 1).

Later-Feelings and Behaviours

Two separate content analyses were conducted to explore how PTs felt (henceforth later-feeling) and behaved (henceforth later-behaviour) after they remembered/imagined the past/future-related events involuntarily. In the first content analysis, PTs' later-feelings were examined, while, in the second content analysis, their later-behaviours were examined.

The first content analysis revealed that it was possible to distinguish between positive, negative and neutral later-feelings. Positive later-feelings included feeling happy, relaxed or excited, while negative later-feelings included sadness, anger or anxiety. Neutral later-feelings were those which had no obvious positive or negative valence (e.g. curiosity).

The second content analysis revealed that the later-behaviours were also classifiable as positive, negative and neutral. Positive later-behaviours were those which showed evidence of the PTs paying more attention to the lesson than they had before the involuntary memory/future image. Negative later-behaviours included becoming distracted from the lesson, or a reduction in attention following the involuntary memory/image. Neutral behaviours were identified by direct expressions that nothing had changed as a result of the involuntary memory/future image, or those lacking any overt positive or negative valence. The inter-rater agreement was at an acceptable level for both later-feelings ($k = .83$) and later-behaviours ($k = .72$). Any discrepancies were resolved through discussion.

The content analyses also showed that the PTs' positive, negative and neutral later-feelings could be followed by positive, negative or neutral later-behaviours. Table 2 shows examples of the later-feelings and later-behaviours in a relational manner in terms of the involuntary memories. As seen in Table 2, matches between the valence of the later-feeling and that of the later-behaviours were observed; for example, the involuntary memory of an incident at elementary school caused one participant to feel happy (positive); this in turn led

to him realizing the relevance of the lesson to real life (positive) (see Table 2). However, as depicted in Table 2, there were also examples in the data of mismatches between the valences of the later-feelings and later-behaviours; for example, one participant felt happy at remembering a course given by another lecturer (positive), and as a result she lost interest in the current lesson (negative). Notably, there were no occurrences of neutral later-behaviours arising from negative later-feelings.

Behaviour	Feelings		
	Positive	Negative	Neutral
Positive	I remembered what my friends did every time my elementary school teacher asked a question and how s/he reacted angrily./I felt a sweet sense of happiness as I remembered those times. ^a /I recognized that the subject we were covering in class happened in real life. ^b	My teacher at junior high school sat the good students at the front and only paid attention to them./I felt sorry for my other friends./I recognized that what was being covered in the lesson were real life events.	I remembered my Geometry teacher last year. He had the same same type of beard as this lecturer./ I remembered him singing songs./ I missed that teacher I wondered where these thoughts had come from I started to enjoy this course, because the lecturer had some similarities with my old teacher.
Negative	Mr. X using the CD player in the Pronunciation course./ I felt happy and smiled./ I wanted to be in that lesson. I lost interest in	I had a Micro-processing lesson at high school. The teacher was good, friendly. The lessons were really fun and we'd both learn and laugh. But university hasn't been like this at all. The courses are boring and it's as if I'm not learning anything./I felt sad, as if I didn't belong here. Then I smiled bitterly and the memory finished. I tried hard to forget it./I thought that the lecturer was teaching because s/he had to and that I was in class because I had to be.	The one and only good picture I had ever drawn with the instructions of my junior high school teacher./I realized that I missed my teacher and friends./ I wished the courses we are taking now were as much fun as those at junior high school.
Neutral	Summer school and the Material we made./I felt relaxed because the past had been lived and was over/Nothing.	Not-observed	Our teacher taught us using a cassette player. I felt as if I was living that moment./I recognized that life was full of repetition.

^a Later-feeling; ^b Later-behaviour

Table 2: Involuntary Memories with Later- Feelings and Later-Behaviours

Table 3 shows examples of the later-feelings and later-behaviours in a relational manner in terms of the involuntary future images. As with the findings related to involuntary memories, there were both matches and mismatches between the valences of the later-feelings and those of the later behaviours (see Table 3).

Behaviour	Feelings		
	Positive	Negative	Neutral
Positive	The subject being, discussed, that is, how I would behave when I started teaching in the future, appeared like a short, pleasant film./I thought that being a teacher was a nice feeling, and I thought once more how suitable this profession was for me. ^a /I saw a connection between this course and real life and I realized the importance of the subject-matter. ^b	I was trying to increase motivation and interest by giving positive examples to the students in a class who were prejudiced against Maths or who looked anxious./To be honest I felt a little apprehensive. I felt I wouldn't succeed. Everything the lecturer now said gained extra value for me.	What I would be like as a university lecturer. /I wondered if I would be able to be as calm as this lecturer./ I thought positively about the lecturer's teaching style.
Negative	I imagined myself advancing in the Police Force after passing the Civil Service Entrance Examination./ I felt happy about the prospect of my life my life developing in this direction./I wanted the lesson and university to finish right away.	I was teaching in a The place changed, sometimes there were university students and sometimes elementary school students. I was telling them that I would reward them with a game for listening to the lesson./I felt that life was monotonous and I wondered what I could do to liven it up./I wanted this lesson and university to finish as soon as possible.	I wondered where I would be in the future. /I felt I needed to develop myself further. /I thought that 90% of the lessons were unnecessary and that I could learn better at home.
Neutral	I had a cup printed with letter 'M' on the teacher's desk and students in front of me listening to me./I felt good./ I continued where I left off.	Students criticizing me in a similar way while I was teaching./ I wondered what I would do in a similar situation and I felt a little bad./ I thought the lecturer needed to try new techniques."	Where would I be after graduation? Would I be appointed as a teacher or would I stay at university to continue my studies and be a university lecturer./ I was just curious. There is still a lot of time ahead of me./I focused once more on the lesson, if a little late, and I continued to take notes.

^a Later-feeling; ^b Later-behaviour

Table 3: Involuntary Future Images with Later- Feelings and Later-Behaviours

To summarize, results of the content analyses signified that the PTs' later-feelings and behaviours were linked to each other in terms of the temporal directions. Additionally, a categorical regression analysis (CatREG), in which the later-feeling was determined as the independent variable and the later-behaviour as the dependent variable, was also conducted in order to validate the relationships between the later-feelings and later-behaviours (Kritzer, 1986). Results of the CatREG showed that the later-feelings significantly predicted the later-behaviours in terms of both involuntary memories ($\beta = .32, p = .000$) and involuntary future images ($\beta = .66, p = .000$), advocating that the later-feelings and behaviours were significantly related to each other.

The Effects of IMTT on Later-Feelings and Behaviours

Four separate MFAs were conducted to examine the effects of the involuntary memories/future images on PTs' feelings and behaviours. In terms of the involuntary memories, results of the first MFA demonstrated that the main effects of negative valence ($z = -17.69, p = .000$), learning-related events ($z = -3.10, p = .002$), and detailed events ($z = -31.46, p = .000$) on positive later-feelings were significant; whereas the effects of the remaining categories of the mentioned characteristics on later-feelings, as well as the main effects of distances in time and cue type on later-feelings, were non-significant (all $ps \geq .10$). A significant amount of details and event type interaction was also detected in the analysis. Specifically, teaching-related and detailed events interaction significantly and positively affected the positive later-feelings ($z = 20.10, p = .000$). No other significant interactional effects were observed (all $ps \geq .96$).

Results of the second MFA, which examined the effects of the characteristics of involuntary future images on later-feelings, showed that the main effect of distances in time (i.e. today) on negative later-feelings ($z = 6.96, p = .000$) and the main effect of positive valence on positive later-feelings ($z = 2.37, p = .018$) were significant; whereas the effects of the remaining categories of distances in time and valence on later-feelings, as well as the main effects of cue type, event type, amount of details on later-feelings, were trivial (all $ps \geq .13$). No significant interactional effects were observed in the analysis (all $ps \geq .56$).

Results of the third MFA revealed that the main effects of positive valence on learning-related positive behaviours ($z = 8.00, p = .000$), negative valence on learning-related negative behaviours ($z = 45.99, p = .000$), learning-related events on learning-related positive behaviours ($z = -15.71, p = .000$), and the main effect of detailed events on learning-related negative behaviours ($z = 19.49, p = .000$) were significant in terms of the involuntary memories. The main effects of the cue type and distances in time on later-behaviours were non-significant (all $ps \geq .10$).

Significant interactional effects were also observed in the analysis. Specifically, positive valence and teaching-related events interaction ($z = 4.49, p = .000$) and positive valence and learning-related events interaction ($z = 13.11, p = .000$) were effective on the learning-related positive behaviours. Furthermore, the effect of detailed events and teaching-related events interaction on the learning-related negative behaviours was also significant ($z = -11.86, p = .000$). No other significant interactional effects were detected in the analysis (all $ps \geq .99$).

Results of the final MFA showed that the main effect of positive valence on learning-related positive behaviours ($z = 10.41, p = .000$), and the main effect of detailed events on learning-related negative events ($z = 6.73, p = .000$) were considerable in terms of the involuntary future images. However, the main effects of cue type, distances in time, and event type on later-behaviours were negligible (all $ps \geq .66$). The interaction between the

teaching-related events and positive valence was also effective on the learning-related positive behaviours ($z = 2.72$, $p = .023$). No other significant interactional effects were detected in the analysis (all $ps \geq .99$).

Discussion

Involuntary MTT in the Classrooms and its Characteristics

The results of the preliminary analyses revealed that the participants experienced at least one evident and important involuntary memory or future image. Indeed, previous studies provided evidence that IMTT into the past (e.g. Berntsen, 1996, 1998; Ball & Little, 2006) and into the future (e.g. Berntsen & Jacobsen, 2008) are common in everyday life. It should be noted that these studies were largely based on diary methods, and were mainly conducted under laboratory conditions. Although diary methods provide a detailed picture of involuntary memories/future images, they have significant potential to cause a 'priming effect', because participants are fully aware of the nature of the process (e.g. how they will describe the content of their involuntary memories/future images by taking notes) and the concepts (e.g. involuntary memories/future images) at the beginning of the experiments.

On the other hand, without taking advantage of such kinds of methods (i.e. diary methods), it is difficult to examine the contents of involuntary memories/future images in a detailed manner as individuals may forget, or at least, experience some difficulties in remembering or imagining the original events over time (Schacter, 2001). At this point, it can be said that the results of the present study were free from the possible effect of 'priming', because the PTs did not know they would be asked for their IMTT into the past and into the future at the end of the class period. Furthermore, each lesson lasted approximately 50 minutes, which was a short enough period of time for the PTs not to forget the involuntary memories/future images. Thus, the present study significantly contributes to the relevant literature by providing a reliable picture in which the emergence of involuntary memories/future images was evident in natural settings such as classrooms.

In line with previous research (Eren, 2010), the contents of the involuntary memories/future images were classified as teaching-related events, learning-related events, and unrelated events, indicating that there were links between the context (i.e. teacher education) and contents of the events (Berntsen, 2009). Results of the MFA showed that the involuntary future images were more positive, closer in time and more teaching-related than the involuntary memories; whereas the involuntary memories were more negative, more distant in time, and more learning-related than the involuntary future images.

Recent research on both voluntary and IMTT revealed that the future images were more positive and temporally closer than the past events (Eren, 2010; D'Argembeau & Mathy, 2011; D'Argembeau & Van der Linden, 2006; Jacobsen & Berntsen, 2008). This positivity bias and the temporal closeness in IMTT into the future were interpreted based on the possibility that MTT into the future mostly contained goal-related cultural life scripts such as getting married, leaving school, and having children (Bernsten & Jacobsen, 2008; Berntsen & Rubin, 2004). Moreover, regardless of whether it is voluntary or involuntary, MTT into the future is associated with individuals' future-related goals (Conway, 2009). If this is so, the reason why the teaching-related involuntary images were more positive and closer in time can be explained by the PTs' most salient future-related goal: to become a teacher in the near future. However, it does not explain why some of the PTs' involuntary memories were more negative, neutral, and learning-related. Although it was not examined in this study, this may be due to the relationship between the PTs' beliefs and their memories (Bandura, 1993).

Given that beliefs are strongly linked to well-remembered episodes of personal memories (Woolfolk Hoy & Murphy, 2001), it can be claimed that the PTs' involuntary memories may be unconsciously filtered by their beliefs, which, in turn, may paint the contents of their memories in a different manner; for example, "a belief about the unfairness of school rules might be traced to an unfortunate personal encounter with a rule" (Woolfolk Hoy & Murphy, 2001, p. 147). Such a belief may not only selectively affect the involuntary retrieval of this personal encounter, but also provide a framework for perceiving the current situation in line with the subjective meaning of the mentioned encounter. Nevertheless, this issue deserves further investigation.

How did PTs Feel and Behave after Their IMTT into The Past and into The Future?

The first content analyses of the later-feelings showed that they were discernible as positive, negative or neutral. This finding is not surprising considering that these valences of feelings are the most frequently reported types in the literature (e.g. D'Argembeau & Van der Linden, 2006). There was also evidence of the involuntary memories/images causing a display of physical reaction, such as laughing, smiling or crying (see Table 2), which parallels the findings of Berntsen and Jacobsen (2008) and Johannessen and Berntsen (2010).

The second content analysis showed that these later-feelings had an effect on the learning-related behaviour of the participants. More specifically, following the later-feelings, they paid more attention to the lesson, became distracted, or experienced no change in attention. This finding can also be expected, given the key role of emotions in the coordination of physiological responses and cognition (Mayer, Caruso, & Salovey, 1999).

Notably, a mismatch of valences was also observed to a certain degree. Some PTs reported that they paid more attention to the lesson following a negative later-feeling. For others, positive feelings caused them to become distracted from the lesson (see Tables 2 and 3). This result can be explained in the light of the evaluative space model (Cacioppo & Berntson, 1994) which predicts that "a stimulus may vary in terms of the strength of positive evaluation activation and the strength of negative evaluative activation it evokes" (Cacioppo, Larsen, Smith, & Berntson, 2004, p. 227). Accordingly, a dissonance between the emotional valence of a memory, or a future image, and a later-behaviour can be expected because the PTs' later-behaviours may significantly depend on the strength of their subjective negative or positive evaluations on the content of involuntary memories/future images.

Did PTs' Involuntary Memories/Future Images Significantly Affect Their Later-Feelings and Behaviours?

Results of the present study demonstrated that the effects of characteristics of the involuntary memories/future images on later-feelings were evident. Specifically, in terms of the involuntary memories, negative valence, learning-related events, and detailed events were inversely related to positive later-feelings, suggesting that the participants felt more positive during the lessons as long as the contents of involuntary memories were less negative, less learning-related, and were less detailed. In addition, the current results revealed that the teaching-related and detailed past events were positively related to later-feelings, meaning that the PTs' feelings were positively affected by their teaching-related and detailed past events. It is difficult to discuss these results based on previous studies, because no previous research has investigated these issues to date. Given the motivational role of the involuntary memories (Eren, 2010; Rasmussen & Berntsen, 2009), and also given that the contents of these memories not only contain cognitive details, but also emotional details that have strong

potential to affect current feelings (Eichenbaum, 2010), the mentioned inverse effects of the negative past events on positive later-feelings can be understood.

On the other hand, the negative effects of the learning-related and detailed past events, and the positive effects of teaching-related and detailed past events on positive later-feelings can be explained based on the fact that the contents of the PTs' learning-related events were more negative than the contents of their teaching-related past events in the present study. Seemingly, the effects of involuntary memories on PTs' later-feelings were more subjected to valence than content. This could be because the emotional aspects of episodic memories are processed faster in the human brain than their cognitive aspects (Damasio, 1999; Eichenbaum, 2010). If so, it is obvious that PTs' later-feelings may significantly be affected by the emotional aspects of past events rather than their cognitive aspects. These explanations provide a solid basis to realize why PTs' later-feelings were more subjected to valence than content.

In terms of the involuntary future images, the present results showed that the distances in time significantly and positively affected both negative later-feelings and positive later-feelings, indicating that the closer the future image in time the greater its effect on later-feelings regardless of the valences of these feelings. Previous studies demonstrated that future-related events are more generic and closer in time than the past-related events (e.g. D'Argembeau & Van der Linden, 2004, 2006; Lavalley & Persinger, 2010), signifying that to imagine possible future events is more difficult than to remember past events. This difficulty is particularly evident when the time of the future images diverges from the present (Szpunar, 2010). In line with these explanations, the current results showed that the involuntary future-images were closer in time than the involuntary memories. Thus, it is not surprising to find that the distances in time significantly and positively affected PTs' later feelings regardless of their valences, because the future-events were accessible to the participants as long as they were imagined closer in time.

Results of the present study also revealed that the PTs' learning-related behaviours were more positive after they involuntarily remembered the positive and less detailed past events, whereas their learning-related behaviours were more negative after they involuntarily remembered the negative and learning-related past events. The results further showed that both teaching-related positive events and learning-related positive events significantly and positively affected PTs' learning-related positive behaviours.

These results can be explained based on the major function of episodic memories: to inform and coordinate behaviour (Conway, 2009; Szpunar, 2010). In other words, episodic memories are beneficial in coordinating individuals' behaviours by informing the current behaviours on the basis of their past experiences (Szpunar, 2010). Given that these experiences carry emotional aspects, the interactional effects of event types and valence on PTs' later-behaviours can be understood. Likewise, the emotional aspects of episodic memories themselves may energize and direct behaviours (Conway, 2009). Seemingly, PTs' learning related later-behaviours in classrooms were no exceptions in terms of the degree to which emotional contents of their involuntary memories were effective on their learning-related behaviours. Thus, these results underscore the directive role of emotional contents of involuntary memories in PTs' learning-related positive behaviours during the period of a class hour.

Furthermore, the current results showed that the positive involuntary future images, as well as the teaching-related and positive future images, also significantly and positively affected PTs' learning-related positive behaviours, whereas the detailed events significantly and positively affected learning-related negative behaviours. In fact, these results echoed the beneficial effects of the emotional aspects of episodic memories on learning-related positive behaviours in terms of future images. It could be that involuntary memories/future images

motivate PTs' learning-related behaviours as long as they contain positive emotional aspects. Likewise, previous research has demonstrated that PTs' teaching-related positive future images, but not their teaching-related positive memories, were effective on their situational intrinsic motivations (Eren, 2010).

On the other hand, the positive effect of detailed events on learning-related negative events can be due to the distracting effect of focusing on the details of involuntary memories (Berntsen, 1998). That is to say, if PTs are engaged in the contents of their involuntary memories, their focus of attention could easily shift from the learning-related activities to details of these memories, which, in turn, may cause the emergence of learning-related negative behaviours.

Implications for Teacher Education

The current results suggest that teacher educators may significantly affect their students' learning related positive behaviours in a positive manner by providing meaningful external cues such as teaching-related positive examples and/or scenarios in order to trigger teaching-related positive involuntary memories/future images in the class.

This is important in teacher education for at least two reasons. First, learning related positive behaviours during the lessons are related to adaptive educational/instructional outcomes such as academic achievement and meaningful or deep learning (Woolfolk, 2010), indicating that to increase the PTs' learning related positive behaviours may significantly affect both the quality and quantity of the learning process in classroom settings, and enable teacher educators and their students to achieve the educational/instructional goals more effectively. Second, to activate involuntary memories/future images through meaningful external cues may also enable PTs to process the semantic content of the class together with their episodic memories/future images during the learning process. In turn, this may increase their learning performance. After all, the learning performance is, at least partly, due to the combining episodic content with previously stored semantic content (Greve, van Rossum, & Donaldson, 2007; Herbert & Burt, 2004).

In addition, the results of the present study demonstrated that the PTs' later-feelings and behaviours were significantly related to one another. This indicates the importance of considering their feelings together with their behaviours in order to see the whole picture of the effects of the IMTT on learning related behaviours in educational settings. This result further points out that to increase the PTs' learning related positive behaviours by activating involuntary memories/future images through meaningful external cues during the lessons is highly required to understand how PTs feel after they involuntarily remembered/imagined the memories/future images. Thus, teacher educators should consider the emotional aspects of the external cues such as verbal (e.g. giving positive and personal examples in relation to teaching and learning processes) and non-verbal cues (e.g. smiling, looking interested) each of which has potential to trigger positive involuntary memories/future images in the class. By doing so, they can take the advantage of the effects of their students' positive later-feelings on learning related behaviours. However, it should be noted that the contents of teaching-related examples and/or scenarios should be regulated in terms of both their emotional aspects and amount of details as the results of the present study also showed that the effect of detailed events on learning-related negative events was significant.

Limitations and directions for future studies

This study, like all studies, has some limitations, each of which provides a solid basis for future studies. First, the sample of the study was quite small. This means that future studies should be conducted based on a larger number of PTs in order to provide more comprehensive results regarding the current topic. Second, the present study examined the characteristics of PTs' involuntary memories/future images in terms of temporal directions, event type, cue type, valence, distance in time, and amount of details only. Although these were the most frequently examined characteristics of involuntary memories/future images in the relevant research, there are also others such as identity, duration, and perspective (i.e. first-person or third-person perspective) (e.g. Mace et al., 2011). Thus, in future studies, these characteristics should also be included in order to define the characteristics of involuntary memories/future images more comprehensively.

Third, in the present research, involuntary memories/future images were considered only. However, future research which both involuntary and voluntary memories/future images are investigated may broaden our understanding regarding the effects of episodic memories/future images on PTs' later-feelings and behaviours by enabling researchers to compare the effects of these memories/future images with one another. Given the significant relationship between IMTT and voluntary MTT (Berntsen & Jacobsen, 2008), it can be said that this issue deserves further investigation.

Fourth, although the factor structure of the MTTs was replicated in the current sample, diverse types of validity other than structural validity were also relevant to the MTTs. For example, recent research has shown that both voluntary and involuntary MTT into the past and into the future are significantly related to PTs' self-efficacy beliefs and situational intrinsic motivations (Eren, 2009, 2010). This means that future research in which PTs' IMTT into the past and into the future are investigated together with their self-efficacy beliefs and situational intrinsic motivations may provide evidence regarding the predictive validity of the MTTs. In addition, the convergent validity of the MTTs can also be examined by including the measures of time perspectives (see Zimbardo & Boyd, 1999) in future research as the MTTs is conceptually relevant to associate with the past and future time perspectives.

Finally, despite the fact that it was quite reasonable to examine the later-feelings and behaviours as the consequences of involuntary memories/future images because the PTs' feelings and behaviours appeared after they remembered/imagined involuntary memories/future images, the correlational nature of the present study prohibits the making of possible causal inferences. Therefore, experimental studies, in which PTs' involuntary memories/future images are manipulated through diverse methods such as priming teaching-related past and possible future events are required in order to make causative inferences regarding the present topic.

Conclusions

The results of the study lead to four major conclusions: First, IMTT into the past and into the future occurred in educational settings such as classrooms even during the period of a class hour. Second, both involuntary memories/future images were significantly discernible in terms of their characteristics. Third, the PTs' feelings and learning-related behaviour subsequent to the involuntary memories/images were clearly distinguishable in terms of their valences. Finally, the characteristics of the involuntary memories/future images were significantly effective on the PTs' feelings and learning related behaviours in the classrooms.

Overall, the present study has a clear answer regarding the question of ‘Does involuntary mental time travel make sense in prospective teachers’ feelings and behaviours during lessons? The answer is ‘yes, it does’, as long as the PTs feel emotionally good after they come back from their mental journeys in the classrooms.

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